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| Part 1 | General   |
| 1.1    | GENERAL   |
| .1     | All drawings and all sections of the specifications shall apply to and form an integral part of this section.   |
| 1.2    | CODES AND STANDARDS   |
| .1     | Electrical installation shall be in accordance with current approved edition of the Canadian Electrical Code CSA C22.1.   |
| .2     | Electrical installation shall be in accordance with current edition of the Canadian Electrical Code, Provincial and other codes, rules and regulations. It is not the intention of the drawings and specifications to reiterate the Code. It is expected that the Contractor will be responsible for, but not limited to access panels, ground fault receptacles, tamper-resistant receptacles, wire sizes and methods, conduit sizes, fire rating of cables, coordination of circuit protection components, fire alarm ancillary devices, exit and emergency lighting requirements, specialty ratings for cable for elevators etc. Notify the Consultant of any detected code deficiencies prior to submission of tender. In the absence of such notifications, it will be assumed that the Contractor has accepted responsibility for a complete code-compliant installation, and no additional compensation will be provided for code-related items. |
| .3     | Supply materials and labour required to meet requirements of codes, rules and regulations, whether or not such work is indicated on the drawings or in specifications.  |
| .4     | Where Divisions 26, 27 and 28 specifies better quality of construction (or materials) than minimum code requirements, the more expensive of the two will be provided.   |
| .5     | Electrical installation shall be in accordance with the requirements of the electrical supply authority and local inspections authority.  |
| .6     | Emergency systems to be in accordance with CSA C282.  |
| .7     | All underground systems will be installed in accordance with CSA C22.3 except where specified otherwise.  |
| 1.3    | CARE, OPERATION AND START-UP  |
| .1     | Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components. Arrange care and instructional sessions to be provided at a time convenient to the Owner.  |
| .2     | Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.  |

- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.
- 1.4 VOLTAGE RATINGS
  - .1 Operating voltages: to CAN3-C235.
  - .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- 1.5 PERMITS, FEES AND INSPECTION
  - .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
  - .2 Pay all fees for permits and inspections as required for the electrical installation.
  - .3 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
  - .4 Furnish Certificates of Acceptance from Electrical Inspection Department on completion of work to Consultant. Include copies of certificate in maintenance manuals.
- 1.6 DEFINITIONS
  - .1 The following are definitions of terms and expressions used in the Specification:
    - .1 Consultant means Electrical Engineering Consultant: KGS.
    - .2 Inspection Authority means agent of any authority having jurisdiction over construction standards associated with any part of the electrical work on site.
    - .3 Supply Authority means electrical power utility company responsible for delivery of electrical power to project.
    - .4 Electrical Code means Canadian Electrical Code or Local Code in force at Project location.
    - .5 Indicated means as shown on contract drawings or noted in contract documents.
    - .6 Type Tested means that each piece of equipment produced by manufacturer is not fully tested. An original piece with similar arrangement has been fully tested and results of that test are available.
    - .7 Provide means to supply, install and leave in working order all materials and necessary wiring, supports, access panels, etc., as necessary for equipment.
    - .8 Concealed means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions;

- .9 Exposed means work normally visible, including work in equipment rooms, tunnels, and similar spaces;
- .10 Finished means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished;
- .11 Install (and tenses of "install") – means secure in position, connect complete, test, adjust and verify;
- .12 Supply means to procure, arrange for delivery to site, distribute to floors, inspect, accept delivery and administer supply of manufacturer's products and/or systems, and includes manufacturer's supply of any special cables, standard on site testing, initial start-up, programming, basic commissioning, warranties and assistance to Contractor;
- .13 Delete or Remove (and tenses of "delete" or "remove") – means to disconnect, make safe, remove including any back box and exposed conduits, patch and repair/finish surfaces to match adjoining similar construction, include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Consultant. All items to be deleted are to be disconnected and completely removed in its entirety, any branch circuit wiring, outlet, etc. for any system no longer required to remain in use is to be removed or if this is not possible rendered permanently inaccessible and completely disconnected from panel.
- .14 BAS means building automation system; "BMS" – means building management system, "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same;
- .15 Electrical Divisions refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and /or on drawings is responsibility of Electrical Contractor, unless otherwise noted;
- .16 Mechanical Divisions refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which work as defined in Specifications and /or on drawings is responsibility of Mechanical Contractor, unless otherwise noted;

#### 1.7 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into operation and maintenance manuals. Operation and maintenance manuals shall be submitted to Owner in time to be used in the commissioning of the project.
- .2 Include detail of design elements, construction features, components function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .3 Include technical data, product data; supplement by bulletins, component illustration, exploded views, technical description of items, and parts lists. Advertising or sales literature will not be accepted.

- .4 Include wiring, schematic diagrams and performance curves.
- .5 Include driver data sheets, wiring device types, data sheets for each lamp type including emergency lighting system, final panel board directories, survey at motor data sheets.
- .6 Include name and addresses of local suppliers for items included in maintenance manuals.
- .7 Maintenance manuals shall be submitted to Consultant for review. Manuals that are incomplete shall be returned to electrical subcontractor for completion. Completed manuals must be submitted, to the satisfaction of the Consultant, before final payment may be considered to be due.

1.8 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- .1 Submit shop drawings, product data and samples for review by Consultant. Manufacture of equipment must not commence until shop drawings have been reviewed.
- .2 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other sections.
- .5 Submit samples in accordance with General Conditions. Deliver samples to Consultant's office. Pay all transportation costs to ship samples to Consultant's office including return costs. Approved samples will be retained until after tender closing, then all samples will be returned except for the samples submitted by successful Contractor in tender documents. This sample will be used for comparison with the actual production run of successful manufacturer.
- .6 Shop drawing submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing.
- .7 Each drawing submission to bear following signed stamp, and include name of project, equipment supplier and clause number equipment is specified under.

CONTRACTORS CERTIFICATION

This drawing has been reviewed by

(firm name)

All dimensions have been checked and found compatible with the contract drawings and all capacities, quantities, sizes and other data contained in the contract documents have been listed by the supplier on this drawing and have been checked by the undersigned and found correct.

Date

Per

- .8 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done 'By Others' or 'By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.
- .9 Provide field dimensions required by electrical supplier and sub-subcontractors. In cases where fabrication is required prior to field dimensions being available, check all related drawings and obtain clarification from Consultant if necessary.
- .10 All main service, service entrance equipment, utility metering facility and location, panels, etc. shall bear the approval stamp of the electric utility prior to submission for Consultant's review.
- .11 Division 26 shall check all shop drawings and make necessary changes, prior to submission to the Consultant. They will be reviewed by the Consultant and, if re-submission is required, Division 26 shall ensure that the supplier's drawings have been changed to comply before returning them to the Consultant for another review. If the drawings still do not comply, and require additional review by the Consultant, the Consultant shall be reimbursed by Division 26 for the time required for such additional reviews.
- .12 Review of the shop drawings by the Consultant shall not relieve the Contractor from responsibility for errors and omissions therein.
- .13 Shop drawings reflecting additional design or change in design shall be reviewed by the Consultant and Owner.
- .14 Provide shop drawings for all electrical components, including but not limited to wiring devices, lamps, starters, luminaires, etc.

#### 1.9 EQUIVALENT MATERIALS AND EQUIPMENT

- .1 Bidder shall submit a tender based on the specified materials and equipment only.
- .2 Bidders may submit a tender based on equivalent material and equipment, only if such items have been approved as equal by the Consultant.
- .3 Refer to Section 01 23 10 for alternate prices information
- .4 Request for equal submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing in the left hand margin. Every clause of the applicable specification section must be individually marked indicating details of how compliance is met or, how the non-compliance items should be considered equal.

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- .5 All luminaire submittals will be required to be accompanied with a complete photometric site/and or floor plan for lighting level confirmation.
  - .6 Submittal list will be returned and may be picked up at the Consultant's office when directed by the Consultant. Where submissions are not returned by the Consultant before tender or forty (40) working hours before close of tender, they are considered not approved.
  - .7 The approval of equivalent products will be granted on the basis of general design only. Such approvals will not relieve the electrical trade from providing all necessary components and functions required in the specifications or on the drawings.
  - .8 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done 'By Others' or 'By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.
- 1.10 RECEIPT SUBMITTAL
- .1 At the time of purchase of electrical components, (mainly but not limited to light fixtures), which are components that may require review by regulatory agencies such as Efficiency Manitoba Certification process, the Contractor shall provide the owner and Consultant with copies of the corresponding receipts. The submittal of receipts is intended to verify quantities and specification of the components for submittal to the regulatory agencies.
- 1.11 LOT PRICING
- .1 Package lot pricing from manufacturers, suppliers, and/or wholesalers will not be acceptable.
- 1.12 FIELD QUALITY CONTROL
- .1 All electrical work to be carried out by qualified licensed electricians or apprentices as per conditions of the Provincial Act respecting manpower vocational training and qualifications. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
  - .2 The work of this Division to be carried out by a Contractor who holds a valid Master Electrical Contractor license as issued by the Province that the work is being constructed.
  - .3 Conduct and pay for all tests as indicated in Section 26 08 01 "Electrical Testing Requirements".

1.13 CO-ORDINATION WITH OTHER TRADES

- .1 Refer to architectural, structural and mechanical design drawings and specification for electrical work in connection with other divisions. The most stringent or restrictive requirement of specifications or drawings from any Division shall apply and be included in the tender price. This will be applicable even after the work was installed with the lesser requirement. Provide all required work to the full satisfaction of the Consultant.
- .2 Co-ordinate electrical work with work of other trades to avoid conflict with pipes, air ducts and other equipment. Provide additional supports, wiring, etc. to all relocated equipment as required where relocation is necessary to avoid interferences.

1.14 EXAMINATION OF SITE

- .1 Prior to submitting a tender, examine site and local conditions, which may affect work. Claims for extra payment resulting from conditions, which may have been foreseen during examination of the site, will not be recognized.
- .2 Ensure that all equipment designated as "existing to remain" or "existing to be relocated" is suitable for its intended re-use, including panelboards and circuits. Report any discrepancies to the Consultant before tender close.

1.15 RECORD DOCUMENTS

- .1 Submit project documents in accordance with Division 01 - General Conditions.
- .2 Allow for computer aided drafting (CAD) of original drawings to show as constructed information. Submit three (3) copies of the maintenance manuals to the owner, in 3-ring binders. Include a copy of all inspection and testing certificates, shop drawings, name/ address/phone # of each supplier, contractor and engineer, table of contents, and a copy of project "as-built" drawings in an envelope at the back of the binder and electronic files on a USB stick. Include all costs in contract. CAD files can be obtained from consultant.
- .3 The Contractor shall keep a set of white prints on the job site at all times on which he shall record all additions or deviations from the contract documents including all changes covered by addenda, change orders, field changes, job conditions, etc. A set of drawings shall be utilized for each system and the contractor shall obtain prints as required. Drawings to include locations of all junction and pull boxes, routing of feeders and conduits, and changes to circuit numbers.
- .4 All principle below grade or inaccessible conduits, systems, etc. shall be dimensioned at each change in direction. All conduit routes not shown by the Consultant on original drawing shall be shown including circuit wiring, junction boxes, zoned conduit runs, etc.
- .5 The Contractor shall provide one set of clean marked-up drawings for approval and a final set with changes as may be requested by the Consultant.

- .6 If corrections are required after the second Consultant review, due to missing information, the Electrical Subcontractor shall be responsible for the Consultant's time to indicate the required corrective measures and all courier and printing costs.
- .7 The Contractor is responsible for the total cost of mylars, and white prints taken from mylars, and electronic files.
- .8 Corrected, revised "Mylars", white prints, electronic files, etc. will be forwarded to the Owner by the Consultant. Final payment on the contract will not be made until correct mylars, and files are prepared and submitted to the Owner.

## Part 2 Products

### 2.1 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Electrical equipment shall be new and of the type and quality specified.
- .3 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .4 Provide labour, materials, transportation, equipment and facilities, etc. required for the complete electrical installation as indicated or can be reasonably implied from the drawings and specifications.
- .5 Provide factory assembled control panels and component assemblies.
- .6 Provide minimum 1500mm (59") clearance and access/working space at all equipment access doors/panels, breakers, switches, transformers, controls, etc. that is rated 1200A or more or rated over 750V and minimum 1000mm (39.4") clearance in all other areas.
- .7 Equipment shall not be located near pipe shafts or fluid piping.
- .8 Equipment, conduits and cables shall not restrict or interfere with necessary access space required to safely service mechanical equipment (ventilation fans, filters, etc.) which are existing and/or to be installed under this contract.

### 2.2 MAINTENANCE MATERIAL

- .1 Provide all maintenance materials as outlined in Section 26 05 01 "Supplementary Components and Revisions – Electrical".



## 2.3 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "Seafoam Green" finish to EEMAC Y1-1-1955 to match Manitoba Hydro Transformer, unless otherwise indicated.
  - .2 Paint indoor switchgear, switchboards and distribution enclosures ANSI 61 grey (PI100-Q) for normal power.
  - .3 Paint indoor housekeeping pads "Hazard" yellow.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

## 2.4 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminium conductors.

## 2.5 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 volts, related to control systems, are specified in Division 25.
- .3 All electrical connections, terminations, power requirements related to electrical work shown on architectural or mechanical drawings are to be included by this Division.

## 2.6 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible, after equipment is installed.

## 2.7 WARNING SIGNS

- .1 Provide warning signs on equipment, as required, to meet the requirements of the Inspection Authorities and Consultant.

## 2.8 FIRE STOPPING

- .1 Refer to Section 07 84 00 for all fire stopping requirements.

- .2 Provide approved fire stopping systems and smoke seals for all electrical penetrations at all fire rated walls and floors to maintain the integrity of wall/floor fire rating being penetrated.

## 2.9 ACCESS DOORS

- .1 Refer to section 08 31 00 - Access Doors and Panels.
- .2 Supply access doors in inaccessible construction to give access to all concealed junction boxes, pull boxes, conductor joints and other similar electrical work, which may require maintenance or repair.
- .3 Before commencing installation of electrical work, submit to the Consultant for approval a list of required access doors showing the exact sizes and locations of such access doors. Locate access doors in walls and partitions to the Consultants approval, and arrange electrical work to suit. Access doors shall be, wherever possible, of a standard size for all applications. Confirm exact dimensions with the Consultant, prior to ordering.
- .4 Access doors will be installed by the Division responsible for the particular type of construction in which access doors are required. Supply the access doors to the Division installing same at the proper time to avoid construction delays.

## Part 3 Execution

### 3.1 PROCEDURE SCHEDULE

- .1 All electrical work shall be coordinated with Owner and sub-trades involved. Manner and areas of work shall be pre-arranged prior to proceeding.

### 3.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver all materials to the site in an orderly fashion.
- .2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials to be left in shipping containers until required for use.
- .3 Provide additional protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment and as directed by the Architect.

### 3.3 WORKMANSHIP

- .1 Install equipment, conduits and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Consultant. Install conduit and cable runs parallel and perpendicular to building lines, in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.

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- .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearance and accessibility for same.
  - .3 Include in the work all requirements shown on the shop drawings or manufacturer's installation instructions.
  - .4 Replace work unsatisfactory to the Consultant without extra cost.
- 3.4 SUPERVISION
- .1 Supervise the work at all times through a responsible and competent supervisor.
  - .2 Employ the same supervisor on the project from the start to the finish to ensure continuity of the work.
  - .3 Employ experienced, qualified journeymen and apprentices.
- 3.5 CUTTING AND PATCHING
- .1 Pay the costs of all cutting and patching required for the installation of electrical work. Payment for cutting and patching shall be made through the GC.
  - .2 Cutting and patching required for the installation of electrical work shall be done by the particular trade whose work is involved.
  - .3 Obtain the approval of the Architect and/or Owner before arranging for any cutting. Patching shall restore the affected area to the original condition; material used for patching shall be compatible with existing condition.
  - .4 Cutting or patching shall be carried out by the tradesmen of the subcontractor who normally works with materials involved, with the cost being the responsibility of Division 26, 27 or 28 Sub-Contractors.
- 3.6 CONDUIT, SLEEVES AND HOLES
- .1 Make necessary arrangement for cutting of chases, drilling of holes and other structural work required to install electrical conduits, cables, pull boxes and outlet boxes. In existing facilities - Do Not core without Owner's permission or without x-ray or scanning of floors.
  - .2 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete to be sized for free passage of conduit.
  - .3 Flash and weatherproof any penetrations or holes through exterior walls and roof.
  - .4 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to a minimum.
  - .5 All sleeves and access conduits shall protrude through the floor min. 25mm above finished floor surface.
  - .6 Provide fire-stop all floor and wall penetrations.

### 3.7 LOCATION OF OUTLETS

- .1 Locate outlets as indicated.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'-0"), and information is provided before installation.
- .4 Locate light switches on latch side of doors.
- .5 Drawings are schematic only, co-ordinate mounting height and location of all equipment with architectural, mechanical and structural drawings prior to installation.
- .6 Vertically align outlets of different systems when shown in close proximity to each other and occur at different mounting heights.

### 3.8 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated on electrical drawings, architectural elevations, or instructed otherwise:
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 450 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters: 150 mm.
    - .4 Above top of counter splash backs: 100 mm.
    - .5 In mechanical rooms: 1200 mm.
  - .3 Panelboards: 2000 to top.
  - .4 Voice, data and cable TV outlets: 450 mm.
  - .5 Wall mounted telephone outlets: 1200 mm.
  - .6 Wall mounted emergency lights: 2286mm
  - .7 Fire alarm devices shall be installed as per CAN/ULC-S524-06.

### 3.9 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.10 PROTECTION

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage in English.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.11 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. Record hour and date on which each load was measured, including voltage at time of test.

3.12 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.13 CLEANUP

- .1 The electrical trade and his/her sub-trades shall at all times during construction, keep the site free of all debris, boxes, packing, etc., resulting from work of this trade.
- .2 At the completion of the work, the electrical installation shall be left in a clean, finished condition to the satisfaction of the building owner.

3.14 GUARANTEE/WARRANTY

- .1 Satisfactory operation of all work and equipment installed under this contract shall be guaranteed for a period of one (1) year from the date of final acceptance of this work except where otherwise noted. Refer to Section 26 50 00 for luminaire/driver warranty requirements.

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- .2 All unsatisfactory work and any equipment that does not perform satisfactorily within the guarantee period shall immediately be repaired or replaced at no cost to the Owner, providing such failure is not due to improper usage by the Owner. The warranty on any replacement equipment or components shall be one year from the date of their installation.
  - .3 Any equipment that has been placed in use for any reason prior to the beginning of the guarantee period, such as for heating during construction, shall be cleaned and provided with whatever maintenance and repair is required so that its condition is equal to that of new equipment, or it shall be replaced, at no cost to the Owner.
  - .4 Equipment that fails as a result of its use prior to the beginning of its one-year guarantee period shall be repaired or replaced at no cost to the Owner, even after the normal one-year guarantee period has expired.
  - .5 All details of warranty repairs shall be documented in letters to the Owner, with a copy sent to the Consultant.
  - .6 No certificate given, payment made, or the use of the equipment by the Owner, shall be construed as acceptance of defective work or of improper materials.
  - .7 This guarantee shall not act as a waiver for products that are warranted by the manufacturer for longer than one year.
- 3.15 CASH ALLOWANCES
- .1 Refer to General Conditions for further requirements under this section.
- 3.16 ALTERNATE PRICES
- .1 Do not include alternate price in base bid. Refer to Section 01 23 10.
  - .2 Refer to General Conditions for further requirements under this section.
- 3.17 PRICING OF CHANGES AFTER TENDER
- .1 Within a week of contract award, the Electrical Contractor shall submit an itemized cost breakdown for labour, including an hourly rate for foreman (or journeyman) for all work to be performed on changes of the Contract (PCNS). Refer to General Conditions for further requirements under this section.
  - .2 The Electrical Consultant reserves the right to review costing using acceptable pricing standards based on Means "normal" pricing guide. Refer to Section 26 05 01 "Supplementary Components and Revisions - Electrical".
- 3.18 MONITORING
- .1 Before substantial performance will be granted, contractor shall arrange for monitoring of the Intrusion and Fire Alarm systems. Provide print-out of all events at monitoring company denoting time and type of signal from each device for Intrusion and FA systems.

The print-out shall list time and type of signal received. Contractor shall produce a list of tested devices to show time of time testing. The list shall be produced in the same format as the print-out for fast cross-reference. A letter from monitoring company stating conformance to ULC requirements is required. This letter shall be provided and the connection incorporated in the Fire Alarm system verification as described elsewhere in this specification.

### 3.19 INTEGRATED SYSTEMS TESTING OF FIRE PROTECTION AND LIFE SAFETY SYSTEMS

- .1 In addition to general building commissioning the fire protection and life safety systems shall be tested and verified in accordance with Standard CAN/ULC-S1001 Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems. A third-party commissioning agent engaged by the Contractor to act as the Integrated Testing Coordinator to perform all required tasks as listed in CAN/ULC S1001. The Integrated Testing Coordinator is to lead all testing and commissioning procedures and provide all documents required to fulfill the full extent as described in the standard.
- .2 The Integrated Systems Coordinator is to be a registered Professional Engineer in Manitoba in good standing and have all necessary certifications as dictated by S1001 and the local AHJ.

### 3.20 FINAL ELECTRICAL ACCEPTANCE

- .1 As the Consultants are required to give professional assurance that all electrical systems have been installed, tested, commissioned and verified in accordance with the current edition of the Manitoba Building Code and the Canadian Electrical Code, the following items are required from the Contractor prior to substantial performance acceptance and issuance of "Assurance of Field Review and Compliance."
  - .1 "Certificate of Final Electrical Inspection" certificate signed by the Electrical Inspector for the project (a declaration form signed by the Electrical Contractor is not acceptable);
  - .2 Certificate of Fire Alarm System Verification; (Certificate shall include checklist for each and every item of the Fire Alarm System), Inspection, Testing and Maintenance Technician sheets; this implies that system is fully operational.
  - .3 Verification Certificate of Exit and Emergency Light Inspection and Testing Systems; this implies that system is fully operational.
  - .4 Confirmation of F.A. System monitoring of Alarm, Trouble and Supervisory Signals. Contractor shall obtain this confirmation from the owners monitoring company in the form of a print-out letter. The letters shall show the time each event signal occurred and has been reset during the verification.
  - .5 Obtain and Complete a Efficiency Manitoba Rebate Form and submit to the Project Manager with all required backup.
  - .6 Certificate and report that systems as listed in Standard CAN/ULC-S1001 Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems have been tested and verified.

- .7 Submit all testing reports and certifications as specified in Section 26 08 01 – Electrical Testing Requirements.

3.21 EVALUATION OF "PROGRESS CLAIMS"

- .1 Contractor shall submit to the Consultant for review and approval a detailed breakdown of material and labor. This detailed breakdown shall be formatted as per the following table.
- .2 The Progress Claim form(s) shall be submitted to the Consultant prior to the initiation of the Contractor's first claim for payment for review and acceptance. Failure to submit the Progress Claim form(s), and to subsequently submit all Progress Claims based on the same format, will delay the processing of the Contractor's Progress Claim.

END OF SECTION



Part 1 General

1.1 RELATED WORK

- .1 Refer to all sections of the specification for related work.

1.2 COORDINATION

- .1 Contractor shall allow for off-hours work as required and approved by the owner.
- .2 Where existing services or systems, such as electrical power, telephone system, data systems, equipment alarm system, fire alarm system, etc. are required to be disrupted and/or shut-down, coordinate the shut-downs with the Owner and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruptions and/or shutdowns and ensure the duration of same is kept to the absolute minimum. Submit for approval, a written concise schedule of each disruption at least 120 hours in advance of performing work and obtain written consent prior to implementing. Allow for after-hours work.
- .3 If a significant portion of the fire alarm system is not in operation, such as an entire initiating device, signaling line, or notification appliance circuit or if taken out of service the contractor shall provide a fire watch till the system is back in service. The fire watch will allow for the assignment of a person or persons to an area for the express purpose of notifying the fire department, the building occupants, or both of an emergency; preventing a fire from occurring; extinguishing small fires; or protecting the public from fire or life safety dangers.

The fire watch should at least involve some special action beyond normal staffing, such as assigning an additional security guard(s) to walk the areas affected. Such individuals should be specially trained in fire prevention and in occupant and fire department notification techniques, and they should understand the particular fire safety situation for public education purposes.

In addition, in the event of any shutdown of fire protection equipment or part thereof, the Authority having jurisdiction and the building occupants must be notified and instructions must be posted as to alternate provisions or actions to be taken in case of an emergency. These provisions and actions must be acceptable to the Winnipeg Fire Paramedic Service. An attempt to minimize the impact of the malfunctioning equipment must be indicated (e.g. whole portions of a sprinkler, fire alarm or standpipe system is placed out of service, service to remaining portions must be maintained) and where necessary, the use of watchmen, bull horns, walkie-talkies, etc. should be employed to notify concerned parties of emergency procedures. Directions for specific situations may be sought from the Winnipeg Fire Paramedic Service, Fire Prevention Branch. In all cases when a fire alarm system is out of service, hourly fire watch patrols must be implemented immediately. Fire watch patrols may also be required in the event of a shutdown of other fire protection systems.

Contractor to coordinate with building owner for a written fire watch plan. Include all costs in contract.

- .4 Should any temporary connections be required to maintain services or systems during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing equipment or system be damaged, make full repairs without extra cost, and to the satisfaction of the Owner and Consultant.
- .5 Refer to General Requirements for phasing and staging of work and adhere to that schedule. Comply with instructions regarding working hours necessary to maintain the building in operation.
- .6 Coordinate complete installation of relocated utility services, if required, with utilities to ensure minimum interruption of service. Coordinate the disconnection and re-connection of the existing electrical circuits in order to keep power interruptions to a minimum.
- .7 The drawings indicate major items of equipment to be deleted or relocated but may not indicate every item of equipment or conduit to be deleted or relocated. Contractor shall be responsible for determining which existing equipment is to be deleted or relocated by examining all site conditions and all construction documents.
- .8 No drilling in concrete floors shall take place unless the floor has been scanned (or x-rayed) to confirm exactly what is in the floor. The Contractor shall notify the Owner's Construction Officer before drilling. The Contractor assumes complete responsibility for any and all damages or work stoppages occurring from unforeseen problems. The Owner does not want any facility disruptions.

### 1.3 EXISTING DEVICES IN NEW CONSTRUCTION

- .1 Disconnect and remove existing electrical equipment made obsolete due to renovations. Remove associated wiring and conduits back to source panel.
- .2 Where existing devices (receptacles, switches, etc.) are presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc., as required, to mount device to new wall finish.
- .3 All existing electrical equipment to remain, which is located in or on portions of existing walls being demolished, shall be relocated to nearest wall. This equipment shall include cabinets, panels, switches, receptacles, etc.
- .4 Where existing conduits, which are in use, pass vertically through a wall being demolished, relocate those conduits and conceal in a new wall or surface mount in a service area. Extend conduit, wiring, etc. as required.
- .5 Where new ceilings are to be installed, relocate all existing ceiling mounted devices down to new ceiling. This equipment shall include but not be limited to smoke

detectors, heat detectors, speakers, luminaires, etc. Extend existing conduit and wiring as required.

- .6 All existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.
- .7 Include all costs to x-ray existing floors to be drilled or sleeved to ensure no existing services are severed or damaged. Damages could be very serious. Any damages resulting from failure to x-ray (or scan) is the Contractor's responsibility.
- .8 Redundant existing circuit breakers will not be connected to any wiring and are to be labelled as spares.
- .9 Field-check all existing fire alarm work on site including existing terminal boxes on each floor before submitting tender. Include all required work and re-work as may be required for a completely finished working system. No compensation will be given to the Contractors for work that should have been foreseen before submitting tenders.
- .10 Some new outlets may require shallow boxes to fit into existing walls with shielding. Contractor shall confirm site conditions prior to submitting bid.
- .11 All existing fire alarm devices that are being relocated or disconnected during areas of renovation should have all open loops closed to eliminate trouble signals in fire alarm panel during construction period. Allow for reprogramming of fire alarm panel to allow for all offline devices during construction period.

#### 1.4 REMEDIAL WORK

- .1 It is the Electrical Contractor's responsibility to ensure that any coring of holes through decks or floor slabs, will not penetrate existing conduits, cables or mechanical equipment in walls, ceilings or floor slabs. The Contractor, at his cost, is responsible to take all actions required and as may be deemed necessary by the Owner to correct any damage. No coring shall be undertaken unless permission is given by the building Owner's Construction Officer.

#### 1.5 RELOCATE EXISTING CABLING IN NEW CONSTRUCTION

- .1 Include allowance to relocate existing cabling that may exist in ceiling spaces. Allowance includes replacing entire lengths of cables, testing and commissioning.

#### 1.6 DAMAGE

- .1 Where existing structure, grade or pavement has to be removed, altered or otherwise defaced to facilitate electrical installation, Contractor shall arrange for breaking of openings or grooves in any building structure or breaking of pavement and/or digging of trenches.

- .2 Any equipment, structure, pavement or grade damaged by the execution of this Contract shall be repaired to its original condition. Any cost incurred for such work shall be allowed for in tender sum.
- .3 Irreparably damaged equipment shall be replaced at no cost to the Owner.
- .4 If the finish of new equipment is damaged, the Contractor shall, at the discretion of the Consultant, either replace or restore the equipment to its original condition by re-spraying, refinishing, etc., at no cost to the Owner.
- .5 Openings and cutouts shall not be burned into panels. Oversize openings shall not be patched up with loose plates or oversize washers. Oversized openings will be considered damage to the equipment and are to be treated as specified above.
- .6 The Contractor shall use extreme care when working near existing services and any services disturbed shall be replaced by the contractor at no cost to the Owner to the satisfaction of the Consultant.
- .7 Contractor shall determine the location of the existing underground services from the authorities having jurisdiction and/or Owner and/or Architects before excavation of existing grade and sub-grade, or new construction begins.

## 1.7 SCHEDULE OF WORK

- .1 Carefully note and refer to Division 01 Section 01 11 00 Summary of Work for general schedule of work and include for all requirements to conform to it.

## Part 2 Products

### 2.1 MATERIALS

- .1 Provide all materials required for the complete interface and reconnection installation.
- .2 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturer's requirements and instructions.
- .3 Add new grounding materials as required to make existing grounding systems good in renovated areas only. Confirm existing on site.
- .4 Add modules, switches, etc., in existing control panels, as required, to extend existing systems to the new or renovated areas only. Confirm existing on site.
- .5 Where an existing panelboard requires to be relocated, provide as many junction and/or pull boxes in accessible ceiling space as necessary to properly extend all conductors. Provide permanent compression connections or, appropriate terminal blocks. Provide permanent identification on all related junction and pull boxes.

- .6 New system devices, speakers, starters, panelboards, breakers, etc. that are required to be tied into existing systems, quality of new materials to match or exceed existing. Confirm existing on site.
- .7 Add modules, switches, etc. in existing control panels, as required, to extend existing systems to new or renovated areas.
- .8 It is the intent of these specifications to not re-use any existing wiring.

Part 3 Execution

3.1 INSTALLATION

- .1 Install boxes, conduit and wiring through existing areas as required for the new installation.
- .2 Patch and repair walls and ceilings in existing building that have been damaged or cut open due to the new electrical installation.
- .3 Patch and make good existing walls which are to remain where existing electrical devices have been removed.
- .4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.
- .5 Test and confirm all existing grounding systems are effective and in good condition. Include work and materials required to change wiring and make good existing.
- .6 Electrical Contractor shall confirm the exact position and mounting height of each outlet prior to commencement of work. Special efforts are required to coordinate outlets, conduit routes, etc. with architectural, mechanical and other related work.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all sections of the specifications for related work.

1.2            REFERENCES

- .1            CSA C22.2 No. 65 Wire Connectors.
- .2            CSA C22.2 No. 0.3 Test Methods for Electrical Wires and Cables.
- .3            CSA C22.2 No. 131 Type Teck 90 Cable.

Part 2            Products

2.1            WIRE CONNECTORS

- .1            Copper long barrel compression connectors sized for conductors. Use two-hole long barrel compression connectors for feeder conductors.
- .2            Solderless, self-insulated connectors for hand twist wire joints for lighting, small power, and associated control devices, with nylon insulator. Standard of acceptance: Thomas & Betts Marettte Type II Winged or Ideal Cantwist.
- .3            Solderless, self-insulated connectors for hand twist wire joints for solid to stranded connections (e.g. heater thermostats), nylon insulator. Standard of acceptance: Thomas & Betts Marettte ACS.
- .4            Terminate conductors #8 AWG and larger with Thomas & Betts Color-Keyed compression connectors 54000 Series, or on lugs provided with equipment. Use Thomas & Betts "KOPR-SHIELD" compound Series CP8-TB on all terminations for compression connectors.

2.2            CABLE CONNECTORS

- .1            Provide rain-tight connector fittings, complete with O-rings for use on all enclosures. Side entrances to enclosures are preferred.

2.3            RAIN-TITE COUPLINGS

- .1            Rain-tight couplings shall be used for all conduits.

Part 3          Execution

3.1              CABLE INSTALLATION

- .1      Install cables for feeders or branch circuits in raceways, cable trays, wireways or trenches.
- .2      Prevent over-heating by induction in accordance with rule 12-3022(6) and 12-3022(7) and Appendix B Canadian Electric Code, Part 1 where single conductor cables connect to boxes and cabinets.
- .3      Provide mechanical protection for cables where cables are turned up above the floor through sleeves or slots. Provide channels, angle sills or rigid conduit sleeves which protrude at least 150 mm above the finished floor.
- .4      Support on channels where cables are grouped and not run in tray.
- .5      Run cables parallel to the lines of the building.
- .6      Bends to be concentric.
- .7      Seal cables which penetrate air barrier and vapour boxes to barrier and boxes.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the specification for related work.

1.2            REFERENCES

- .1            CSA C22.2 No. 0.3 Test Methods for Electrical Wires and Cables.
- .2            CAN/CSA-C22.2 No. 131.

1.3            PRODUCT DATA

- .1            Submit product data in accordance with Section 26 05 00 Common Work Results - Electrical.

1.4            FIRE RATING

- .1            Fire ratings shown are minimum required. Provide cable of fire rating as required by authority having jurisdiction.
- .2            Fire rate entire cable support system. This shall include but not be limited to cable racks, support rods, anchors, etc.

Part 2           Products

2.1            CABLE IDENTIFICATION

- .1            Cables to be identified with wire markers.
- .2            Machine printed self laminating label type.
- .3            Thermal transfer type with printable area and translucent vinyl film.

2.2            BUILDING WIRES

- .1            Conductors in conduit:
  - .1            Type: RW90, RWU90
- .2            Conductors for panel and branch circuits:
  - .1            Solid copper #10 AWG and smaller
  - .2            Stranded copper #8 AWG and larger.
  - .3            Sized as required (minimum #12 AWG).
- .3            Insulation:
  - .1            Cross link polyethylene (XLPE), 90°C.



- .4 Configuration:
  - .1 Single conductor.
- .5 Voltage Rating: 600V.
- .6 Certification:
  - .1 CSA C22.22 No. 38 or latest revision.

## 2.3 ARMOURED CABLE

- .1 Type: AC90 (BX).
- .2 Conductors:
  - .1 Solid copper #10 AWG and smaller.
  - .2 Stranded copper #8 AWG and larger.
  - .3 Sized as required (minimum #12 AWG).
- .3 Insulation:
  - .1 Cross link polyethylene (XLPE), 90°C.
- .4 Configuration:
  - .1 Multi-conductor, as required, complete with a separate bare CU ground wire.
- .5 Voltage Rating: 600V.
- .6 Armour: Bare inter-locked aluminum.
- .7 Certification:
  - .1 CSA C22.22 No. 51 or latest revision.

## 2.4 ARMOURED CABLE (TECK)

- .1 Type: TECK 90
- .2 Conductors for panel and branch circuits:
  - .1 Solid copper #10 AWG and smaller.
  - .2 Stranded copper #8 AWG and larger.
  - .3 Sized as required (minimum #12 AWG).
- .3 Insulation:
  - .1 Cross link polyethylene (XLPE), 90°C.
- .4 Configuration:
  - .1 Single or multi-conductor, as required.
- .5 Colour Code:

- .1 Black, red, blue and white in 4/C cable. Cables of more than 4/C to be number coded.
  - .6 Voltage Rating: 600V.
  - .7 Inner Jacket:
    - .1 Black polyvinyl chloride (PVC).
    - .2 Low flame spread (LFS).
    - .3 Low gas emission (LGE).
  - .8 Armour:
    - .1 Inter-locked aluminum.
  - .9 Outer Jacket:
    - .1 Black polyvinyl chloride (PVC), -40°C.
    - .2 Low flame spread (LFS).
    - .3 Low gas emission (LGE).
  - .10 Fire Rating: FT4, AG14.
  - .11 Certification:
    - .1 CSA C22.22 No. 131 or latest revision.
- 2.5 ALUMINUM SHEATHED CABLE
- .1 Type: RA-90 (Corflex)
  - .2 Conductors:
    - .1 Solid copper #10 AWG and smaller.
    - .2 Stranded copper #8 AWG and larger.
    - .3 Sized as required (minimum #12 AWG).
  - .3 Insulation:
    - .1 Cross link polyethylene (XLPE), 90°C. (194°F).
  - .4 Configuration:
    - .1 Single or multi-conductor as required.
  - .5 Voltage Rating: 600V.
  - .6 Aluminum Sheath:
    - .1 Liquid and vapour tight solid corrugation.
  - .7 Outer Jacket:
    - .1 Polyvinyl chloride (PVC), -40°C (-40°F).

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- .2 Low flame spread (LFS).
    - .3 Low gas emission (LGE).
  - .8 Fire Rating: FT4, AG14.
  - .9 Certification:
    - .1 CSA C22.22 No. 123 or latest revision.
  - 2.6 VARIABLE FREQUENCY DRIVE CABLE:
    - .1 Cable:
      - .1 Variable frequency drive cable to CAN/CSA C22.2 No. 131.
    - .2 Conductors:
      - .1 Copper power and ground.
    - .3 Ground conductors:
      - .1 Three bare ground conductors spaced evenly around circumference of cable (sectored ground).
    - .4 Insulation:
      - .1 Cross linked polyethylene, 1000V.
    - .5 Armour:
      - .1 Continuous aluminum sheath formed into corrugates seamless heath.
    - .6 Outer jacket:
      - .1 PVC, UV resistant.
    - .7 Fire rating: FT4, HL and AG14.
    - .8 Connectors:
      - .1 As for RA90.
    - .9 Standard of Acceptance: Nexans DriveRX cable.
  - 2.7 ELECTRONIC CABLES
    - .1 Conductors:
      - .1 #18 AWG - STC solid copper.
    - .2 Insulation:
      - .1 Polyvinyl chloride (PVC).
    - .3 Configuration:
      - .1 Twisted pairs (number as required).

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- .4 Shielding:
    - .1 Copper braid.
  - .5 Voltage Rating: 300V.
  - .6 Certification:
    - .1 CSA.
- 2.8 FIRE ALARM CABLES
- .1 Conductor:
    - .1 Solid copper minimum #18 AWG.
    - .2 Minimum #12 AWG for signaling circuits, in accordance with Manufacturer's recommendations.
  - .2 Insulation:
    - .1 105°C. (221°F) flame retardant PVC.
  - .3 Configuration:
    - .1 Multi-conductor (minimum 4 conductors per cable).
  - .4 Voltage Rating: 300V.
  - .5 Conductor Identification:
    - .1 Colour coded.
  - .6 Shielding:
    - .1 Aluminum mylar foil.
  - .7 Outer Jacket:
    - .1 105°C. (221°F) red PVC jacket.
  - .8 Certification:
    - .1 CSA Class #5851-01 File #LR41741.
    - .2 UL subject 1424 File #E-83163.
- 2.9 EXTRA LOW VOLTAGE CONTROL CABLES
- .1 Type: LVT.
  - .2 Conductors:
    - .1 Solid copper #18 AWG.
  - .3 Insulation:
    - .1 Thermoplastic, colour coded.

- .4 Configuration:
  - .1 Single, two conductors – parallel.
  - .2 Three or more conductors – twisted.

- .5 Voltage Rating: 30V.

- .6 Outer Jacket:
  - .1 Thermoplastic.

- .7 Certification:
  - .1 CSA C22.22 No. 35.

## 2.10 INSTRUMENTATION CABLES

- .1 Type: Instrumentation cable.
- .2 Conductors:
  - .1 7-wire, concentric lay, Class B tinned copper, #18 or #14 AWG as required.
- .3 Voltage Rating: 300V or 600V as required.
- .4 Insulation:
  - .1 Fire retardant - cross link polyethylene (XLPE), 90°C.
- .5 Configuration:
  - .1 Single or multi pairs or triads, as required.
- .6 Shielding:
  - .1 Aluminum/mylar shield with drain wire for each pair triad.
  - .2 Overall aluminum/mylar shield with drain wire.
- .7 Drain Wires:
  - .1 7-wire, concentric lay, Class B tinned copper.
  - .2 Individual shields to be one size smaller than conductor size.
  - .3 Overall shields to be the same as conductor size.
- .8 Colour Codes:
  - .1 300V Pairs:
    - .1 black, white and number code.
  - .2 300V Triads:
    - .1 black, white and number code.
  - .3 600V Pairs:
    - .1 black, red and number code.
  - .4 600V Triads:

- .1 black, red, yellow and number code.
  - .9 Armour:
    - .1 Inter-locked aluminum.
  - .10 Outer Jacket:
    - .1 Grey polyvinyl chloride (PVC).
    - .2 Low flame spread (LFS).
    - .3 Low gas emission (LGE).
  - .11 Fire Rating: FT4.
  - .12 Certification:
    - .1 CSA C21.1 or latest revision.
    - .2 CSA C22.2 No. 174 or latest revision.
- 2.11 CONNECTORS
  - .1 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs, as required.
  - .2 Refer to Section 26 05 20 Wire and Box Connectors and 26 05 22 Connectors and Terminations.
- Part 3 Execution
- 3.1 CABLE INSTALLATION & WORKMANSHIP
  - .1 Install cables for feeders or branch circuits in raceways, cable trays, wireways or trenches as required.
  - .2 Prevent over-heating by induction in accordance with rule 12-3022(6) and 12-3022(7) and Appendix B Canadian Electric Code, Part 1 where single conductor cables connect to boxes and cabinets.
  - .3 Install sleeves where cables pass through poured concrete or masonry.
  - .4 Provide mechanical protection for cables where cables are turned up above the floor through sleeves or slots. Provide channels, angle sills or rigid conduit sleeves which protrude at least 150 mm above the finished floor.
  - .5 Where cables are grouped and not run in tray, support on channels.
  - .6 Run cables parallel to the lines of the building.
  - .7 Bends to be concentric.

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- .8 Seal cables which penetrate air barrier and vapour boxes to barrier and boxes.
  - 3.2 PHASE BALANCING
    - .1 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting for optimum balancing.
    - .2 Record all changes on "as-built" drawings.
    - .3 Phase rotation to match existing
  - 3.3 MINIMUM CABLE SIZE
    - .1 Minimum wire size to be #12 gauge throughout except where indicated otherwise.
    - .2 Be responsible for providing the minimum wire size to meet the code where the wire size shown on the drawing is inadequate to serve the load.
    - .3 Minimum size of panelboard and motor feeders is to be in accordance with CEC.
  - 3.4 VOLTAGE DROP
    - .1 Size wiring for branch circuits to achieve a maximum 3% voltage drop.
    - .2 Base on distance from overcurrent device to furthest wiring device/load.
    - .3 Provide cable size for entire length of circuit.
    - .4 Submit voltage drop calculations when requested.
  - 3.5 NEUTRAL CONDUCTORS
    - .1 Reduced neutrals not permitted.
    - .2 Provide separate neutrals for all dimmers, laser printers or as otherwise indicated.
    - .3 Provide 200% Neutral connections where shown on single line drawings and on K-rated and harmonic mitigating transformers.
  - 3.6 BONDING CONDUCTORS
    - .1 Provide a green insulated bonding conductor equal in size to current carrying conductors within all raceways.
  - 3.7 FIRE SEPARATIONS
    - .1 Submit drawings showing proposed method of sealing fire separations.

### 3.8 INSTALLATION OF BUILDING WIRES

- .1 Install wiring in conduit system in accordance with Section 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Ensure conduits are dry and free of debris before pulling cables.
- .3 Provide colour coding and identification as per this Section.
- .4 Wires in outlet, junction and switch boxes, not having a connection within the box shall not be spliced, but shall continue unbroken through the box.

### 3.9 INSTALLATION OF ARMOURED CABLES (BX)

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 21 - Wire and Box Connectors.
- .3 Type AC90 armoured cable (Bx) with screw type connectors shall be used for connections from conduit systems to luminaires in accessible ceilings only.
- .4 Type Bx cable shall not be used for any other application.
- .5 Maximum length of AC90 armoured cable for connections to luminaires mounted in stud partitions shall be 1.5 metres. Cable drops for luminaires in accessible ceilings shall be of sufficient length to allow the luminaire to be relocated to any location within a 3m radius.
- .6 Cable shall be clamped before entering the lighting fixture and shall be clipped before entering the conduit system junction box.

### 3.10 INSTALLATION OF ARMOURED CABLES (TECK)

- .1 Group cables wherever possible on channels, spaced one (1) cable diameter apart.
- .2 Do not splice cables.
- .3 Terminate cables in accordance with Section 26 05 21 - Wire and Box Connectors. Terminate cables using non-magnetic connectors. Cable armour shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate at the load end of the cable.
- .4 Cable bending radius shall be at least twelve (12) times the overall cable diameter and bend shall not damage or distort the outer sheath.
- .5 Do not install PVC jacketed cables in circulating air plenums.

### 3.11 INSTALLATION OF ALUMINUM SHEATHED CABLES

- .1 Group cables wherever possible.



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- .2 Terminate cables in accordance with Section 26 05 21 - Wire and Box Connectors.
  - .3 Do not use aluminum sheathed cable in cast concrete or masonry construction.
- 3.12 INSTALLATION OF VARIABLE FREQUENCY DRIVE CABLE
- .1 Install variable frequency drive cable from VFD to associated motor.
  - .2 Route cables from distribution to variable frequency drive along a physically separate path than from cables from VFD to associated motor.
  - .3 Other installation requirements as for RA90.
- 3.13 INSTALLATION OF EXTRA LOW VOLTAGE CONTROL CABLES
- .1 Install extra low voltage control cables in conduit.
  - .2 Ground control cable shield.
- 3.14 INSTALLATION OF INSTRUMENTATION CABLES
- .1 Install instrumentation cables in conduit.
  - .2 Ground cable shield.
- 3.15 INSTALLATION IN EQUIPMENT
- .1 Group and lace-in neatly, wire and cable installed in switchboards, panel boards, cabinets, wireways and other such enclosures.
- 3.16 TERMINATIONS
- .1 Terminate wires and cables with appropriate connectors in an approved manner.
- 3.17 MOTOR CONNECTIONS
- .1 Flexible connections to motors shall not exceed 2m unless authorized in writing by Consultant.
- 3.18 IDENTIFICATION
- .1 Provide cable identification on all cables.
  - .2 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, colour coded as listed below.
  - .3 Wire in conduit #1/0 AWG and larger and single conductor cables shall be identified at each outlet box and termination with a 150mm band of coloured vinyl tape of the appropriate colour. Neutral and ground conductors shall be identified. Paint or other means of colouring the insulation shall not be used.

- .4 Colour code wire in conduit and single conductor cables as follows unless otherwise shown on the drawings:

Three Phase Systems:			Single Phase Systems:		
Phase A	-	red	Phase A	-	red
Phase B	-	black	Phase B	-	black
Phase C	-	blue	Neutral	-	white
Neutral	-	white	Ground	-	green
Ground	-	green			

- .5 Maintain phase sequence and colour coding throughout project.
- .6 Use colour-coded wires in communication cables, matched throughout the system.
- .7 Identify control conductors in motor control equipment, contactors, fire alarm panels, etc. with mylar/cloth wire markers.
- .8 Identification text to include panel name, wire number and wire type (A, B, C, N or G). Identification to be independent of circuit numbers to allow phase balancing.
- .9 Provide identification on cables at:
- .1 Inside distributions/panelboards.
  - .2 Inside device boxes or at terminations.
  - .3 Wide junction boxes where joints are made.
- .10 Distribution feeders to be identified as follows:
- .1 Color code of feeder phase shall appear on every cable in two locations at any distribution; once inside the distribution enclosure near the cable termination and once outside the distribution enclosure, in a visible location near the enclosure.
- .11 Color code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc., by means of colored insulation or markers. Use markers of a type not subject to aging or deterioration through heating, drying or easy erasure. Color code in accordance with Rule 4-032 of the CEC. Phasing to be ABC, left, centre, right respectively.
- .12 Demonstrate to the Consultant that each wire has been clearly identified with wire markers where requested.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all sections of the specification for related work.

1.2            PRODUCT DATA

- .1            Submit product data in accordance with Section 26 05 00 Common Work Results - Electrical.

Part 2            Products

2.1            CONNECTORS AND TERMINATIONS

- .1            Copper, long barrel or short barrel compression connectors as required, sized for conductors.
- .2            Provide compression lugs for feeder cables. Set screw connectors not allowed.

Part 3            Execution

3.1            INSTALLATION

- .1            Install terminations and splices in accordance with manufacturer's instructions.
- .2            Bond and ground as required.

END OF SECTION

- Part 1            General
- 1.1            RELATED WORK
- .1        Refer to Section 26 05 00 - Common Work Results - Electrical for related sections applicable to this project.
- 1.2            STANDARDS
- .1        Refer to Section 26 05 00 - Common Work Results - Electrical for standards applicable to this project.
- .2        Latest issue of C22.1 as amended by Provincial Requirements or Inspection Authorities, specifically Section 10 - Grounding
- 1.3            SHOP DRAWINGS AND PRODUCT DATA
- .1        Submit shop drawings and product data in accordance with Section 26 05 00 - Common Work Results - Electrical.
- 1.4            STATION GROUND
- .1        Establish a station ground at the existing building consisting of four ground electrodes installed a minimum of 3m (10'-0") apart.
- .2        All ground electrodes shall be connected together with a common continuous copper ground wire, minimum #4/0.
- .3        Provide inspection cans at all ground electrodes.
- .4        Maximum resistance to ground to be 5 ohms.
- Part 2           Products
- 2.1            ELECTRODES
- .1        Ground electrodes: copper clad steel, minimum 3m long, 19mm diameter.
- 2.2            INSPECTION CANS
- .1        #14 gauge hot dipped galvanized steel
- .2        254mm diameter x 305mm deep
- .3        Complete with cover
- .4        Standard of Acceptance: Hydel Enterprises 700 series, Erico T416B series or Thompson Lightning Protection GWP series.

## 2.3 GROUND CONDUCTORS

- .1 Bare, stranded, un-tinned, soft annealed wire, sized as per the Canadian Electrical Code. Minimum size to be #4/0.

## Part 3 Execution

### 3.1 INSTALLATION – GENERAL

- .1 The ground electrodes shall be driven vertically, if rock is encountered use horizontal grounding. Ground rods driven vertically as far as possible and the remainder bent over and laid in a trench at least 450mm (18") below finished grade. Use enhanced ground backfill over rod as required.
- .2 Make buried connections using copper welding by Thermit process.
- .3 Provide "no-ox" compound at all connection points.

### 3.2 GROUND RESISTANCE TESTING

- .1 The preferred method for testing the resistance of the new ground grid including individual rod tests is three terminal fall-of-potential method as defined in IEEE 81.
- .2 Readings for each ground grid test shall be taken in a minimum of three directions at the location of the ground grid being tested. Minimum of ten test points in each direction shall be measured.
- .3 Test points shall be made along a straight line from the ground grid to the reference probe (RP).
- .4 The distance between the ground grid and the reference probe shall be consistent with normal practices for ground grid testing as outlined in IEEE 81.
- .5 Where site conditions are not suitable for applying three terminal fall-of-potential method alternative ground grid testing method shall be proposed by the testing company.
- .6 Submit a written proposal including rationale for using the alternative method. Obtain approval from Consultant prior to proceeding.
- .7 Ground grid/rod resistance measurements shall be made before the electrical distribution system is energized.
- .8 Provide additional ground electrodes or enhanced ground material as required if readings are not acceptable.
- .9 The test shall be made in normally dry conditions not less than 48 hours after the last rainfall.

- .10 Test the resistance of each individual rod and the entire grid as a complete system and submit test report to Consultant for review.
- .11 The ground rods shall be tested prior to interconnecting into system. Include test results from each individual rod in the report. Each ground rod shall be identified with unique name (i.e. A1, A2...B1, B2... etc.).
- .12 The resistance test of the entire ground grid shall be performed after all rods are installed and all interconnected conductors backfilled.
- .13 The test shall be performed before loaming and seeding or paving work has been performed.
- .14 If a new ground grid is intended to be interconnected to an existing ground grid system, the resistance measurements of the new ground grid shall be made and recorded before the grids are bonded together.
- .15 Equipment with automatic frequency control must be used.
- .16 If test must be performed on a ground grid that is surrounded by asphalt, concrete or other hard surface areas, where auxiliary terminals cannot be driven easily, then metal screens/plates and water can be used to replace the auxiliary terminals.
- .17 As part of the report, provide a site layout drawing/sketch showing the ground grid tested and the surrounding area including the directions in which the readings were taken from (when three probe or similar methods are implemented). Identify each ground rod with the assigned name on the drawing.
- .18 The drawing shall also include the following:
  - .1 Major nearby objects such as buildings, structures, fences, outdoor distribution, light standards, parking lot receptacles, walkways, streets, ditches, etc. shall be also shown.
  - .2 Identify each surface area (i.e. concrete, asphalt, natural soil, disturbed soil, gravel, etc.)
- .19 The report form shown on the following page shall be filled out and submitted to Consultant for review, as part of the test report and in addition to the test results, in sufficient time for review prior to energizing (minimum 3 weeks).
- .20 Provide test equipment calibration certificate with report.
- .21 Acceptable service provider:
  - .1 Western Lightning Protection or approved equal.

### 3.3 WORKMANSHIP

- .1 Ensure that all components make good contact at connections to form a continuous metallic ground through the system. Torque bolts in accordance with manufacturer's recommendations.
- .2 Ensure that contact surfaces are free of grease, oil, paint, primer and similar surface coverings. Clean all conductor contact surfaces thoroughly before installation by scratch brushing until bright and shiny.
- .3 For welding type connections, follow manufacturer's instructions.
- .4 Size conductors in accordance with code requirements if size is not specifically shown.

#### GROUND GRID RESISTANCE TEST - FIELD REPORT

Company Name:	Project Name:
Address:	
Phone:	Email:
Date of Test:	
Customer:	
Project Name:	
Soil Conditions: <input type="checkbox"/> Wet <input type="checkbox"/> Moist <input type="checkbox"/> Dry <input type="checkbox"/> Frozen Other: _____	
Date of Last Rain:	
Surface Layer Soil Type: <input type="checkbox"/> gravel <input type="checkbox"/> sand <input type="checkbox"/> clay <input type="checkbox"/> asphalt <input type="checkbox"/> concrete <input type="checkbox"/> loam <input type="checkbox"/> Other: _____	
Presence of Vegetation: <input type="checkbox"/> No <input type="checkbox"/> Yes If Yes, Describe: _____	
Ambient Air Temperature _____ °C Humidity _____ % Surface Layer Temperature _____ °C	
Test Location or Address:	
Test Completed by:	Signature:
Test Method:	
Test Equipment Brand Name & Model:	
Serial Number:	
Test Equipment Calibration Date: _____, Provide Calibration Certificate	
Test Equipment Calibration Certificate <input type="checkbox"/> Provided <input type="checkbox"/> Not Provided	
Site Layout Drawing: <input type="checkbox"/> Provided <input type="checkbox"/> Not Provided	

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the specification for related work.

1.2            SECTION INCLUDES

- .1            Provision of low voltage and extra low voltage grounding/bonding system for the facility.
- .2            Includes but is not limited to grounding/bonding for:
  - .1            Electrical service.
  - .2            Transformer neutral.
  - .3            Water/gas/sewer pipe grounding.
  - .4            Equipment.

1.3            REFERENCES

- .1            Canadian Standards Association:
  - .1            CAN/CSA C22.2 No. 41 Grounding and Bonding Equipment.

Part 2           Products

2.1            MANUFACTURERS

- .1            Acceptable manufacturers:
  - .1            FCI Burnay Limited.
  - .2            Erico Eritech.

2.2            EQUIPMENT

- .1            Ground equipment: to CAN/CSA C22.2 No. 41
- .2            Clamps for grounding of conductor: size as required to electrically bond to underground water piping.
- .3            Grounding conductor system, circuit and equipment, grounding to be bare standard copper, sized in accordance with the Canadian Electrical Code.
- .4            Ground bus: copper; minimum 300mm long, 25mm high and 6mm thick with pre drilled holes, complete with appropriate insulated supports sized to suit, fastenings, connectors.



.5 Compression fittings to ground conductors to existing electrical system grounding.

.6 Insulated grounding conductors: green, insulated.

## 2.3 ACCESSORIES

.1 Non-corroding, necessary for complete grounding system, type, size, material as required, including:

.1 Grounding and bonding bushings

.2 Protective type clamps

.3 Bolted type conductor connectors

.4 Thermit welded type conductor connectors

.5 Bonding jumpers, straps

.6 Pressure wire connectors

.2 Copper alloy castings with silicon bronze bolts, nuts and washers for connecting pipe, tube, cable, flat bar and special bus shapes.

.3 Wire connectors and terminations: to Section 26 05 22 – Connectors and Terminations.

## Part 3 Execution

### 3.1 INSTALLATION GENERAL

.1 Ensure that all components make good contact at connections to form a continuous metallic ground through the system. Torque bolts in accordance with manufacturer's recommendations.

.2 Ensure that contact surfaces are free of grease, oil, paint, primer and similar surface coverings. Clean all conductor contact surfaces thoroughly before installation by scratch brushing until bright and shiny.

.3 Install complete permanent, continuous system and circuit grounding systems including electrodes, conductors, connectors and accessories to conform to requirements of local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.

.4 Install connectors in accordance with manufacturer's instructions.

.5 For welding type connections, follow manufacturer's instructions.

.6 Protect exposed grounding conductors from mechanical injury.

.7 Make buried connections and connections to conductive water main and electrodes using copper welding by thermit process or permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837 as required.

.8 Use mechanical connectors for grounding connections to equipment provided with lugs.

- 
- .9 Soldered joints not permitted.
  - .10 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
  - .11 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
  - .12 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
  - .13 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end as necessary and run separate ground conductor.
- 3.2 CONDUCTIVE FLOORING
- .1 Provide recessed junction box above each flooring ground strip.
  - .2 Coat flooring ground strip with "no-ox" compound and crimp on connector.
  - .3 Provide ground wire from each junction box back to electrical ground bus.
- 3.3 PIPING SYSTEMS
- .1 Provide a #6 ground to service entrances of all electrically conductive piping systems in the building. Connect on street side of meters.
  - .2 These are to include, but not be limited to:
    - .1 Domestic water system.
    - .2 Building heating and cooling systems.
    - .3 Gas system.
  - .3 Install meter ground shunts.
  - .4 Utilize permanent mechanical connectors or wrought copper compression connectors to connect to pipe. Connectors are to be inspectable.
  - .5 Interconnect the grounding system with the main building ground.

- 3.4 SYSTEM AND CIRCUIT GROUNDING
  - .1 Install system and circuit grounding connections to neutral of low voltage system(s).
  - .2 In addition to grounding achieved through conduit grounds and cable ground wires, provide a #1/0 ground conductor from each derived ground (ie: transformers, drive isolation transformer, ATS) back to the main electrical room ground bus. Route to be identical to route used for main feeder.
- 3.5 EQUIPMENT GROUNDING
  - .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchboard, duct systems, frames of motors, starters, control panels, building steel work, generators, distribution panels, outdoor lighting.
- 3.6 GROUNDING BUS
  - .1 Install copper grounding bus mounted on insulated supports on wall of the main electrical room.
  - .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #1/0 AWG.
- 3.7 COMMUNICATION SYSTEMS
  - .1 Refer to Section 27 05 26 for requirements.
- 3.8 FIELD QUALITY CONTROL
  - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical and Section 26 08 01 – Electrical Testing Requirements.
  - .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation. Record readings and place copy in maintenance manual.
  - .3 Perform tests before energizing electrical system.
  - .4 Disconnect ground fault indicator during tests.
- 3.9 GROUND RESISTANCE TESTING
  - .1 Provide ground resistance testing as required by the Consultant.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the specification for related work.

Part 2            Products

2.1            SUPPORT CHANNELS

- .1            U shape, galvanized steel, size 41mm x 41 mm, 2.5mm thick, surface mounted, suspended or set in poured concrete walls and ceilings as required.
- .2            Acceptable manufacturers: Burndy, Electrovert, Unistrut, Pilgrim, Pursley.
- .3            Support equipment to be of type and size required to withstand the fire rating where used (rack hangers, rods, anchors).

Part 3            Execution

3.1            INSTALLATION

- .1            Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2            Secure equipment to poured concrete with cast in or expandable inserts.
- .3            Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4            Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation. Provide additional support where required.
- .5            Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6            Fasten exposed conduit or cables to building construction or support system using straps.
  - .1            One-hole steel straps to secure surface conduits and cables 32mm and smaller.
  - .2            Two-hole steel straps for conduits and cables larger than 32mm.
  - .3            Beam clamps to secure conduit to exposed steel work.

- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6mm diameter threaded rods and spring clips.
  - .2 Support two or more cables or conduits on channels supported by 10mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use U-channels at 1500mm on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Provide a separate fire rated system of supports where required (e.g. mineral insulated cables).
- .15 Install continuous vertical channel supports for conduits in utility service rooms and mechanical room.
- .16 Where conduit and cable runs are installed on support systems, they shall run so as to be as inconspicuous as possible. Coordinate support system with equipment of other trades to ensure proper installation of equipment. Run support system paths perpendicular or parallel to building lines.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the specification for related work.

1.2            REFERENCES

- .1            CAN/CSA C22.2 No. 40 Cutout, Junction and Pull Boxes.
- .2            CAN/CSA C22.2 No. 75 Splitters.

1.3            SHOP DRAWINGS AND PRODUCT DATA

- .1            Submit shop drawings and product data for splitters and cabinets in accordance with Section 26 05 00 Common Work Results - Electrical.

Part 2           Products

2.1            SPLITTERS, JUNCTION BOXES, PULL BOXES AND CABINETS - GENERAL

- .1            ANSI 61 grey polyester powder coat finish inside and out over phosphatized steel.
- .2            Gasketed and waterproof for wet and damp locations.
- .3            Locate splitters, junction and pull boxes as needed for each system.

2.2            SPLITTERS

- .1            Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2            Main and branch lugs to match required size and number of incoming and outgoing conductors.
- .3            At least three spare terminals on each set of lugs in splitters less than 400A, two spare terminals in all other splitters.

2.3            JUNCTION AND PULL BOXES

- .1            Code gauge sheet steel, welded construction.
- .2            Screw-on hinged flat covers.
- .3            For flush mounting, covers to overlap box by 25mm minimum all round with flush head cover retaining screws.

## 2.4 CABINETS

- .1 Cabinets: code gauge sheet steel, welded construction, suitable for field painting with handle lock and catch.
- .2 Locks: to match panelboards, complete with two keys.
- .3 Backboards: 21mm GIS fir painted plywood, one piece per cabinet, covering entire cabinet interior.
  - .1 Type E: with hinged door and return flange overlapping sides, for surface mounting, size as indicated or to suit.
  - .2 Type T: surface, or flush with trim, and hinged door.

## Part 3 Execution

### 3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

### 3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Supply all pull boxes and junction boxes shown on the drawings and as required for the installation.
- .2 Install in inconspicuous but accessible locations, above removable ceiling or in electrical rooms, utility rooms, or storage areas. Advise Consultant of locations prior to installation.
- .3 Size in accordance with Rule 12-3036, Canadian Electrical Code, as a minimum. Sizes shown on the drawings may be adjusted to suit available space. Review with Consultant where necessary.
- .4 Mount cabinets with top not greater than 2000mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.
- .5 Install terminal block as Type T cabinets.
- .6 Where junction and pull boxes are not indicated, install pull boxes so as not to exceed 30m of conduit run between pull boxes.
- .7 Install junction and pull boxes clear of all mechanical duct work and piping.

### 3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 53 - Identification for Electrical Systems.

- .2 Install size 2 identification labels indicating system name and system voltage (where voltage is applicable).

END OF SECTION



Part 1            General

1.1            RELATED SECTIONS

- .1            Refer to all Sections of the specification for related work.

1.2            REFERENCES

- .1            CAN/CSA C22.2 No. 18.1 Metallic Outlet Boxes.
- .2            UL 514C Non-Metallic Outlet Boxes, Flush Device Boxes and Covers.
- .3            Latest issue of CSA C22.1 Canadian Electrical Code, Part 1.

Part 2            Products

2.1            OUTLET AND CONDUIT BOXES - GENERAL

- .1            Minimum size of boxes to be in accordance with Canadian Electrical Code, Section 12.
- .2            Boxes to be hot dip galvanized to ASTM a924(M), designation zinc coating Z180 (G60).
- .3            102mm square or larger outlet boxes as required for special devices.
- .4            Provide multi-gang boxes where wiring devices are grouped.
- .5            Provide blank cover plates for boxes without wiring devices.
- .6            Provide barriers where outlets for more than one system are grouped.
- .7            All electrical equipment to be sprinkler-proof.

2.2            SHEET STEEL OUTLET BOXES

- .1            Hot dipped galvanized steel device boxes for flush installation, minimum size 102mm (4") square with extension and plaster rings as required.
- .2            Hot dipped galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit.
- .3            102mm (4") square or octagonal outlet boxes for lighting fixture outlets.
- .4            102mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3            MASONRY BOXES

- .1            Hot dipped galvanized steel masonry single and multi-gang boxes, 89mm (3½") deep, for devices flush mounted in block walls.

- .2 Provide 64mm (2½") deep boxes only when wall thickness does not allow 89mm (3½") box to be used.
- 2.4 CONCRETE BOXES
  - .1 Hot dip galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- 2.5 CONDUIT BOXES
  - .1 Cast ferrous boxes, 64mm (2½") deep, with factory-threaded hubs and mounting feet for surface mounting of wiring devices and for use in electrical or mechanical rooms and service spaces/corridors.
    - .1 Provide 43mm (1 11/16") deep boxes only when installation does not allow 64mm (2½") boxes to be used.
    - .2 Not approved for telecommunications use.
- 2.6 SECTIONAL BOXES
  - .1 Sectional boxes shall not be utilized.
- 2.7 FITTINGS - GENERAL
  - .1 Bushing and connectors with nylon insulated throats.
  - .2 Knock-out fillers to prevent entry of debris.
  - .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
  - .4 Double locknuts and insulated bushings on sheet metal boxes.
- Part 3 Execution
  - 3.1 INSTALLATION
    - .1 Install all outlets flush, plumb and square with building lines.
    - .2 Surface mount above suspended ceilings and in mechanical and electrical rooms.
    - .3 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry wall to achieve net openings for all boxes.
    - .4 Where a two gang box is required for single gang device, provide special plate with device opening in one gang and blank second gang.
    - .5 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.
    - .6 Use plaster rings to correct depth. Use 32mm on concrete block.

- .7 Installation to be in accordance with Rules 12-3000 to 12-3036, Canadian Electrical Code, "Installation of Boxes, Cabinets, Outlets and Terminal Fittings". Minimum box size to be in accordance with Rule 12-3036 and Table 23, Canadian Electrical Code, "Number of Conductors in Boxes". Use more than one outlet box where the number of joints exceeds the requirements for the boxes specified.
- .8 Support boxes independently of connecting conduits.
- .9 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .10 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .11 Provide correct size of openings in boxes for conduit and cable connections. Reducing washers are not allowed.
- .12 Align outlets that are installed in the same general location so that they are centered.
- .13 Boxes installed in walls with air barriers require vapour boxes in accordance with Section 07 27 10. Apply acoustical sealant around conduits and cables which penetrate vapour boxes. Maximum VOC Content: 250 g/L for acoustic sealant.

END OF **SECTION**

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the specification for related work.

1.2            REFERENCES

- .1            Canadian Standards Association (CSA)
- .1            CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .2            CAN/CSA C22.2 No. 45, Rigid Metal Conduit.
- .3            CAN/CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4            CAN/CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5            CAN/CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

1.3            PRODUCT DATA

- .1            Submit product data for non-metallic raceways in accordance with Section 26 05 00 Common Work Results - Electrical.

1.4            LOCATION OF CONDUIT

- .1            Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.
- .2            Electrical contractor shall produce layout sketches of conduit runs through mechanical and electrical service areas to avoid any conflict with other construction elements and to determine the most efficient route to run conduit. Submit sketches prior to roughing-in of conduits.

1.5            FIRE RATING

- .1            Fire rating of combustible conduits shown are minimum required. Provide conduit of fire rating as required by authority having jurisdiction.

Part 2            Products

2.1            CONDUIT FASTENINGS

- .1            One hole steel straps to secure surface conduits 32mm and smaller. Two hole steel straps for conduits larger than 32mm.
- .2            Beam clamps to secure conduits to exposed steel work.
- .3            U-channel type supports for two or more conduits at no more than 2m o.c. spaced as per code and manufacturer's recommendations, whichever is closer.

- 
- .4 Threaded rods, 6mm diameter, to support suspended channels.
  - .5 Perforated metal and field fabricated hangers and supports not acceptable.
- 2.2 CONDUIT FITTINGS
- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
  - .2 Factory "ells" where 90° bends are required for 27mm and larger conduits.
  - .3 Steel set screw connectors and couplings are not permitted.
  - .4 Rain-tight connector fittings and couplings complete with O-rings for use on all enclosures and conduit installations, etc.
- 2.3 EXPANSION FITTINGS FOR RIGID METAL AND PVC CONDUIT
- .1 Weatherproof expansion fittings suitable for 200mm linear expansion.
  - .2 Watertight expansion fittings suitable for linear expansion and 19mm deflection in all directions.
  - .3 Weatherproof expansion fittings for linear expansion at entry to exterior enclosures/panels.
  - .4 With internal bonding assembly for metallic conduits.
- 2.4 FISH CORD
- .1 Polypropylene, minimum 200 kg strength, UV resistant.
- 2.5 CONDUIT - GENERAL
- .1 Minimum conduit size shall be ¾" (21mm) unless otherwise indicated.
- 2.6 ELECTRICAL METALLIC TUBING (EMT)
- .1 Conduit: electrical metallic tubing with wall thickness less than rigid conduit, hot dipped galvanized with corrosion resistant and friction reducing coating on inside, to CAN/CSA C22.2 No. 83.
  - .2 Connectors and fittings to be rain-tight type.

2.7 FIRE ALARM EMT

- .1 Provide EMT conduits for fire Alarm system for all areas.
- .2 Hot galvanized with a vibrant top coat for easy identification and durability
- .3 Excellent mechanical protection for conductors
- .4 Ductility for faster and easier bending
- .5 E-Z Pull™ interior finish provides a smooth interior surface for fast, less labor-intensive wire-pulling
- .6 EMF shielding characteristics
- .7 Certified to CSA C22.2 No. 83.1 and manufactured in accordance with ANSI C80.3
- .8 Label EMT as per specification Section 26 05 53.
- .9 Provide sample of labelling to Consultant for final approval prior to installation.

2.8 RIGID METAL CONDUIT

- .1 Conduit: rigid galvanized steel, heavy wall, with threaded joints and connections to CAN/CSA C22.2 No. 45.
- .2 Connectors: liquid and dust tight with insulated throat.
- .3 Rigid conduit fittings: outlet boxes, junction boxes, LB's and other fittings cast metal with factory applied epoxy paint.
- .4 Expansion joints: rigid conduit type with external bonding jumper.
- .5 Ground bushing: threaded type with insulated throat.

2.9 RIGID PVC CONDUIT

- .1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride to CAN/CSA C22.2 No. 211.1.
- .2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied and recommended by conduit manufacturer.
- .3 Fire rating: FT4.
- .4 Expansion joints: as supplied and recommended by conduit manufacturer, complete with two O-rings.

- 
- 2.10 FLEXIBLE CONDUIT
- .1 Conduit: flexible metal conduit, spirally wound, interlocked zinc coated steel strip which may be easily bent without use of tools to CAN/CSA C22.2 No. 56.
  - .2 Connectors: steel slip-proof, complete with insulated throat.
- 2.11 LIQUID TIGHT FLEXIBLE CONDUIT
- .1 Conduit: construction same as flexible conduit, with liquid-tight PVC outer jacket to CAN/CSA C22.2 No. 56.
  - .2 Connector: type providing seal to conduit jacket and positive ground to interior of conduit, with high pull-out resistance and insulated throat, straight or angles.
- Part 3 Execution
- 3.1 CONDUIT INSTALLATION
- .1 Provide a separate raceway for each electrical system.
  - .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
  - .3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
  - .4 Do not surface mount conduits in other areas unless specifically indicated.
  - .5 Wiring homeruns to panel boards and main branch circuit wiring runs in ceiling space to be run using TECK or in conduit. Wiring drops from conduit systems to light fixtures shall not run horizontally more than 1.8m from conduit system junction boxes in ceiling space.
  - .6 Type AC90 armoured cable (Bx) with screw type connectors shall be used for connections from conduit systems to luminaires in accessible ceilings and stud partitions or to magnetic door holders. Maximum length of AC90 armoured cable for connections to luminaires mounted in stud partitions shall be 1.5m. Type BX cable shall not be used for any other application.
  - .7 Armour of TECK cable shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate at the load end of the cable.
  - .8 Use electrical metallic tubing (EMT) above 2.4m and in areas where it will not be subjected to physical damage.
  - .9 Rigid galvanized steel conduit shall be used where exposed to damage, in wet or hazardous locations or under floor slabs and where shown on the drawings.

- .10 Use Rigid PVC Conduit in poured concrete, in duct banks, in areas subject to intermittent or continuous moisture (i.e. coolers, etc.). These areas may not necessarily be shown on the drawings.
- .11 Use flexible metal conduit in dry locations for connection to motors movable partitions not served by a solid (wiremold type) raceway, fluorescent fixtures recessed in T-bar ceilings, suspended fixtures, transformers and equipment subject to movement or vibration, A Motor connections and connections to transformers in damp locations to be liquid-tight.
- .12 All flush mounted branch circuit panelboards shall have two 27mm spare conduits stubbed out and extended into accessible ceiling space so that future circuits can be installed without damaging walls or finishes surrounding the panel.
- .13 The length of any conduit run shall not exceed 30m and no conduit run shall have more than four 90° bends before a pull box is required. Pull boxes to be installed in accessible ceiling space. Conduits shall be supported within 300mm of entering any junction box, pull box, cabinet or panel board.
- .14 Conduit to be sized as per Canadian Electrical Code. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit at no extra cost.
- .15 Seal around all conduit penetrations through floors to ensure penetrations are watertight.
- .16 Use explosion proof flexible connection for connection to explosion proof motors.
- .17 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Radius of bend shall be not less than 600mm.
- .19 Mechanically bend steel conduit over 21mm diameter.
- .20 Install fish cord in empty conduits.
- .21 Install expansion joints where conduits cross building expansion joints or for outdoor installations.
- .22 Ream conduit ends to remove all burrs.
- .23 Seal to air barriers conduits which penetrate barrier.
- .24 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .25 Dry conduits out before installing wire.



### 3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits within 300mm of flues, steam or hot water lines.
- .7 When a conduit can be run surface, it shall be primed and painted with two coats to match the wall.

### 3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings unless otherwise indicated.

### 3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Installation of conduits in concrete floor slabs is acceptable for feeding free-standing equipment only. Installation of conduits in concrete floor slabs shall not be permitted for any other application.
- .2 Obtain approval from Consultant:
  - .1 Where conduits are spaced closer than 3 diameters.
  - .2 For conduits greater than 53mm diameter.
  - .3 Where conduits must be run less than 8 diameters from columns.
- .3 Locate to suit reinforcing steel. Install in centre one third of slab. Do not strap directly to parallel reinforcing steel (and reduce concrete bond). Strap to reinforcing steel perpendicular to conduit.
- .4 Protect conduits from damage where they stub out of concrete.
- .5 Install sleeves where conduits pass through slab or wall.
- .6 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .7 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

- .8 Encase conduits completely in concrete with minimum 50mm concrete cover.
- .9 Organize conduits in slab to minimize crossovers.
- 3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE
  - .1 Installation of conduits in cast-in-place slabs on grade is acceptable for feeding free-standing equipment only. Installation of conduits in cast-in-place slabs on grade shall not be permitted for any other application.
- 3.6 CONDUITS UNDERGROUND
  - .1 Slope conduits to provide drainage.
  - .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.
- 3.7 GROUNDING
  - .1 Where current carrying conductors are installed in raceway, provide ground wire of equal size.
  - .2 Where non-current carrying/telecommunication conductors are installed minimum ground wire size #6 AWG.
  - .3 Ensure raceways are large enough to accommodate additional (ground) wire.
- 3.8 INSTALLATION OF EMT CONDUIT
  - .1 Use EMT strictly in accordance with Rules 12-1400 to 12-1414 inclusive of CEC.
- 3.9 INSTALLATION OF FIRE ALARM EMT
  - .1 Installation to be as for EMT.
  - .2 Touch-up all nicks and scratches with red color matching paint.
- 3.10 INSTALLATION OF RIGID METAL CONDUIT
  - .1 Touch up damage to epoxy finish on rigid conduit fittings with touch-up paint supplied by manufacturer. Paint exposed threads on rigid conduit with epoxy paint.
- 3.11 INSTALLATION OF RIGID PVC CONDUIT
  - .1 Use strictly in accordance with Rules 12-1100 inclusive of CEC.
  - .2 When not encased in concrete:
    - .1 Provide expansion joints and follow manufacturer's recommendations and code requirements with respect to expansion/contraction, particularly where temperature variations are anticipated.
    - .2 Install conduits loosely with straps and clamps to allow movement.

3.12 INSTALLATION OF LIQUID TIGHT FLEXIBLE CONDUIT

- .1 Provide a separate ground conductor within flexible conduit, bonded to motor frames and system ground.
- .2 Install conduit to prevent liquids draining to connectors.

3.13 CONDUIT AND CABLE IDENTIFICATION

- .1 Refer to Section 26 05 53 "Identification For Electrical Systems" for scope of work.

3.14 WORKMANSHIP

- .1 Install all conduit and wiring concealed, except where specifically noted otherwise. Install conduit in furred spaces or recessed in block or masonry walls. Do not recess conduits in columns or concrete walls, except as noted, without permission. Where conduit is necessary to be run exposed, run parallel to building lines.
- .2 Where metal conduit is placed in concrete, screw up joints tight and paint joints with sealant paint. Before concrete is poured, tightly pack outlet boxes with paper and cap open ends of conduit to prevent concrete intrusion. At junction between exposed conduit and concrete, paint conduit before concrete is poured.
- .3 Take extreme care and ream the ends of all conduits to ensure a smooth interior finish that will not damage the insulation of the wires. Ensure electrical continuity in all conduit systems.

END OF SECTION

Part 1            General

1.1            GENERAL

- .1            Suitably identify with nameplates all pieces of electrical equipment such as lighting, power and distribution panels, power conditioner unit, panelboards, motor control centre, telephone panels, transformers, disconnect switches, contactors, motor starters, control devices, pull boxes, exit lights, splitters, system panels, receptacle coverplates and all equipment connected direct to the power supply.
- .2            Revise and update all existing electrical identification plates (lamacoids) and panel directories affected by room number changes made in this project. This shall include all electrical distribution components which are fed from or which feed equipment located in areas where room number changes have been made.

1.2            NAMEPLATES AND PANEL DIRECTORIES

- .1            Laminated phenolic nameplates with engraved white letters on:
  - .1            Black for normal power.
- .2            Unless specifically indicated otherwise lettering size to be as follows:
  - .1            Lamacoid nameplates: 3mm (1/8") thick plastic engraving sheet, black or red faced, white core, mechanically attached with shelf-tapping screws or split rivets, unless otherwise specified. Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2            Label receptacle and other outlet box coverplates: 5 mm minimum height (.76 mm inscription width).
- .3            Motor control centre identification lamacoid (top one), large sub-distribution panel identification lamacoid (top one), all main distribution identification lamacoids: 100 mm minimum height (1.52 mm inscription width).
- .4            Breakers:
  - .1            Sub-distribution panels: 7 mm minimum height. May be reduced to 5 mm if there are space restrictions.
  - .2            Panelboards: 5 mm minimum height. May be reduced to 3 mm if there are space restrictions.

- .5 Others: 7 mm minimum height (1.02 mm inscription width) when less than 2500 mm (100") above floor; 10 mm minimum height (1.52 mm inscription width) when more than 2500 mm (100") above floor.
  - .3 Prior to nameplate fabrication, submit to the Consultant/Owner for approval a copy of all panel directories with a list stating exact wording and fabrication details for all nameplates.
    - .1 Submit one complete package, including details for all equipment and devices connected to or part of the electrical distribution.
    - .2 Submission to be received by Consultant a minimum of 7 weeks prior to schedule completion of the work.
  - .4 Submit panel directories in electronic format to accommodate future revisions.
    - .1 Submit copies of all 'as-built' panel directories for all new and existing panelboards worked on.
    - .2 Do not destroy old directories. For existing panels, insert old directory behind the new one where possible, otherwise turn them over to Owner's representative on site.
  - .5 Use Owner's building and location codes to provide permanent equipment identification. Architectural room numbers on drawings are not acceptable. Confirm permanent building and location codes with Consultant and Owner prior to making name plates and directories.
  - .6 In each maintenance/operating manual, include a copy of all panel directories and nameplate listings which were reviewed by Consultant, including any changes or corrections prior to lamacoid fabrication. Nameplate listing schedule shall have exact description of what appears on installed lamacoid, for all lamacoids (excluding receptacle lamacoids) installed by Division 26.
  - .7 Co-ordinate names of equipment and systems with mechanical to ensure consistency.
  - .8 All nameplates and panel directories to be installed and 100% complete prior to commissioning.
- 1.3 PANELBOARD AND DISTRIBUTION CENTRE IDENTIFICATION
- .1 Provide nameplates to identify the following:
    - .1 Panelboard or distribution centre title and code number and voltage characteristics.
    - .2 Supply feeder panelboard or distribution centre title and code number, slot number and location (Owner's building and location code).
    - .3 Slots on distribution centres stating either "spare" or location (Owner's building and location code) of panelboard being fed, and panelboard title and code number.
  - .2 Rivet nameplate to top, exterior on cabinet door.

- .3 Provide a typewritten data card enclosed in a clear plastic pouch attached inside the door of each panelboard or distribution centre. Information listed on the data card shall include the following:
  - .1 Panelboard or distribution centre title and code number.
  - .2 Supply feeder panelboard or distribution centre title and code number, slot number and location (Owner's building and location code).
  - .3 The following information for each circuit:
    - .1 Circuit # and location(s) (Owner's building and location code).
    - .2 Circuit function i.e. lighting, receptacles, equipment (state equipment name), spare, etc.
- .4 When a lighting and/or receptacle panelboard sub-feeds other lighting and/or receptacle panelboards, supply and install a lamacoid on supply feeder panelboard door (inside) below directory. Information on lamacoid shall identify the following:
  - .1 Circuit # and location(s) (Owner's building and location code).
  - .2 Panelboard identification of panel being sub-fed. This lamacoid identification and directory shall be identical. Rivet or screw lamacoid to panelboard door. Letter size shall be minimum 5 mm high.
- .5 Insert a copy of each data card into each maintenance/operating manual.
- .6 All existing panelboards or distribution centres affected by this project shall have their directories neatly updated. A copy of updated directories shall be included in each maintenance/operating manual.
- .7 Panel and circuit identification (examples provided):
  - .1 Panel directory identification:
    - .1 Near the top of the directory, provide the following information: PANEL: A (panel identification code no.) 120/208V/3PH/4W (panel voltage, # of phases and wires) FED FROM SD-2A IN B-005 (origin of feeder).
    - .2 If panel is connected to emergency power, indicate: EMERG. POWER: EA.
  - .2 Receptacle colour and circuiting:
    - .1 Refer to wiring devices section for color
  - .3 Sample panel directory:

Panel: A

120/208V/3PH/4W

Fed from SD-2A in B-01

Circuit	Three Phase	Circuit
Receptacles, Rm 100	1A 22A	Receptacles, Rm 101
Receptacles, Rm 100	2B 23B	Receptacles, Rm 101

	Receptacles, Rm 102	3C	24C	Crane
	Receptacles, Rm 103	4A	25A	10 Ton Crane
	Receptacles, Rm 103	5B	26B	10 Ton Crane
	Receptacles, Rm 104	6C	27C	10 Ton Crane
	Receptacles, Rm 104	7A	28A	Receptacles, Rm 105
	Receptacles, Rm 104	8B	29B	Receptacles, Rm 106
	Receptacles, Corr.	9C	30C	B/B Heater BB-1
	Receptacles, Corr.	10A	31A	B/B Heater BB-1
	Receptacles, Print	11B	32B	UnitHeater UH-1
Rm				
	Receptacles,	12C	33C	UnitHeater UH-1
Reception				
	Lights, Rm 100	13A	34A	UnitHeater UH-2
	Lights, Rm 101	14B	35B	UnitHeater UH-2
	Lights, Rm 101	16A	37A	Spare
	Lights, 102/103	17B	38B	Spare
	Lights, Rm 104	18C	39C	Spare
	Fan, F-1	19A	40A	Space
	Fan, F-2	20B	41B	Space
	Fan, F-3	21C	42C	Space

The contractor is to supply a sample of the proposed panel designations to the Owner for approval, prior to all labeling.

#### 1.4 OTHER EQUIPMENT IDENTIFIED BY NAMEPLATE

- .1 Panels and terminal cabinets for low voltage systems: Indicate panel designation, system, and load, system or load location and area served. Provide directories to identify equipment and locations of equipment connected to each circuit. Insert a copy of directory in clear plastic pouch attached inside panel door and in maintenance operating manuals.
- .2 Splitters and pullboxes: Indicate their function and characteristics (equipment description and location where fed from and what it feeds).
- .3 Miscellaneous equipment and exit lights: All equipment, including equipment supplied by others, wired directly to the power source such as exit lights, electromagnetic door hold-open devices, magnetic door holders, drinking fountains, line voltage thermostats, control panels, alarm panels, power supplies, fans, heaters and other equipment, shall have lamacoid mechanically fastened onto the piece of equipment, in a conspicuous location, stating: e.g. POWER FROM PANEL A/22 IN 100. Letter size on lamacoids shall be 5 mm high.
  - .1 Dyno markers maybe used for labeling small devices and use of the dyno markers must be pre-approved by the Owner.
  - .2 Division 26 to site check space available on equipment to determine lamacoid dimensions. Lamacoid shall be flush mounted and shall not project over

equipment edges nor conceal other information or elements on surface of equipment. The installation shall have a neat appearance.

- .4 Computer equipment lamaroids are not to be mechanically fastened. . Discuss method of labeling with Owner prior to labeling of equipment.
- .5 Panel Breakers:
  - .1 Sub-distribution panels: All breakers to have lamaroid identification with 7 mm high letters. Examples are:
    - .1 For mechanical equipment:  
CONDENSING UNIT CU-1 (equipment description)  
ON Roof (equipment location)
    - .2 For electrical distribution equipment:  
FEEDS TR-1 (equipment description)  
IN Room 100 (equipment location)
  - .2 Panelboards: Provide lamaroid identification with 5 mm high lettering for breakers which control sub-fed panels. If there is insufficient space available adjacent to breakers, lamaroids to be mechanically fastened to the interior of panel door, either above or below the directory. If lamaroids are fastened adjacent to individual breakers, circuit numbers may be omitted from lamaroids.  
  
EXAMPLE: CCT. #14, 15, 16  
PANEL: A IN Rm 100
- .6 Battery Powered Emergency Lighting: Provide lamaroid with 7 mm high white lettering as indicated, AC power to battery bank determines lamaroid colour, black for normal power, red for emergency power.
  - .1 At each battery bank which serves remote fixtures: BATTERY BANK #  
FOR EMERG. LIGHTING IN Rm 100 (state room numbers) AC power fed from distribution SD-A in Rm B-001.
  - .2 At each remote light fixture: BATTERY POWERED FROM BANK # IN Rm 100 (state room number).
  - .3 Lamaroid identification described in this clause is not required if battery bank does not serve remote fixtures. However, on battery bank provide a lamaroid indication: AC power fed from distribution A in Rm. 100.
  - .4 Exit lighting powered by both AC and DC:
    - .1 AC power fed from panel A in Rm. 100.
    - .2 DC battery powered from bank # in Room 101.



1.5 LIGHT SWITCH AND RECEPTACLE IDENTIFICATION

- .1 Provide lamacoid identification as indicated below for receptacles including those supplied by other sections and those forming integral part of equipment supplied by owner.
- .2 Secure lamacoid with rivets to coverplate. Pressure indented adhesive strip nameplates are not acceptable.
- .3 Identification of receptacles, fasten lamacoid near the bottom of the cover plate:
  - .1 For normal power, state floor designation, panel board identification, circuit number
  - .2 For Emergency power, state Emergency (abbreviation), floor designation, panel board designation, circuit number
  - .3 All receptacles should also be permanently marked on the receptacle faceplate, using permanent marker, stating the panel board designation and circuit number. This designation should be visible when the receptacle cover plate is removed.

1.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code of feeder phase (Refer to Section 26 05 34 "Conduits" for colour coding.) shall appear on every cable in two locations at any distribution; once inside distribution enclosure near cable termination and once outside distribution enclosure, in visible location near enclosure.
- .2 Junction boxes with power wiring, all circuits inside the box shall be identified on the inside of the cover plate with permanent marker.
- .3 Provide Thomas and Betts stick-on conduit markers for the following systems. Markers to be:
  - .1 Style B 28.6 mm x 114.3 mm for 25 mm conduit and larger.
  - .2 Style C 12.7 mm x 57.2 mm for conduit under 25 mm.
- .4 Space markers 10 metres on centres maximum for exposed conduits and conduits in accessible ceiling spaces and, in addition, attach markers before and after all barriers, where conduits pass through closets, cupboards, stairwells, etc., and adjacent to all panels, cabinets, pullboxes and access fittings. Markers to be laminated mylar with orange background and black letters. Identify systems as follows:

NORMAL POWER	VOICE/DATA
DATA PROCESSING	FIRE ALARM
CCVS	MONITORING SYSTEM
INTRUSION ALARM	ACCESS CONTROL
CONTROL WIRING	DC EMERG. LIGHTING
GROUND CONDUCTOR	

Others: Check with Consultant. All conduit systems shall be identified.

- .5 All stick-on conduit markers must be installed during installation of related conduit systems, not after installation of complete conduit systems.
- .6 Do not apply stick-on conduit markers onto exposed wiremold raceways.

## 1.7 FIRE ALARM IDENTIFICATION

### .1 Identification Plates:

- .1 Provide engraved laminated phenolic identification plates to identify various components of the fire alarm system, as specified. All identification plates shall be mechanically fastened with either rivets or screws.
- .2 Prior to identification plate fabrication, submit to the Consultant for approval a complete list stating exact wording and fabrication details for all identification plates. Submission to be one complete package for all Section 28 31 01 identification plates. Submission to be received by Consultant a minimum of 6 weeks prior to scheduled completion of work.
- .3 Colour of lamacoid identification plates:
  - .1 For zone modules:
    - .1 Pre-action initiating zones: red background with white letters.
    - .2 All other zone modules: white background with black letters.
  - .3 For identification of power supply:
    - .1 As described in Section 26 05 31.
  - .2 For smoke control system panel:
    - .1 White background with black letters.
  - .3 For all other fire alarm components:
    - .1 Red background with white letters for all other components including, but not limited to, the following:
      - .1 Tubs, cabinets, enclosures.
      - .2 End-of-line devices.
      - .3 Pre-action detector identification plates.
      - .4 Remote alarm lamp (RAL) identification.
      - .5 Duct detector identification.

### .2 Terminal, Wire and Cable Identification:

- .1 Identification:
  - .1 Use permanent markers to identify all cables, terminals and corresponding wires at all termination points and junctions stating the identification code of the circuit alarm module in the fire alarm panel.

- .2 Coding system shall be consistent throughout the entire alarm system, corresponding exactly to the designations used at the main panel. As-built drawings and directories shall list colour coding by circuit.
  - .3 Colour scheme for cable and wiring shall be consistent throughout the entire alarm system installation. Refer to Section 26 05 53.
  - .2 Directory: Provide a typewritten directory in a clear plastic pouch inside all tub and master terminal cabinet covers describing the following:
    - .1 Enclosure nameplate code number and location code.
    - .2 The following for each terminal point in each enclosure:
      - .1 Terminal code number and/or colour.
      - .2 Areas served (state locations).
      - .3 Zone number.
      - .4 Function (i.e. equipment name and location, etc.).
    - .3 Cable codes and corresponding wire colour codes and/or code numbers. State cable function. Insert a copy of each tub or cabinet directory into each maintenance/operating manual.
  - .3 Changes to existing: Whenever changes are made to existing wiring, panels, annunciators, etc., re-label as required and update corresponding directories and drawings, to reflect as-built conditions.
  - .4 All identification and labeling shall be approved by the owner prior to installation.
  - .5 All system identification (nameplates, directories, cable, wire, etc.) to be installed and 100% complete prior to system verification.
- Part 2          Products
- .1 Not used.
- Part 3          Execution
- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Refer to all Sections of the specification for related work.
- .2 Motor Starters Section 26 29 10.
- .3 Motors Mechanical.

Part 2 Products

2.1 NAMEPLATES

- .1 Lamacoid, black with white lettering for normal power.
- .2 Refer to Section 26 05 53 - Identification for Electrical Systems.

Part 3 Execution

3.1 MOTOR SURVEY

- .1 Make a complete survey of all electrical motors. Number every motor, both single phase and 3 phase. Label every motor to show the motor number, the motor name and location of the starter. Example: 'Motor #1 Exhaust Fan #2, Starter in MCC#1'. Label every starter to show motor it controls and where motor is not in same area, give location of motor. Identify voltage and panel being fed from. Co-ordinate with mechanical so survey and labeling are consistent.
- .2 For every motor and starter, fill in the form illustrated herein. List each motor on a separate 200 x 300 mm page. Provide three typed copies of this list in each maintenance manual prior to substantial completion. Where motors are controlled by more than one control device, prepare an accurate elementary diagram of the controls on a 200 x 300 mm sheet. Forms and diagrams are to be neatly typed and drafted. Labels to be consistent with the mechanical section.

3.2 NAMEPLATES

- .1 Securely screw to equipment, so as to be clearly visible.

## SURVEY OF MOTORS

Motor Designation ..... Use .....

Location .....

Manufacturer .....

Type (TEFC) etc.) ..... CEMA Design ..... Frame Size .....

Serial Number .....

KW ..... Voltage ..... Phases ..... RPM .....

Starter Manufacturer .....

Catalogue Model # .....

Type (FVNR etc.) .....

Special Controls \*\* .....

.....

.....

Manufacturer's recommended overload setting\* .....

Overload relay setting\* .....

Manufacturer's recommended insulation resistance .....

Measured insulation resistance .....

Measured Running Amps .....

Nameplate Full Load Amps ..... Service Factor .....

Measured Voltage ..... Circuit No. ....

Acceleration Time ..... Rated Start Sec. ....

Thermistor, Type ..... O/L Relay Type .....

Capacitor, KVAR\* .....

PREPARED BY: ..... DATE: .....

\* Indicate adjustment made to compensate for addition of capacitor

\*\* List type and location of each.

Give elementary diagram on separate sheet if more than one control or interlock.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Refer to all Sections of the specification for related work.
- .2 Mechanical Divisions.

1.2 REQUIREMENTS

MOTOR SIZE

VOLTAGE SYSTEM

3/4 HP (0.562 kW) and larger

600 V, 3Ø

1/2 HP (0.373 kW) and smaller

120 V, 1Ø

- .1 Provide a complete system of power wiring to motors and controls.
- .2 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under this Contract. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied by other Divisions.
- .3 Where control wiring diagrams are shown illustrate typical control circuits applicable to the equipment. Control circuits may vary with different manufacturers of equipment. Verify all control circuits with the suppliers of the equipment and make any corrections that may be required.
- .4 Unless specifically noted otherwise, supply all pushbuttons, relays, starters, etc. necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.
- .5 Do not operate motors and controls until approval is obtained from the trade providing equipment.
- .6 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on other Division drawings and specifications. Where necessary, obtain conduit locations from other trades' drawings & shop drawings. The complete list of motors may not be shown on the electrical drawings.
- .7 Assist in placing in operation all mechanical equipment having electrical connections.
- .8 Provide three phase starters with primary and secondary fused 120 volt control transformers and overload relays.

- .9 In general, wiring for freezestats, firestats, EP switches P.E. switches, dampers, temperature controllers, flow switches, solenoid valves, etc., for heating, ventilating and air conditioning equipment will be by Mechanical Contractor, from control panels supplied and installed by Mechanical Contractor. Provide terminations in starters and MCC's for control wiring, so that starter control circuits may be extended by Mechanical Contractor. Where 120 volt power is required for mechanical equipment, i.e.: for roll type filters, refrigerated aftercoolers, control cabinets, etc., wiring to the equipment terminals is the work of the Electrical Contractor. Electrical Contractor to wire all 120V AHU internal lighting and receptacles, condensers and rooftops weatherproof outdoor receptacles.

## Part 2 Products

### 2.1 3Ø MOTOR DISCONNECT SWITCHES

- .1 Industrial Type "A" having quick-make, quick-break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use EEMAC-4 enclosures outdoors, EEMAC-1 indoors and drip proof shield watertight for areas exposed to sprinklers. Switches to be kW rated, Square "D" Type A heavy duty.

### 2.2 120V 1Ø DISCONNECT SWITCHES

- .1 Manual starter without overload relay.

### 2.3 208V 1Ø MOTOR DISCONNECT SWITCHES

- .1 Manual starter without overload relay.

## Part 3 Execution

### 3.1 GENERAL

- .1 For all motors, provide disconnect switches adjacent to the motors.
- .2 Wall mount disconnects adjacent to equipment or floor mount at motor locations. Wall mounted disconnects to be 1400 mm above floor.

### 3.2 CONTROL CABINETS & CONTROLS

- .1 Verify the location of all control cabinets, and provide power wiring to each cabinet from the nearest electrical panel where not specifically shown from a particular panel.
- .2 Power wiring for mechanical equipment is the responsibility of the Electrical Contractor. Provide circuits and wiring to suit the controls contractor requirements. All control power wiring requirements may not be specifically shown on the drawings.

- .3 All control wiring shall be run in conduit. Coordinate with controls subcontractor.

### 3.3 BOILER SHUT-OFF SWITCHES

- .1 Provide a manually operated emergency shutdown switch for each boiler located just outside the boiler room door and marked for easy identification ("boiler shut-off switch"). Consideration should be given to the type and location of the switch to safeguard against tampering. If the boiler room door is on the building exterior, the switch should be located just inside the door. If there is more than one door to the boiler room, there should be a switch(s) located at each door.
- .2 Activation of the emergency shutdown switch shall immediately shut off the fuel or electrical supply.
- .3 Cover plate and switch shall be red.

### 3.4 FLOW SWITCHES

- .1 Verify the location of all sprinkler flow switches, valve monitor switches, jockey pumps, etc. with Mechanical Contractor and connect these devices to the fire alarm panel. Devices may not be specifically shown on the electrical drawings.

### 3.5 COMMISSIONING

- .1 Do not start motors until the supplier of the equipment has verified that the electrical connection has been made in accordance with the nameplate information.
- .2 Extreme caution must be taken in connection of motors with nameplates having multiple connection diagrams i.e.: WYE-DELTA Start, MULTISPEED.
- .3 Be responsible for replacement of motors or other equipment damaged by starting-up prior to being checked by equipment supplier.

END OF SECTION



Part 1 General

1.1 INCLUDED SYSTEMS AND EQUIPMENT

- .1 The following is a partial list of equipment and system test requirements included in this section:
  - .1 Distribution systems including phasing, voltage, grounding, load balancing hipot and/or megger testing.
  - .2 Circuits originating from existing and new central distribution and branch distribution panels.
  - .3 Grounding systems.
  - .4 Lighting systems and controls, and interior and exterior light level readings.
  - .5 Motors and associated control equipment including sequenced operation of systems where applicable.
  - .6 Emergency Lighting and power systems.
  - .7 600V equipment, power feeders and systems downstream of new and existing distributions.
  - .8 Receptacles.
  - .9 Connections and circuits to Owner supplied equipment.
  - .10 Telecommunications systems as outlined in Section 27 05 00.
  - .11 Coordinate testing requirements with Commissioning requirements. Refer to Sections 01 91 00 – General Commissioning Requirements.
  - .12 Connections to mechanical equipment.

1.2 DESCRIPTION

- .1 This section specifies the functional testing and commissioning requirements for electrical systems and equipment as performed by the electrical contractor. The test requirements for each piece of equipment or system shall contain the following:
  - .1 A list of the integral components being tested.
  - .2 Pre-functional checklists associated with the components.
  - .3 Functions and modes to be tested.
  - .4 Required conditions of the test for each mode.
  - .5 Special procedures.
  - .6 Required methods of testing.
  - .7 Required monitoring.
  - .8 Acceptance criteria.
- .2 Include the cost of testing in the contract price.
- .3 In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

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- .4 Provide a copy of the O&M manual submittals of tested equipment, through normal channels, to the Consultant for review and approval.
  - .5 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure technicians are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests and adjustments. Provide suitable notice to the owners and allow them to be present during testing if they deem necessary
  - .6 Prepare O&M manuals according to the Contract Documents. Include clarifying and updating the original sequences of operation to as-built conditions.
  - .7 Provide training of the Owner's operating personnel. Provide a DVD of all training as approved by the Owner.
  - .8 Immediately prior to building occupancy, test the entire electrical system by performing a loss and return of utility power test as approved by the Owner.
- 1.3 TEST EQUIPMENT
- .1 Electrical Contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division.
- Part 2 Products
- .1 Not used
- Part 3 Execution
- 3.1 GENERAL
- .1 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
  - .2 Carry out tests in presence of the Consultant's and owner's representative.
  - .3 Give advance notice of proposed time of tests so that the Consultant and owner can be represented at the tests.
  - .4 Submit test results for review by the Consultant. Complete deficiencies within construction schedule.
  - .5 Include copy of test results in maintenance manuals.

- .6 Testing methods and test results: in accordance with CSA, CEC and regulations of the supply authority, other authorities having jurisdiction and manufactures recommendations.
- .7 Conduct dielectric tests, megger tests, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment.

### 3.2 EQUIPMENT TESTING

- .1 With the systems completely connected and lamped, conduct the following tests on the power system:
  - .1 Control and Switching: test all circuits for the correct operation of devices, switches and controls.
  - .2 Polarity Tests: test all circuits for correct operation of devices, switches and controls.
  - .3 Voltage Tests: make a voltage test at the last outlet of each circuit. Maximum drop in potential permitted will be 3% on 120V, and 208V branch circuits. 3% on 208V feeder circuits, and 3% on 600V feeder circuits. Correct any deficiency in this respect.
  - .4 Phase Balance: measure the load on each phase at each switchboard, distribution panelboard and lighting and power panelboards. Report results in writing to the Consultant. Re-arrange phase connections as necessary to balance the load on each phase as instructed by the Consultant with the re-arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After marking any such changes, make available to the Consultant, drawings or marked prints showing the modified connections.
  - .5 Supply Voltage: measure the line voltage of each phase at the load terminals of the main breakers and report the results in writing to the Consultant. Perform this test with the majority of electrical equipment in use.
  - .6 Motor Loading: measure the line current of each phase of each motor with the motor operating under load and report the results in writing to the Consultant. Upon indications of any imbalance or overload, thoroughly examine the electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Consultant. Verify motor full load amps and overload relays are properly sized and adjusted accordingly.
  - .7 General Operations: energize and put into operation each and every electrical circuit and item. Make repairs, alterations, replacements, tests and adjustments necessary for a complete and satisfactory operating electrical system.
- .2 When tests are performed, the Consultant may require that equipment be opened and removed from their housings to examine interior of equipment, terminations and connections. Provide all required labour and tools.

- .3 Coordinate the testing of motors with the trades providing the equipment driven by the motors so that they are carried out at the time the driven equipment is put on test. In addition to the motor loading tests, provide labour and instruments to take and record all motor load readings required to supplement the tests on the driven equipment through various load sequences, as required by the trades involved.
- .4 General Component Starting and Testing:
  - .1 Prior to energizing:
    - .1 Confirm components nameplate data with characteristics of power supply.
    - .2 Verify supply voltage and phase rotation.
    - .3 Ensure all testing as specified has been completed and deficiencies have been corrected.
    - .4 Close and open all devices to ensure proper mechanical operation.
    - .5 Megger all feeders and record results on approved verification forms.
  - .5 Load balancing:
    - .1 At time of acceptance carry out the following work at peak load hours:
      - .1 Measure load balance on all feeders at distribution centres, motor control centres and panelboards with normal loads (lighting included). If load unbalance exceeds 15%, reconnect circuits to obtain the best possible balance of current between phases. Revise panelboard directories and wiring identification accordingly.
      - .2 Measure phase voltages at distribution centres, motor control centres and panelboards with normal loads (lighting included). Adjust transformer taps, where required, to within 2% of rated voltage of components.
- .6 Insulation Resistance Testing:
  - .1 After installing cable and terminating reform insulation resistance test with megger on each phase conductor.
  - .2 Megger all circuits, feeders and components up to 350 V with a 500 V instrument.
  - .3 Megger all 350-600 V circuits, feeders and components with a 1000 V instrument.
  - .4 Check insulation resistance to ground before energizing.
  - .5 Megger cables for one minute, graph results at 10 second intervals. Submit graphs to Consultant and include graphs in O & M manuals.
  - .6 Minimum insulation resistance to earth or between phases: 100.
  - .7 Instrument to have minimum of 100 Megaohm resolution in the 0 to 500 Megaohm range.
  - .8 Check insulation resistance after each termination to ensure that cable system is ready for acceptance testing.

- .7 Ground Resistance Testing:
  - .1 Measure ground resistance with earth test megger to verify compliance with CSA C22.2 No. 0.4 and Canadian Electrical Code.
- .8 Coordination of Protective Devices:
  - .1 Ensure circuit protective devices such as overcurrent trip relays, fuses are installed to values and settings determined by the Coordination Study.
  - .2 A certified testing agency normally engaged in field service equipment testing shall be engaged and shall test all the circuit breaker settings for coordination verification as follows (to include new and existing breakers that require adjustment of settings):
  - .3 Verification of coordination testing shall consist of:
    - .1 Testing of all circuit breaker solid state relays with the breaker test kit to verify at least 3 points on each time-current characteristic. One point shall be tested at the breakpoint of the characteristic at the high end and another point shall be tested at the breakpoint of the characteristic at the low end. The other points shall be tested along the straight line of the characteristic.
    - .2 Ductor (contact resistance) testing and meggar (insulation) testing of all breakers including moulded case breakers in CDP type panels, other breakers with solid state trips, high voltage breakers, etc.
  - .4 The report shall be bound in a 3-ring loose leaf binder, similar to the Short Circuit and Time-Coordination Study, with title sheet, table of contents, purpose, test criteria, test equipment used, summary and test data. The test data shall list all devices in table form with both the actual tested values and the required values listed. All test values shall fall within +/- 10% of the required values. Necessary corrective action shall be taken to correct any problems and then re-tested until the equipment passes all required tests. Compare test results to the time current coordination study and confirm that the curves as actually tested provide the required coordination. After all tests and analysis has been completed successfully, the summary in the final report shall clearly state that all equipment has successfully passed all tests and is in good operating condition. The test report shall be certified by the testing agency and shall be signed and sealed by a professional engineer responsible for the testing. A minimum of 3 copies shall be submitted.
  - .5 The breaker co-ordination test report shall be included in the Operating and Maintenance Manuals.
- .9 L.V. Power Distribution:
  - .1 Completely isolate from all sources of power, the CDP enclosure to be tested and inspected.
  - .2 Remove necessary access panels, doors and cover plates.
  - .3 Cleaning:
    - .1 Check for accumulations of dirt especially on insulating surfaces and clean all interiors of compartments thoroughly using a vacuum or blower.
    - .2 Use only clean, lint free cloth.

- .3 Remove all filings caused by burnishing of contact.
- .4 Visual and Mechanical Inspection:
  - .1 Check physical, electrical and mechanical condition.
  - .2 Compare equipment nameplate data with latest contractual documents/requirements.
  - .3 Check for proper anchorage, required clearances, physical damage and proper alignment.
  - .4 Check physical appearance of all doors, panels, and sections for paint, dents, scratches, fit and missing hardware. Lubricate in accordance with manufacturer's instructions.
  - .5 Inspect all insulators and insulating surfaces for evidence of physical damage, cracks, chips and tracking or contaminated surfaces.
  - .6 Check condition of all bussing for moisture or other contamination, check for proper torque using calibrated torque wrench, and clearance to ground. Seal all bolted connections with red lacquer. Document all conditions, torque readings, clearances etc. and include all information in the O and M manuals.
  - .7 Check all mechanical devices for proper operation. Exercise all active components.
  - .8 Check and verify that circuit breakers comply with latest contractual documents/requirements:
- .5 Check condition of all contacts.
- .6 Check and report all discovered unsafe conditions.
- .7 Check cable and wiring condition, appearance, termination. Perform electrical tests as required.
- .8 Inspect for proper grounding of components.
- .9 Molded case circuit breakers 150 amp frame and larger:
  - .1 Visual and Mechanical Inspection:
    - .1 Check physical, electrical and mechanical condition. Inspect for cracks or other defects.
    - .2 Compare equipment nameplate data with latest contractual documents/requirements. Check for proper mounting. Ensure correct protection elements.
    - .3 Operate circuit breaker to ensure smooth operation.
    - .4 Check tightness of connections using calibrated torque wrench.
  - .2 Electrical Tests:
    - .1 Megger test.
    - .2 Mechanical function test
    - .3 Set all units with adjustable magnetic trip units.
  - .3 Where solid state protection is provided with large breakers, test units as follows:

- .1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.
  - .2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instruction
  - .3 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of the relay circuit to test the trip operation.
  - .4 Check C/T and P/T ratios and compare to coordination data.
  - .5 Record all observations, data and test results.
  - .6 Molded case circuit breakers to 150 amp:
- .4 Visual and mechanical inspection as for the larger moulded case breakers.
- .5 Mechanical function test.
- .6 Set all units with adjustable magnetic trip units.
- .7 Record all observations, data and test results.
- .10 Dry Type Transformers up to 600V primary:
  - .1 Inspect for physical damage, broken insulation, tightness of connections using calibrated torque wrench, defective wiring and general condition.
  - .2 Thoroughly clean unit prior to making any tests.
  - .3 Complete verification form for each transformer
  - .4 Perform insulation resistance test from winding to winding and each winding to ground. Calculate dielectric absorption ratio and polarization index.
  - .5 Perform core to ground test as for the high voltage transformer.
  - .6 Test operation of temperature and operation of all associated alarm contacts, where applicable.
  - .7 Test and calibrate ground fault relays and function test to trip associated breakers, where applicable.
  - .8 Verify taps and connect to the desired tap.
  - .9 Energize primary winding with system voltage and measure secondary voltage with secondary load disconnected.
  - .10 Record all observations, data and test results.
- .11 Disconnect Switches - Fused/Unfused:
  - .1 Visual and mechanical inspection:
    - .1 Check physical, electrical and mechanical condition. Inspect for cracks or other defects.
    - .2 Compare equipment nameplate data with latest contractual documents/requirements. Operate switch to ensure smooth operation.
    - .3 Check tightness of connections using calibrated torque wrench.
    - .4 Check blade alignment.
    - .5 Check each fuse holder for adequate mechanical support of each fuse.

- .6 Check all electrical and mechanical interlocks.
- .7 Check proper phase barrier materials and installation.
- .8 Inspect all indicating devices for proper operation.
- .9 Clean entire switch using approved methods and materials.
- .10 Lubricate to manufacturer's recommendations.
- .11 Exercise all active components.
- .2 Electrical Tests:
  - .1 Perform a contact resistance test across each switch blade and fuse holder.
- .12 Distribution, Power and Lighting Panelboards:
  - .1 Conduct load balancing as defined in this section.
  - .2 Carry out visual inspection
  - .3 Torque all bus connections using calibrated torque wrench
  - .4 Record all observations, data and test results
- .13 Wiring and Cables:
  - .1 Test all conductors, including those at distribution centres and panelboards for insulation resistance to ground (megger test).
  - .2 Test service grounding conductors for ground resistance.
  - .3 Provide list of test results on approved verification form showing location at which each test was made, circuit tested and results of each test.
  - .4 Remove and replace entire length of cable if cable fails to meet any of the test criteria.
- .14 Grounding:
  - .1 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
  - .2 Perform tests before energizing electrical distribution.
  - .3 Provide test report documenting successful test results.
- .15 Motor Starters:
  - .1 Operate switches, contactors to verify correct functioning.
  - .2 Perform starting and stopping sequences of contactors and relays.
  - .3 Check that sequence controls, interlocking with other separate related starters, components and control devices operate as per component verification form.
  - .4 Record all observations, data and test results
- .16 Motors:
  - .1 Prior to starting motors:
    - .1 Confirm motor nameplate data with motor starter heater overloads, setting of MCP's and sizing of fuses.



- .2 Verify rotation. Ensure disconnects are installed.
  - .3 Confirm labeling of motors, disconnects and starters.
- .17 Surge Protection Device (SPD):
  - .1 Visual and mechanical inspection:
    - .1 Check physical, electrical and mechanical condition. Inspect for damage or other defects.
    - .2 Compare equipment nameplate data with latest contractual documents/requirements. Check for proper mounting and adequate clearances.
    - .3 Check tightness of connections using calibrated torque wrench.
    - .4 Check for proper grounding.
- .18 Receptacles:
  - .1 Verify all receptacles have been wired correctly using an outlet circuit tester. Provide written test results.
  - .2 Tests to include, but not be limited to the following:
    - .1 Conductor Insulation Integrity Test.
    - .2 Voltage Drop Test for Grounded Systems.
    - .3 Receptacle Retentive Force Test.
    - .4 Voltage Difference Between Ground Points.
    - .5 Ground Return Path Voltage Rise for Grounded Systems.
    - .6 Polarity.
  - .3 Submit formal typewritten test reports to the electrical Consultant which describes all the methods, results, and conclusions resulting from the tests. Failed tests shall indicate work to be re-done and re-tested. Include final approved test results in maintenance manuals. Standard of Acceptance: Systems Electronics Ltd, Eaton, Schnieder.
- .19 Lighting Systems:
  - .1 Lighting components:
    - .1 Function test all light switches, luminaires, dimmers and lighting control components.
    - .2 Record all time settings.
    - .3 Verify that correct lamps and drivers have been used.
  - .2 Lighting Controls:
    - .1 For each of the lighting control systems, examine all components individually for physical condition and compliance with the latest contractual documents. Also check each component for correct operation. Record all observations, data and test results.
    - .2 Occupancy sensors/override switches

- .1 Test all sensors for correct time out settings and operation as per manufactures recommendations and design drawings/specifications.
    - .2 Test all sensors/vacancy operation with override switches for proper operation.
    - .3 Adjust settings as directed by Consultant.
  - .3 Dimming:
    - .1 Complete lighting system start up tests.
    - .2 Demonstrate that dimming systems are installed as indicated.
    - .3 Demonstrate that dimming systems operate as designed and that there are no problems in starting lamps, nor in keeping them lit at any setting of dimming intensity control.
    - .4 Adjust programmed levels as directed by the Consultant.
  - .4 Exterior Lighting:
    - .1 Complete lighting system start up tests.
    - .2 Check connections.
    - .3 Perform operational test.
    - .4 Actuate photoelectric controls in presence of Consultant to demonstrate lighting circuits are controlled as designed.
  - .3 Emergency Lighting:
    - .1 Check operation of all emergency lights.
    - .2 Check for proper operation of all emergency battery lights and lighting units.
    - .3 Record all observations, data and test results.
- .20 Fire Alarm System Testing and Adjusting:
  - .1 Ensure manufacturer conducts an inspection of the fire alarm and smoke detection system and equipment including those components necessary to the direct operation of the system such as manual pull stations, heat detectors, smoke detectors, smoke alarms and controls whether or not manufactured by the manufacturer. The inspection tests to conform to CAN/ULC-S537 Verification of Fire Alarm Systems and also to comprise an examination of such equipment for the following:
    - .2 Type of equipment installed is as described by these electrical specifications.
    - .3 Wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.
    - .4 Equipment of the manufacturer has been installed in accordance with the manufacturer's recommendations and that all signaling devices of whatever manufacturer have been operated or tested to verify their operation.
    - .5 Supervisory wiring of those items of equipment connected to a supervised circuit is operating and governmental regulations, if any, concerning such supervisory wiring have been met to the satisfaction of inspection authorities.

- .6 The manufacturer shall supply to the Electrical Contractor reasonable amounts of technical assistance with respect to any changes necessary. During the period of inspection by the manufacturer, the Electrical Contractor shall make available to the manufacturer, electricians as designated by the manufacturer.
- .7 To assist the Electrical Contractor in preparing his bid, the manufacturer shall indicate the number of hours necessary to complete the inspection described, prior to closing of tenders.
- .8 On completion of the inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the Consultant the following, in accordance with CAN/ULC-S537:
  - .1 A copy of the inspecting technician's report showing the location of each device and certifying the test results of each device.
  - .2 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.
  - .3 Proof of liability insurance for the inspection.
- .9 All costs involved in the inspection described herein, both for the manufacturer's and the Electrical Contractor's work, shall be included in the Electrical Contractor's total tender price.
- .10 Verification procedures, testing requirements, documentation required, etc. shall be in accordance with the requirement of ULC Standard CAN/ULC-S537.

### 3.3 EQUIPMENT COMMISSIONING

- .1 Division 26 shall coordinate all required responsibilities in the commissioning process Refer to section 01 91 13.
- .2 Commissioning requires the participation of Division 26 to ensure all equipment and systems are operating in a manner consistent with the contract documents. Division 26 shall be familiar with all requirements and coordination and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- .3 Include the cost of commissioning in the contract price.
- .4 Attend all necessary meetings schedule by the CA to facilitate the commissioning process.
- .5 Provide all cut sheets and shop drawing submittals to the CA of commissioned equipment.
- .6 Provide all additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.
- .7 Provide a copy of the O&M manual submittals of commissioned equipment. Through normal channels, to the CA for review and approval.

- .8 Provide assistance to the CA in preparation of the specific functional performance test procedures. Sub contractors shall review test procedures to ensure feasibility, safety and equipment protection.
- .9 Develop a full start-up and initial checkout plan of equipment and systems. Execute and document the electrical related portions for all commissioned equipment. Provide a copy to the CA and the owner.
- .10 Provide skilled technicians to execute starting of equipment and to execute functional performance tests.
- .11 Perform functional performance testing under the direction of the CA for all commissioned equipment.
- .12 Correct all deficiencies.
- .13 Provide training of the Owner's operating personnel as specified. Provide training DVD as approved by the Owner.

#### 3.4 TRAINING OF PERSONNEL

- .1 The General Contractor shall be responsible for the overall training schedule and shall ensure that all training activities specified herein are completed.
- .2 Electrical Contractor: The electrical contractor shall have the following training responsibilities:
  - .1 Provide designated personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of tested electrical equipment or system.
  - .2 Training shall be hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
  - .3 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
  - .4 The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
  - .5 Training shall include:
    - .1 Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
    - .2 Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall

- include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
- .3 Discuss relevant health and safety issues and concerns.
- .4 Discuss warranties and guarantees.
- .5 Cover common troubleshooting problems and solutions.
- .6 Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
- .7 Discuss any peculiarities of equipment installation or operation.
- .6 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
- .7 The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls.
- .8 Training shall occur after functional testing is complete, unless approved otherwise by Consultant.
- .9 Duration of Training. The electrical contractor shall provide training on each system for suitable period of time, to ensure a reasonable understanding of its operation by the trainee.

END OF SECTION

- Part 1            General
- 1.1            SUMMARY
- .1            Section Includes:
- .1            Lighting control systems
- 1.2            RELATED SECTIONS:
- .1            Refer to Section 26 05 00 - Common Work Results - Electrical for related sections applicable to this project.
- 1.3            STANDARDS
- .1            Refer to Section 26 05 00 - Common Work Results - Electrical for standards applicable to this project.
- 1.4            SYSTEM DESCRIPTION
- .1            The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control without the use of any centrally hardwired switching equipment (relay panels). The system's control shall be exerted by directly switching lighting loads on and off and/or dimming LED drivers.
- .2            Lighting Control System:
- .1            Factory assembled relays, interfaces and modules.
- .2            Low voltage wall stations, occupancy sensors and wall dimmers.
- 1.5            SUBMITTALS
- .1            Submit under provisions of Section 26 05 00.
- .2            All lighting control equipment including, but not limited to wall switches, occupancy sensors, relays, power packs, wall dimmers, graphic wall stations, etc s to be of one manufacturer.
- .3            Specification Conformance Document: Indicate whether the submitted equipment either:
- .1            Meets specification exactly as stated.
- .2            Meets specification via an alternate means and indicate the specific methodology used.

- .4 Shop Drawings; include:
  - .1 Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, capacity, phase, and corresponding circuit numbers.
  - .2 Schematic of system.
- .5 Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.
- 1.6 QUALITY ASSURANCE
  - .1 Manufacturer: Minimum 5 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.
- 1.7 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 during installation.
- 1.8 WARRANTY
  - .1 Provide manufacturer's full 5 year warranty covering 100% parts and 100% labor from the date of system commissioning.
- 1.9 COMMISSIONING
  - .1 Provide factory-certified field service engineer to make a site visit to ensure proper system installation and operation under following parameters:
    - .1 Qualifications for factory-certified field service engineer:
      - .1 Minimum experience of 2 years training in the electrical/electronic field.
      - .2 Certified by the equipment manufacturer on the system installed.
    - .2 Make a visit upon completion of installation of lighting control system:
      - .1 Verify connection of power feeds and load circuits.
      - .2 Verify connection and location of controls.
      - .3 Energize processor panel and download system data program.
      - .4 Verify proper connection of panel links (low voltage/data) and address panel.
      - .5 Download system panel data to switching panels

- .6 Check load currents and remove by-pass jumpers.
- .7 Verify system operation control by control, circuit by circuit.
- .8 Verify proper operation of manufacturers interfacing equipment.
- .9 Verify proper operation of manufacturers supplied PC and installed programs.
- .10 Verify operation of PC.
- .11 Obtain sign-off on system functions.
- .12 User to be trained on system operation

#### 1.10 MAINTENANCE

- .1 Make ordering of new equipment for expansions, replacements, and 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 24 hours per day, 7 days per week.
- .4 Provide on-site service support within 24 hour.
- .5 Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system commissioning.

#### Part 2 Products

##### 2.1 GENERAL

- .1 Provide hardware that is designed, tested, manufactured, and warranted by a single manufacturer. System to be as manufactured by sensor switch-NLight series.
- .2 BACnet Interface:
  - .1 Provide ability to communicate by means of BACnet IP or BACnet Ethernet communication to centralized lighting system from user-supplied 10BaseT Ethernet network.
  - .2 Provide PIC list definition and object model to other system manufacturers.

##### 2.2 SYSTEM ARCHITECTURE

- .1 All switching relays shall be located within either a sensor device, single gang wall switch device, or power (relay) pack device.
- .2 All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located device).



- .3 System shall have a primary wall mounted network control "gateway" device that is capable of accessing and controlling all other system devices and linking into an Ethernet LAN.
- .4 System shall use "bridge" devices that route communication and distribute power for up to 8 lighting zones together for purposes of decreasing system wiring requirements.
- .5 All devices within a single lighting zone shall be capable of being daisy-chain wired with CAT-5E low voltage cabling.
- .6 Communication and Class 2 system power shall be delivered to each device via standard CAT-5E low voltage cabling with RJ-45 connectors.
- .7 All system devices shall have at least two RJ-45 ports.
- .8 All wall mounted user control / gateway devices shall be low voltage, fit within a two gang switch box, and have a backlit LCD panel. User control shall be made available via finger-touch buttons with no moving parts.
- .9 System must have a web-based software management program that enables system control, status monitoring, and creation of lighting control profiles.
- .10 Each control gateway device shall be capable of linking 400 devices to the management software.
- .11 Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure or the management software becoming unavailable.
- .12 System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Refer to drawing control schedules for room/zone operating sequence.
  - .1 Auto-On / Auto-Off (via occupancy sensors)
    - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
    - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
    - .3 Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
  - .2 Manual-On / Auto-Off (also called Semi-Automatic)
    - .1 Pushing a switch will turn lights on.
    - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

- .3 Manual-On to Auto-On/Auto-Off
  - .1 Pushing a switch will turn lights on.
  - .2 After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
  - .3 Sequence can be reset via scheduled (ex. daily each morning) events
- .4 Auto-to-Override On
  - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
  - .2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
  - .3 Sequence can be reset via scheduled (ex. daily each morning) events
- .5 Manual-to-Override On
  - .1 Pushing a switch will turn lights on.
  - .2 Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
  - .3 Sequence can be reset via scheduled (ex. daily each morning) events
- .6 Auto On / Predictive Off
  - .1 Zones with occupancy sensors automatically turn lights on when occupant is detected.
  - .2 Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
  - .3 If switch is pressed, lights turn off and a short "exit timer" begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
- .7 Multi-Level Operation (multiple lighting levels per manual button press)
  - .1 Operating mode designed specifically for bi-level applications
  - .2 Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
  - .3 Eliminates user confusion as to which of two buttons controls which load
  - .4 Three different transition sequences are available in order to comply with energy codes or user preference)

## 2.3 LIGHTING CONTROL PROFILES

- .1 Changes to the operation of the system can be made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

- .2 Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- .3 All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- .4 Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- .5 All lighting control profiles shall be stored on the network gateway device and on the software's host server.
- .6 Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- .7 Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- .8 Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- .9 Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- .10 Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

## 2.4 MANAGEMENT SOFTWARE

- .1 Include all costs in contract for web based software, including programming of software for all rooms and devices and associated profiles.
- .2 Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.
- .3 The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- .4 The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- .5 A printable network inventory report shall be available via the software.

- .6 Up to 40 simultaneous user sessions shall be capable of being supported.
- .7 Software shall require all users to login with a User Name and Password.
- .8 Software shall provide at least three permission levels for users.
- .9 All sensitive stored information and privileged communication by the software shall be encrypted.
- .10 All device firmware and system software updates must be available for automatic download and installation via the internet.

## 2.5 SENSORS GENERAL

- .1 Occupancy sensing technologies shall be completely passive meaning that they will not emit any radiation that is known to interfere with certain types of hearing aides, or electronic devices such as electronic white board readers. Passive Infrared (PIR) or PIR/Microphone Dual Technology detection technologies shall be acceptable. Ultrasonic or Microwave based sensing technologies shall not be accepted.
- .2 Sensors shall be available with zero, one, or two integrated Class 1 switching relays.
- .3 Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
- .4 Sensors shall be available in multiple lens options which are customized for specific applications.
- .5 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- .6 All sensors shall have two RJ-45 ports.
- .7 Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
- .8 Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.

## 2.6 WALL SWITCH SENSORS

- .1 Sensor shall recess into single-gang switch box and fit a standard GFI opening.
- .2 Sensor must meet CEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.

- .3 Sensor shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
  - .4 Sensors shall be available in White color.
- 2.7 CEILING AND CORNER MOUNT SENSORS
- .1 Sensor shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
  - .2 Sensors with dimming control can control 3 wire dimmable ballasts.
  - .3 All sensors have at least one or two occupancy poles, each of which provides a programmable time delay.
- 2.8 DAYLIGHT (PHOTOCELL) SENSORS
- .1 Sensor shall provide for an On/Off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
  - .2 Sensors' set-point and deadband shall be automatically calibrated through the sensor's micro-controller by initiating the "Automatic Set-point Programming" subroutine. Further adjustment may be made manually if needed. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
  - .3 Sensors with dimming control can control LED drivers.
  - .4 Photocell sensor's set point shall be automatically calibrated through the sensor's micro-controller by initiating the "Automatic Set-point Programming" subroutine. Min and Max dim settings as well as set-point may be manually entered.
  - .5 Dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.
- 2.9 POWER (RELAY) PACKS AND SUPPLIES
- .1 Power Packs shall accept 120VAC, be plenum rated, and provide Class 2 power to the system.
  - .2 All devices shall have two RJ-45 ports.
  - .3 Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
  - .4 Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads.  
Note: UL Listing under Energy Management or Industrial Control Equipment

automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

- .5 Power Pack must be installed inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- .6 Power Pack shall incorporate a Class 1 relay and contribute low voltage power to the rest of the system. Slave Packs shall incorporate the relay, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
- .7 Class 1 Relays used in Power (Slave) Packs shall provide 16 Amp switching of all load types, and be rated for 400,000 cycles.
- .8 Provide dimmer rated relay packs for LED dimming.

## 2.10 WALL SWITCHES AND DIMMERS

- .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
- .2 Devices shall provide user control via touch sensitive buttons that utilize no mechanical parts.
- .3 Devices shall be available with zero or one integrated Class 1 switching relay.
- .4 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5E low voltage cabling with RJ-45 connectors.
- .5 All sensors shall have two RJ-45 ports.
- .6 All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
- .7 Devices shall be available in white color.
- .8 Devices with dimming control outputs can control LED drivers.

## 2.11 SCENE CONTROLLER

- .1 Device shall recess into single-gang switch box and fit a standard GFI opening.
- .2 Device shall provide user control via touch sensitive buttons which have no mechanical parts.
- .3 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5E low voltage cabling with RJ-45 connectors.
- .4 All sensors shall have two RJ-45 ports.

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- .5 Device shall have four touch sensitive buttons for selecting programmable lighting control profiles.
  - .6 Device shall have four LEDs indicating current selection.
- 2.12 COMMUNICATION BRIDGES
- .1 Device shall surface mount to a standard 4" x 4" square junction box.
  - .2 Device shall have 8 RJ-45 ports.
  - .3 Device shall be capable of aggregating communication with connected daisy-chains of system devices.
  - .4 Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5E cabled connection.
- 2.13 NETWORK CONTROL GATEWAY
- .1 Device shall recess into a two-gang switch box.
  - .2 Device shall provide user control via touch sensitive buttons which have no mechanical parts.
  - .3 Device shall have a backlit LCD panel.
  - .4 Device shall contain a real-time clock capable of synchronization with a network time authority.
  - .5 Device shall be capable of communicating on an Ethernet network with a fixed or DHCP assigned IP address.
  - .6 Device shall have three RJ-45 ports for connection to system devices and one RJ-45 port for connection to Ethernet network.
  - .7 Device shall be powered with Class 2 low voltage supplied locally via a directly-wired power supply or delivered via a CAT-5E cabled connection.
- Part 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 Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

3.2 COMMISSIONING

- .1 To facilitate commissioning, all devices daisy-chained together (using CAT-5E) shall automatically be grouped together into a functional lighting control zone.
- .2 All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
- .3 Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
- .4 All system devices shall be capable of being given user defined names.
- .5 All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

END OF SECTION



- Part 1            General
- 1.1            PRODUCT DATA
  - .1            Submit product data in accordance with Section 26 05 00 Common Work Results - Electrical.
- 1.2            REFERENCES
  - .1            CSA International
    - .1            CAN/CSA-C22.2 No.47-[M90(R2007)], Air-Cooled Transformers (Dry Type).
    - .2            CSA C9-[02(R2007)], Dry-Type Transformers.
    - .3            CAN/CSA-C802.2-[12], Minimum Efficiency Values for Dry Type Transformers.
  - .2            National Electrical Manufacturers Association (NEMA)
- 1.3            ACTION AND INFORMATIONAL SUBMITTALS
  - .1            Submit in accordance with Section 26 05 00 – Common Work Results - Electrical.
  - .2            Product Data:
    - .1            Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.4            CLOSEOUT SUBMITTALS
  - .1            Submit in accordance with Section 01 78 00 - Closeout Submittals.
  - .2            Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.
- 1.5            DELIVERY, STORAGE AND HANDLING
  - .1            Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
  - .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 TRANSFORMERS

- .1 Use transformers of one manufacturer throughout project.
- .2 Design 1.
  - .1 Type: ANN.
  - .2 Transformer to conform to CAN/CSA-C802.2
  - .3 3 phase, 600 V input, 208/120 V output, 60 Hz, kVA as shown on drawings.
  - .4 Copper windings.
  - .5 Voltage taps: standard 2 ½% full capacity above and below normal.
  - .6 Insulation: Class H, 150°C temperature rise.
  - .7 Basic Impulse Level (BIL): standard
  - .8 Hipot: standard
  - .9 K-rated where indicated.
  - .10 K-rated transformers to have secondary neutral connections rated at 200% of the rated secondary phase current.
  - .11 All transformer 75kVA and smaller to be of the epoxy encapsulated type.
  - .12 Average sound level: 55 db maximum.
  - .13 Impedance at 170°C: 5% up to 150 KVA, 4-5% over 150 KVA.
  - .14 Enclosure: EEMAC 3R, removable metal front panel complete with sprinkler proof hood.
  - .15 Complete with internal "anti-vibration pads" and external "vibration isolators". Standard of acceptance: "Korfund Dynamics" R-series, Vibro Acoustics RD-series and Caldyn RM series flush type neoprene mounting. No exceptions.
  - .16 Mounting: floor or wall as required.
  - .17 Finish: in accordance with Section 26 05 00 Common Work Results - Electrical.
- .3 Two winding or T connected transformers are not acceptable.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 Common Work Results - Electrical.

.2 Label size: 7.

## 2.3 APPROVED MANUFACTURERS

.1 Approved Manufacturers: GE, Rex, Delta, Hammond or Square D.

## Part 3 Execution

### 3.1 INSTALLATION

.1 Mount dry type transformers in accordance with manufacturer's recommendations.

.2 Wall mount dry type transformers up to 75 kVA.

.3 Mount dry type transformers above 75 kVA on floor.

.4 Ensure minimum clearance of 300mm between transformer and wall for ventilation.

.5 Install transformers in level upright position.

.6 Remove shipping supports only after transformer is installed and just before putting into service.

.7 Loosen isolation pad bolts until no compression is visible.

.8 Make primary and secondary connections in liquid tight, flexible conduit.

.9 Energize transformers after installation is complete.

.10 Mount floor mounted transformers on 100mm concrete housekeeping pads painted yellow.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Refer to all sections of the specification for related work.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with 26 05 00 Common Work Results – Electrical.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 00 Common Work Results – Electrical.

1.4 PLANT ASSEMBLY

- .1 Install circuit breakers in panelboards before shipment.
- .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: product of one manufacturer throughout project.
- .2 347/600V central distribution panels (CDP) bus and breakers rated "minimum" 65 KA RMS or increased to meet coordination study.
- .3 120/208V central distribution panels (CDP) bus and breakers rated "minimum" 18 KA RMS or increased to meet coordination study.
- .4 120/208V branch circuit panelboards bus and breakers rated "minimum" 18 KA RMS or increased to meet coordination study.
- .5 Sequence phase bussing such that circuit breakers shall be numbered vertically in consecutive order, with each breaker identified by permanent number identification as to circuit number and phase.
- .6 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as required.

- .7 Two keys for each CDP, panelboard and key alike.
- .8 All Bus bars, ground bar and main connections: tin plated copper.
- .9 200% rated neutral bus.
- .10 Mains: suitable for bolt-on breakers.
- .11 All panelboards to be c/w door and key.
- .12 Trim, door and enclosure (tub) finish: baked grey enamel.
- .13 Double tub panels to have tubs bolted together with one common trim.
- .14 Flush or surface-mounted tubs as required.
- .15 Load centres shall not be accepted.
- .16 All surface mounted CDP and panelboards shall be sprinkler-proof type c/w doors.

## 2.2 BREAKERS

- .1 Breakers: to Section 26 28 21 Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Lock-on devices for fire alarm, night light circuits.
- .4 Main breakers to be mounted at top of panel, branch mounted main breaker not acceptable.

## 2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 53 – Identification of Electrical Systems.
- .2 Nameplate for each branch circuit panelboard size 4 engraved to indicate panel designation and voltage.
- .3 Nameplate for each circuit in distribution panelboards size 3 engraved to indicate each respective load.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

## 2.4 MANUFACTURERS

- .1 Acceptable manufacturer: GE, Eaton (Cutler Hammer) or Schneider (Square D).

Part 3            Execution

3.1                INSTALLATION

- .1            Locate panelboards as indicated and mount securely, plumb, true and square to adjoining surfaces.
- .2            Install surface mounted panelboards on plywood painted backboards. Where practical, group panelboards on common backboard. Plywood to be no-added urea-formaldehyde.
- .3            Provide 2x 50mm spare conduits into accessible ceiling space for all flush mounted panelboards.
- .4            Mount panelboards to height specified in Section 26 05 00 Common Work Results – Electrical or as required.
- .5            Connect loads to circuits.
- .6            Connect neutral conductors to common neutral bus. Common neutrals shall be shared by vertically adjacent breakers. Common neutrals shall be identified with mylar/cloth wire markers showing circuit numbers of the circuits sharing the neutral.

END OF SECTION

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- Part 1            General
- 1.1            RELATED WORK
- .1          Refer to all Sections of the specification for related work.
- 1.2            SECTION INCLUDES
- .1          Receptacles, cover plates, special wiring devices and their installation.
- 1.3            REFERENCES
- .1          Canadian Standards Association (CSA International)
- .1          CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2          CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices.
- .3          CSA-C22.2 No.55, Special Use Switches.
- .4          CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).
- 1.4            SHOP DRAWINGS AND PRODUCT DATA
- .1          Submit shop drawings and product data in accordance with Section 26 05 00 Common Work Results - Electrical.
- Part 2           Products
- 2.1            SWITCHES
- .1          15 or 20 A, 120 V, single pole, three-way, or four-way switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
- .2          Manually-operated general purpose ac switches with following features:
- .1          Terminal holes approved for No. 10 AWG wire.
- .2          Silver alloy contacts.
- .3          Urea or melamine moulding for parts subject to carbon tracking.
- .4          Suitable for back and side wiring.
- .5          White toggle.
- .3          Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4          Switches of one manufacturer throughout project.
- .5          Acceptable materials: Specification Grade Commercial switches.

## 2.2 RECEPTACLES

- .1 Duplex receptacles, NEMA No. 5-20 R, 125 VAC, 20 A, parallel slot, U ground, with the following features:
  - .1 Commercial grade for office areas and industrial grade for service rooms/areas and process areas for all receptacles.
  - .2 Suitable for #10 AWG back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Decora style.
  - .5 Triple wipe contacts and non-riveted grounding contacts.
  - .6 Tamper-resistant.
  - .7 Aluminum yokes, blades or terminals or with CU/AL rating will not be accepted.
  - .8 Acceptable manufacturer: Cooper, Hubbell, Leviton.
- .2 Single receptacles NEMA No. 5-20R, 125V AC, 20A, U-ground, suitable for #10 back and side wiring.
- .3 Combination Duplex Receptacle/Outlet and USB Charger, NEMA No. 5-20 R, 125 VAC, 20 A, T-slot, U ground, with the following features:
  - .1 5.1A USB Type A/Type-C Wall Outlet Charger c/w the following:
    - .1 Built-in smart chip to recognize the individual device's charging requirement to optimize the charge.
    - .2 Two high-powered charging ports to deliver a combined total of 5.1A charging current and 25+ watts of power.
  - .2 Commercial grade for all receptacles.
  - .3 Suitable for #10 AWG back and side wiring.
  - .4 Break-off links for use as split receptacles.
  - .5 Decora style.
  - .6 Triple wipe contacts and non-riveted grounding contacts.
  - .7 Tamper resistant type.
  - .8 Aluminum yokes, blades or terminals or with CU/AL rating will not be accepted.
- .4 Ground fault circuit interrupter receptacle: Class A rated, CSA type 5-20R, 125V, 20A feed through rated to: CSA-C22.2 No. 144 with the following features:
  - .1 Commercial grade.
  - .2 Nylon moulded housing.
  - .3 Decora style.
  - .4 Suitable for No. 10 AWG for side and back wiring.
  - .5 Solid state ground sensing device.
  - .6 Testing and reset buttons.
  - .7 Tamper resistant type.
  - .8 Indicator light to show status of GFCI protection operation.



- .9 Malfunction protection. Device cannot be reset if GFCI is non-operational or unit is wired incorrectly.
  - .10 5mA trip level.
- .5 Other receptacles with ampacity and voltage as required.
- .6 Receptacles of one manufacturer throughout project.
- .7 Colour of receptacles shall be as follows:
  - .1 White for general use normal power.
- 2.3 INTELLIGENT PARKING LOT CONTROLLER
  - .1 Provide Intelligent Parking Lot Controller c/w pedestal.
  - .2 Unit to be c/w microprocessor, temperature sensors, and red and green LED lights to tell users the status of the system.
  - .3 Unit to measure temperature and wind chill, and is factory programmed to automatically regulate the optimum power flow to ensure strong starts at any temperature.
  - .4 Unit to be factory programmed to deliver no power above  $-5^{\circ}\text{C}$ . Infinitely varies power delivery from 10 percent on-time at  $-5^{\circ}\text{C}$  to 100 percent ontime at  $-25^{\circ}\text{C}$  and colder.
  - .5 Pedestal to be aluminum, 15" overall height, universal mounting, 45 down coverless bonnet.
  - .6 Provide IPLC Data-Mate handheld device designed to transfer information between IPLC units and Windows-based computer. Handheld unit to be c/w software to allow changes to factory settings as well as customize individual or all IPLC outlets (operating times, load limits, temperature response profiles) and to collect data on how the units are being used. Data-Mate to conveniently link to each IPLC using an optical link on the front of the unit c/w a computer interface cable and battery.
  - .7 Parking lot pedestal to be as manufactured by IPLC.
- 2.4 COVERPLATES
  - .1 Provide cover plates for all wiring devices.
  - .2 Cover plates from one manufacturer throughout project.
  - .3 Coverplates for surface mounted receptacles and switches on exposed conduit systems shall be stainless steel 12mm raised type.
  - .4 For all exterior weatherproof receptacle provide "while-in-use" wet listed metal die cast cover box c/w grey powder coat finish, NEMA 3R rating, lockable and c/w gasket, mounting hardware, GFCI receptacle cover. Construction to be all die cast metal heavy duty construction.

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- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for weatherproof duplex receptacles in basement, service rooms and process rooms/areas.
  - .6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches in process rooms.
  - .7 Cast gasketed coverplates for wiring devices mounted in surface-mounted cast Ferroalloy type conduit boxes.
  - .8 Acceptable manufacturer: Cooper, Hubbell, Leviton.
- 2.5 ROOF SERVICE PEDESTAL
- .1 Refer to drawings for further details.
- Part 3 Execution
- 3.1 INSTALLATION
- .1 Location of outlets:
    - .1 Do not install outlets back-to-back in wall, allow minimum 400 mm (16") clearance between boxes.
    - .2 Change location of outlets at no extra cost providing distance does not exceed 3 m (10'-0") in radius and information is provided before installation.
    - .3 Drawings are schematic only, coordinate mounting height and location of all equipment with architectural, mechanical and structural drawings prior to installation.
    - .4 Vertically align outlets of different systems when shown in close proximity to each other and occur at different mounting heights.
  - .2 Receptacles:
    - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
    - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results – Electrical.
    - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
    - .4 Install vertical receptacles ground up on walls and ground down under counters. Horizontal receptacles neutral up on walls and neutral down under counters.
    - .5 Provide GFCI type receptacles for all outlets located within 1500mm of a sink, washbasin, bathtub or shower stall.
  - .3 Cover plates:
    - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

- .2 Install suitable common cover plates where wiring devices are grouped.
- .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 RECEPTACLE WIRING VERIFICATION

- .1 Verify all receptacles have been wired correctly using an outlet circuit tester. Provide written test results. See Section 26 08 01 Electrical Testing Requirements.

END OF SECTION

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|--------|---|
| Part 1 | General   |
| 1.1    | RELATED WORK  |
| .1     | Refer to all sections of the specification for related work.  |
| 1.2    | SHOP DRAWINGS AND PRODUCT DATA  |
| .1     | Submit shop drawings and product data in accordance with Section 26 05 00 - Common Work Results - Electrical  |
| .2     | Include with requests for equal, time-current characteristic curves for breakers with ampacity of 800A and over or with interrupting capacity of 22,000 A symmetrical (RMS) and over at system voltage.   |
| Part 2 | Products  |
| 2.1    | BREAKERS – GENERAL  |
| .1     | Common-trip breakers: with single handle for multi-pole applications.   |
| .2     | Bolt-on moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C (104°F) ambient.   |
| .3     | Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.  |
| .4     | All circuit breakers mounted in switchboards and CDP's to be c/w with electronic trip (L.S.I.) as a minimum.  |
| .5     | All breakers for heat trace cable circuits to be 30mA GFCI type breaker.  |
| .6     | To be of same manufacturer as switchboards, CDP's and panelboards.  |
| 2.2    | THERMAL MAGNETIC BREAKERS   |
| .1     | Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection. |
| 2.3    | OPTIONAL FEATURES   |
| .1     | Include, as required:   |
| .1     | on-off locking devices  |
| .2     | under-voltage release   |

- .3 handle mechanism
- .4 shunt trip
- .5 Red Breaker for fire alarm, in addition provide Elock-FA, E series circuit breaker lock as manufactured by "Space Age Electronics"

#### 2.4 MANUFACTURERS

- .1 Acceptable manufacturers: GE, Eaton (Cutler Hammer) or Schneider (Square D).

### Part 3 Execution

#### 3.1 INSTALLATION

- .1 Install circuit breakers according to manufacturer's recommendations.
- .2 Install on-off locking devices for breakers feeding fire alarm panel, security panels, etc.
- .3 Install red fire alarm breaker.
- .4 Provide GFCI breakers of the class A type for all heaters installed within 1000mm of a sink, washbasin, tub or shower stall.

END OF SECTION

- Part 1            General
  - 1.1            RELATED WORK
    - .1            Refer to all sections of the specification for related work.
  - 1.2            SHOP DRAWINGS AND PRODUCT DATA
    - .1            Submit shop drawings and product data in accordance with Section 26 05 00 Common Work Results - Electrical.
- Part 2            Products
  - 2.1            DISCONNECT SWITCHES
    - .1            Fusible and non-fusible disconnect switch in EEMAC `3R' enclosure for interior sprinkler proof application, unless otherwise indicated.
    - .2            Provision for padlocking in on-off position.
    - .3            Mechanically interlocked door to prevent opening when handle in ON position.
    - .4            Fuses: size as required.
    - .5            Fuseholders: suitable without adaptors, for type and size of fuse indicated.
    - .6            Quick-make, quick-break action.
    - .7            ON-OFF switch position indication on switch enclosure cover.
    - .8            Cover viewing window to allow visual verification of "On-Off" status.
  - 2.2            EQUIPMENT IDENTIFICATION
    - .1            Provide equipment identification in accordance with Section 26 05 00 Common Work Results - Electrical.
    - .2            Indicate name of load controlled on size 4 nameplates.
  - 2.3            APPROVED MANUFACTURERS
    - .1            Approved manufacturers: GE, Eaton (Cutler Hammer) or Schneider (Square D).

Part 3          Execution

3.1            INSTALLATION

- .1          Install disconnect switches complete with fuses only where specifically indicated.
- .2          Install circuit disconnect switches where indicated or where required by the inspection authorities and/or for equipment supplied by other trades.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Refer to all sections of the specification for related work.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 Indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 26 05 00 Common Work Results - Electrical.
- .2 Include operation and maintenance data for each type and style of starter.

1.4 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 26 05 00 Common Work Results - Electrical.

Part 2 Products

2.1 MATERIALS

- .1 Starters: EEMAC (Electrical and Electronic Mfg. Association of Canada) standard "E14-1".
  - .1 Half size starters not acceptable.



## 2.2 MANUAL MOTOR STARTERS

- .1 Single or Three phase manual motor starters of size, type, rating, and enclosure type as required, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 One or Three overload heaters, manual reset, trip indicating handle.
  - .3 Horsepower rated.
- .2 Accessories:
  - .1 Toggle switch.
  - .2 Indicating lights.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

## 2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Power and control terminals.
  - .4 Wiring and schematic diagram inside starter enclosure in visible location.
  - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit protector as follows:
  - .1 Breakers to be specifically designed for motor applications, with adjustable trips fixed with a locking pin.
  - .2 Interrupting rating to suit available RMS sym.
  - .3 Size trip as a function of motor nameplate FLA, and in accordance with manufacturer's recommendations.
  - .4 Locking in "OFF" position with up to 3 padlocks.
  - .5 Locking in "ON" position.
  - .6 Independent locking of enclosure door.
  - .7 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Oil tight selector switches: HOA labelled.
  - .2 Oil tight indicating lights: red running push to test lamps.
  - .3 1-N/O and 1-N/C spare auxiliary contacts.

## 2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with 120 volt secondary voltage unless indicated otherwise, complete with primary and secondary fuse installed in starter.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## 2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 Enclosures to be sprinkler proof.

## 2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 53 – Identification of Electrical systems.
- .2 Manual starter designation label, black plate, white letters, size 1, engraved lamacoid.
- .3 Magnetic starter designation label, black plate, white letters, size 3, engraved lamacoid.

## 2.7 RELAYS

- .1 Install protective relays where motors are provided with thermistors.

## 2.8 MANUFACTURERS

- .1 Acceptable manufacturer: GE, Allen Bradley, Eaton (Cutler Hammer) or Schneider (Square D).

## Part 3 Execution

### 3.1 STARTER VERIFICATION

- .1 Field check motor starters supplied prior to commissioning equipment. As a minimum, verify the following:
  - .1 Check of control circuits.
  - .2 Verify that overload relay installed is correctly sized for motor used.
  - .3 Current test overload relay, to ensure that relay trips at its prescribed rating (use a low-voltage high current test set), or equivalent.
  - .4 Visual inspection of breakers and contactors.
- .2 Measure motor amps under load conditions and compare with full load amps and motor service factor. Report any excessive imbalance. Measure voltage and motor terminals. Voltage to be approximately 575 to 590 volts.

- .3 Record settings of MCP and relays, etc. and include in Operation and Maintenance manual.
- 3.2 OVERLOAD RELAYS
  - .1 For starters provided, select overload relays in accordance with relay and motor manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during start-up to ensure motor operation is satisfactory and relays provide proper protection. For side inlet and other long acceleration time motors, provide special overload relays to suit the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection and to perform a co-ordination study.
  - .2 Adjust relay settings for motors provided with thermistors

END OF SECTION

Part 1            General

1.1            REFERENCES

- .1            Canadian Electrical Code (CEC)
- .2            National Electrical Manufacturers Association (NEMA)
  - .1            NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- .3            Institute of Electrical and Electronics Engineers (IEEE)
  - .1            IEEE 518-2 - Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources
  - .2            IEEE 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.2            SUBMITTALS

- .1            In accordance with Section 01 33 00 and Section 01 78 00.
- .2            Submit the following additional information:
  - .1            Dimensions and weights of drives including enclosure.
  - .2            Catalogue and technical data.
  - .3            Control and schematic drawings indicated all external connections and devices.
  - .4            Instruction manuals for installation and programming, including start-up configuration data.

1.3            VARIABLE FREQUENCY DRIVES (VFD)

- .1            General:
  - .1            Drives shall be capable of constant torque as specified and as required by the application.
  - .2            Selection of VFD shall be coordinated with manufacturer of the equipment and motor to be controlled to ensure compatibility and optimum performance.
  - .3            VFD shall be housed in NEMA 12 rated enclosure suitable to the location where it is installed. All drives located indoors shall be sprinkler proof.
  - .4            The enclosure and installation location shall be selected as to minimize RFI and EMI emissions.
  - .5            Drives shall comply with FCC and CRTC regulations with respect to emissions and radio interference.
  - .6            Drives shall be UL, C-UL listed and CSA approved.
  - .7            Drives shall include all necessary devices, relays, protective devices, wiring and programming to form a complete working system. The adjustable frequency

- drive shall convert three phase, 60 Hz utility power to an adjustable frequency output for speed control from 0 - 100% of base speed.
- .8 The drive must be modifiable to accept standard input voltages accurately.
- .9 The adjustable frequency control shall be designed specifically for variable speed fan and pump applications.
- .10 All products supplied as part of drive including, but not limited to: disconnect switches, circuit breakers. Disconnect switches, motor starters shall be NEMA rated.
- .2 Filters and Reactors
  - .1 General: The VFD shall meet with the First Environment restricted level of EN61800-3, through the use of EMI/RFI filters.
  - .2 Provide filters, 5% reactors and other devices required on the load side of the variable frequency drive to minimize RFI, EMI and harmonic emissions from the drive.
  - .3 Provide filters, reactors and other devices required on the line side of the variable frequency drive to protect the drive from interference and emissions that will compromise its operation.
- .3 Basic Design:
  - .1 Micro processor based pulse width modulation, design employing IGBT technology to convert three phase AC to a fixed DC voltage.
  - .2 A constant speed displacement power factor of .95 shall be maintained at all speeds and rated loads.
  - .3 Insulated grade bipolar transistors in the inverter section converts a fixed DC voltage to a three phase adjustable frequency output.
  - .4 Drive output employ a high carrier frequency to ensure quiet motor operation.
- .4 System Features
  - .1 Drive inline/bypass/isolation contactor.
  - .2 Bypass overload.
  - .3 Mechanical interlock between bypass and full voltage bypass.
  - .4 Four position selector switch (VFD / VFD TEST/ BYPASS / ISOLATION)
  - .5 Drive input circuit breaker, lockable in the open position.
  - .6 Thermal overloads.
  - .7 Thermistor input for motor over temperature protection.
  - .8 Fused control power transformer.
  - .9 Diode or fully gated bridge on input.
  - .10 DC bus inductor on all VFD rated at 7.5 hp and larger.
  - .11 Auxiliary contacts as follows:
    - .1 Drive alarm.
    - .2 Drive speed.

- .3 Control power on.
  - .4 Drive fault.
  - .5 Drive run.
- .12 Communications to include RS232/422/485 and industry standard protocols including BACnet.
- .5 Control Panel:
  - .1 Drive status indicators on the control panel include multi-point status and diagnostics.
  - .2 Adjustments accessible by means of keypad switches:
    - .1 Acceleration/deceleration time: Independently adjustable from approximately 2 to 300 seconds.
    - .2 Minimum speed/maximum speed: Can be calibrated from 5 to 108%.
    - .3 Overload: Adjustable for any percentage of rated current up to 110% to protect motor from excess current at low speeds.
    - .4 Individual selectable resettable fault control: Automatic functioning of the fault counter reset can be allowed or denied for ground fault, over voltage, under voltage, over current, phase loss, overload, over temperature, external fault, and motor open fault.
    - .5 Auto rest time: Calibration available from 0 to 300 seconds to prevent too short a reset time from fault occurrence.
    - .6 Step over frequency (2 ranges): Adjustable from 0 to 100% speed to allow for critical frequency avoidance.
- .6 Additional Features (in addition to start/stop and variable speed):
  - .1 0-10 VDC follower capacity
  - .2 Current limit protection
  - .3 Independently adjustable acceleration/deceleration
  - .4 Automatic restart
  - .5 Over/under voltage protection
  - .6 Over temperature and ground fault protection
  - .7 Minimum 650 V rating
  - .8 96% efficiency
  - .9 Input door-interlocked disconnect switch.
- .7 Quality Assurance:
  - .1 To improve quality and eliminate premature failures, all drives shall be pre-tested and cycled with a motor at an elevated ambient temperature.

1.4 ISOLATION TRANSFORMER

- .1 Purpose built drive isolation transformer, sized to match drive capacity. Refer to Section 26 22 18.
- .2 Housed in NEMA Type 3R enclosure mounted adjacent to drive.
- .3 Transformer windings to be copper.
- .4 Transformers to incorporate vibration isolation pads in their construction located between the transformer core and coil assembly and the transformer case.
- .5 Transformers to incorporate an electrostatic shield for the attenuation of voltage spikes, line noise, and transients.

1.5 STANDARD OF ACCEPTANCE

- .1 Acceptable manufacturer: Danfoss, ABB or Yaskawa.

Part 2 EXECUTION

2.1 GENERAL

- .1 Review shop drawings for the equipment to be connected to the variable frequency drive and confirm compatibility of the equipment.
- .2 Coordinate installation requirements with Division 25.

2.2 INSTALLATION

- .1 Install in accordance with manufacturer's requirements.
- .2 Install drives on strut or other suitable brackets on wall or free-standing in a location that minimizes the length of load side wiring for the equipment. Review with Consultant prior to installation.
- .3 Connect all control wiring and configure to achieve requirements of controls sequence of operation. Controls wiring shall be separated from power wiring by at least 600mm and shall be shielded to prevent problems resulting from interference.
- .4 The manufacturer's representative shall program, start-up, commission and test the drives and shall confirm that settings have been optimized for the application.
- .5 Ensure that critical resonant frequencies are programmed as 'skip frequencies' in the VFD controller.

2.3 TRAINING

- .1 Provide minimum of 8 hours training for each type of variable frequency drive supplied under this contract. Training shall be site-specific and be focused on the particular application.
- .2 Provide training materials in written and electronic format. Ensure that operating manuals and drawings are available and provided to trainees, and form part of the training materials.
- .3 Training shall be focused on the application as well as the operation and maintenance of the drive.

END OF SECTION



Part 1            General

1.1            SHOP DRAWINGS AND PRODUCT DATA

- .1    Provide submittals in accordance with Section 01 33 00 – Submittal Procedures, and Section 26 05 00 – Common Work Results – Electrical.
- .2    Submit complete photometric data prepared by independent testing laboratory for luminaires where specified for approval by Consultant.
- .3    Submit list of replacement lamp data for each luminaire. Include lamp type, voltage, wattage, base type and order code. Include list in maintenance manual.
- .4    Submit a separate shop drawing, including cut-sheet, for each different lighting fixture, driver and lamp being used for all lighting systems.
- .5    Ensure that each of the specified driver features are specifically shown on the shop drawings.

1.2            GUARANTEE

- .1    Replace:
  - .1    Drivers that fail or exceed their labelled noise level rating within 1 year of takeover.
  - .2    Luminaires which show evidence of corrosion, rough handling, scratching of finishes, etc., are to be replaced with new luminaires at no additional cost.
  - .3    Provide MINIMUM five (5) year written warranty on ALL luminaires, leds and drivers.

1.3            OPERATIONAL TESTING

- .1    Check wiring for agreement with design circuits.
- .2    Test for short circuits and improper grounds.
- .3    Test operation of fixture and lamp with driver.

1.4            COORDINATION

- .1    Coordinate luminaire locations with work of other trades.
- .2    Coordinate luminaire types with ceiling finishes to ensure compatibility.
- .3    Install mechanical room and utility rooms' luminaires after other trades have completed their work. Re-locate and re-position luminaires as requested by Consultant to ensure optimum lighting is achieved for the space.

Part 2 Products

2.1 GENERAL

- .1 Provide commercially available stock lighting fixtures meeting specified requirements.
- .2 Provide only luminaires which are structurally well designed and constructed and which use new parts and materials of highest commercial grade available.
- .3 Use aircraft cable systems complete with adjustable locking fastener for suspended luminaires in unfinished areas.
- .4 Luminaires shall carry the CSA label.
- .5 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.
- .6 Provide lenses or diffusers of glass or acrylic material as indicated. Acrylic lenses used with fluorescent luminaires shall be minimum of 1.5mm thick.
- .7 Provide wireless lighting control system for exterior lighting as noted on drawings.
- .9 Where soffits or ceilings have thermal insulation, provide luminaires which are CSA approved for that application.

2.2 LAMPS

- .1 Provide lamps as recommended by the luminaire manufacturer:
  - .1 Fluorescent and HID lights are not allowed.
  - .2 LED lamps to be rated minimum 50,000 hours.
  - .3 Luminaires shall be installed one month before substantial completion of the building, or as instructed by Consultant. Luminaires and lenses shall be thoroughly cleaned before installation of lamps.
  - .4 Provide specific lamp specification cut-sheet with each light fixture shop drawing.

2.3 DRIVERS AND ACCESSORIES

- .1 Provide drivers and accessories as indicated.
  - .1 Drivers shall meet requirements of FCC Rules and Regulations, Part 18.
  - .2 All drivers to be currently listed as "Efficiency Manitoba Approved".
  - .3 Provide specific driver specification cut-sheet with each light fixture shop drawing.

2.4 LUMINAIRES

- .1 Refer to Luminaire Schedules on drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories, as required.
- .2 Review all ceiling types, construction details and mounting arrangements before placing luminaire orders and ensure that all mounting assemblies, framing rings, trims and similar features are included and match the required installation. Confirm compatibility and interface of other materials with luminaire and ceiling systems. Examine the room finish schedule and reflected ceiling drawings. Report discrepancies and defer ordering until clarified.
- .3 Supply plaster frames, trim rings and back-boxes to other trades as the work requires. Provide guards where fixtures are subject to mechanical damage, as required by Code.
- .4 Install luminaires and lens materials in architectural details.
- .5 Install luminaires parallel with building lines and install wall mounted luminaires plumb.
- .6 All luminaires and assemblies shall be properly secured and supported. Support luminaires independent of the ceiling construction, complete with all fasteners, framing and hangars, as may be required. Do not secure luminaires to mechanical ductwork or other vibration producing apparatus, unless specifically detailed on the drawings.
- .7 Where a luminaire is suspended from the ceiling using a self-aligning box cover, an additional ground wire from the outlet box to the luminaire shall be provided.
- .8 Ground lighting equipment with a separate grounding conductor.
- .9 Coordinate with Contractor to avoid conflicts between luminaires, supports and fittings and mechanical and structural equipment.
- .10 Coordinate the installation of luminaires with the work of other Division's, ensuring that the necessary depths and mounting spaces are provided. Luminaires which cannot be installed due to a conflict with structural members, pipes or ductwork shall be relocated to a more suitable location, as directed by the Consultant.

3.2 WORKMANSHIP

- .1 Completely clean all glassware, lamps, and hangers. Polish all metal parts before completion.
- .2 Provide suitable extension couplings for row-mounted fixtures.

- .3 Protect luminaires, lenses, lamps, hangers, supports, fastenings and accessory fittings at the site prior to and during installation. Unless luminaires are erected immediately after delivery to site, deliver in original cartons or enclosed in airtight plastic wrapping. Provide storage in a dry and secure space on site. Protect hangers, supports, fastenings and accessory fittings against corrosion. Take care during installation to ensure that insulation and corrosion protection is not damaged.
- .4 Install recessed luminaires to permit removal from below, for access to outlet or pre-wired luminaires box. Mount surface luminaires on 25mm spacers.
- .5 Hang and mount luminaires to prevent distorting fixture frame, housing, sides or lens frame, and permit correct alignment of several fixtures in a row. Re-align luminaires to be square with building lines.
- .6 Support luminaires rigidly, level, plumb and true with structure and other equipment in horizontal or vertical position as intended. Install wall or side bracket mounted luminaires housing rigidly and adjust to a neat flush fit with mounting surface.
- .7 Adjust length of hangers of suspended luminaires to ensure luminaire bodies are level and in same horizontal plane.
- .8 All lamps are to be provided by the Contractor. Allow for the installation of new lamps in all luminaires provided under this division.

### 3.3 WIRING

- .1 Connect luminaires to C.E.C rated lighting circuits.
- .2 Ground lighting equipment to a separate grounding conductor.

### 3.4 TESTS

- .1 Check luminaires and replace defective lamps, drivers, lenses and accessories.

### 3.5 CLEANING

- .1 Prior to Owners take-over of the project, all luminaires, lenses and reflectors shall be cleaned with damp cloth to remove dust, smudges and fingerprints.

END OF SECTION

Part 1            General

1.1            REFERENCES

- .1            CSA C22.2 No.141, Unit Equipment for Emergency Lighting.

1.2            SHOP DRAWINGS AND PRODUCT DATA

- .1            Data to indicate system components, mounting method, source of power and special attachments.

1.3            TEST REPORTS

- .1            Submit test report showing voltage drop and percentage voltage drop at each emergency lighting head.

Part 2           Products

2.1            MANUFACTURERS

- .1            Battery Unit:
  - .1            Operating time:
    - .1            Minimum 30 minutes.
  - .2            Battery:
    - .1            Sealed maintenance free.
    - .2            10 year life expectancy.
  - .3            Charger:
    - .1            Solid state, multi-rate type.
    - .2            Voltage/current regulated.
    - .3            Inverse temperature compensated.
    - .4            Short circuit protected and reverse polarity protected.
  - .4            Complete with sealed dust tight relay, solid state transformer, low voltage disconnect and test switch.
  - .5            Complete with integral voltage sensing relays as required.
  - .6            Complete with diagnostic LED indicator lights (25 year): Battery Disconnected, Charge Failure, Service Alarm, AC 'On' and Charge High Rate.
  - .7            Complete with 6cct. Fuse panel.
  - .8            Complete with twist lock plug
  - .9            Complete with two adjustable 6 watt, 12 volt LED MR16 emergency lighting heads.
  - .10          CSA C22.2 No. 141 Certified.
  - .11          Supply Voltage: 120V

- .12 Output Voltage: 12V
- .13 Capacity: as indicated on drawings. Refer to emergency battery unit schedule on drawings.
- .14 Mounting: hardwired complete with mounting shelf.
- .2 Remote Emergency Lighting Heads:
  - .1 6 watts per head.
  - .2 Voltage: 12V
  - .3 CSA-C22.1-1994 Certified double head.
  - .4 LED MR16 lamp.
- .3 Voltage Sensing Relay:
  - .1 Relays to be pre-wired by the factory within their respective battery bank enclosure.
  - .2 Each zone to have "push-to-test" pushbutton and pilot light mounted on the battery bank enclosure.
  - .3 Each zone pushbutton shall be clearly identified to the corresponding branch lighting circuit being monitored.
- .4 Lamps:
  - .1 Lamps to be 6 watt MR16 LED lamp type with minimum 540 lumens output.
  - .2 Efficacy to be minimum 106 lumens per watt.
  - .3 Beam angle min./max between 30° -35°.

### Part 3 Execution

#### 3.1 INSTALLATION

- .1 Mount battery units with the bottom of the enclosure not less than 2100mm above the floor, where practicable.
- .2 Junction box for hardwire connection shall not be less than 2400mm above the floor where practical and shall not be more than 600mm from the unit.
- .3 Connect emergency lighting battery banks to the lighting circuit in the area they serve.
- .4 Ensure voltage drop between battery units to remote lamps does not exceed manufacturer's recommendations and, in no case shall it exceed 5%. Provide minimum #10awg cu. wire.
- .5 Aim heads to illuminate path of egress. Re-adjust when instructed by Consultant or authority having jurisdiction.
- .6 Install heads such that failure of a single lamp will not leave the area in total darkness.
- .7 Record on as-built drawings the installed wire sizes to each remote head.

3.2 VOLTAGE DROP TESTING

- .1 Measure & record the voltage and percentage of voltage drop at each remote head & submit to the Engineer for review immediately upon energization of the power system.

3.3 RE-ADJUSTMENT

- .1 The emergency lighting system may require re-adjustment due to the addition of obstructions or by the authority having jurisdiction. Make allowances for the re-aiming & relocations as may be necessary to provide the required illumination over the entire means of egress.

END OF SECTION

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- |        |  |
|--------|--|
| Part 1 | General  |
| 1.1    | REFERENCES   |
| .1     | CAN/CSA C22.2 No.141, Unit Equipment for Emergency Lighting.   |
| 1.2    | SHOP DRAWINGS AND PRODUCT DATA   |
| .1     | Submit product data in accordance with Section 01 33 00 - Submittals.  |
| .2     | Submit product data sheets for exit lights. Include product characteristics, performance criteria, physical size, limitations and finish.  |
| 1.3    | WASTE MANAGEMENT AND DISPOSAL  |
| .1     | Separate and recycle waste materials in accordance with Section 01 74 21 - Construction Waste Management And Disposal, and with Waste Reduction Workplan.  |
| .2     | Collect and separate plastic, paper packaging and corrugated cardboard and place in designated areas for recycling.  |
| .3     | Direct unused metal material and banding to metal recycling facility as approved by Consultant.  |
| .4     | Place materials defined as hazardous or toxic waste in designated containers.  |
| .5     | Ensure emptied containers are sealed and stored safely for disposal away from children.  |
| Part 2 | Products   |
| 2.1    | SERVICE, PROCESS AND BACK OF HOUSE ROOMS   |
| .1     | Exit signs: to NBCC 2010 – National Building Code of Canada.   |
| .2     | Housing: Gasketed fibreglass housing certified NEMA-3R for industrial applications.  |
| .3     | Exit signs to operate with an input voltage of 120Vac/12Vdc and consume less than 2.3 watts for single and double face legends.  |
| .4     | The light source shall be long-life, high-output light-emitting diodes (LED). The LED's shall provide illumination in normal and emergency operation and shall be mounted inside the frame, not on the face.   |
| .5     | The legend pictogram and arrows shall have the shape and colours green and white as per the Standard ISO 7010. The pictogram and arrows shall be sized for a height of minimum 150mm, including the green contour. The whole legend (green and white colours) shall be trans-illuminated and shall meet the luminance criteria of the Standard ISO 3864-1. |
| .6     | Face: Sealed, vandal resistant polycarbonate.  |



- .7 Face: single or double face with directional arrows as required.
- .8 Mounting: universal mounting, ceiling, end or wall mount as required.
- .9 Types: as indicated on schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Install exit lights in accordance with NBC.
- .2 Connect exit signs to exit light circuits.
- .3 Ensure that exit light circuit breaker is locked in on position
- .4 Connect exit signs to branch circuits and battery banks. Identify circuit breakers feeding exit light circuits and install locking straps to prevent breaker from being accidentally turned off.
- .5 PVC conduit shall not be used with wiring for exit signs.
- .6 Wall mount exit signs where practical. Otherwise mount securely & re-enforce where necessary.

3.2 RE-ADJUSTMENT

- .1 Adjustment to the exit lighting system may be required by the authority having jurisdiction. Such an adjustment can result from the addition of obstructions. Make allowances for relocations of the exit lights after obstructions have been installed.

END OF SECTION

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|--------|---|
| Part 1 | General   |
| 1.1    | GENERAL   |
| .1     | All drawings and all sections of the specifications shall apply to and form an integral part of this section.   |
| .2     | This Section covers items common to Sections of Division 27 and 28 and supplement requirements of Division 01 and 26.   |
| 1.2    | CODE AND STANDARDS  |
| .1     | Do complete installation in accordance with CSA C22.1-21, ANSI/TIA/EIA, J-STD, BICSI, except where specified otherwise.   |
| .2     | While not identified and specified by number in these Divisions, comply with CSA, ANSI/TIA, EIA, BICSI Bulletins in force at time of tender submission. Comply with the requirements of all provincial and local laws, rules, ordinances and codes.   |
| .3     | Communications installation shall be in accordance with current edition of above Code and Standards, Provincial and other codes, rules and regulations. It is not the intention of the drawings and specifications to reiterate the Code and Standards. It is expected that the Contractor will be responsible for methods, types of conduit and cable tray support, fire rating of cables, coordination of ancillary devices, specialty ratings for cable for elevators etc. Notify the Consultant of any detected code deficiencies prior to submission of tender. In the absence of such notifications, it will be assumed that the Contractor has accepted responsibility for a complete code-compliant installation, and no additional compensation will be provided for code-related items. |
| .4     | Supply materials and labour required to meet requirements of codes, rules and regulations, whether or not such work is indicated on the drawings or in specifications.  |
| .5     | Where Divisions 26, 27 and 28 specifies better quality of construction (or materials) than minimum code requirements, the more stringent of the two will be provided.   |
| .6     | Communications installation shall be in accordance with the requirements of the Authority having Jurisdiction and local inspections authority.  |
| 1.3    | CARE, OPERATION AND START-UP  |
| .1     | Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components. Arrange care and instructional sessions to be provided at a time convenient to the Owner.  |
| .2     | Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.  |

- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.
- 1.4 VOLTAGE RATINGS
  - .1 Power supply and equipment to operate satisfactorily at 120V, 60 Hz within normal operating limits established by above standard.
  - .2 All equipment and devices that are installed outdoors to operate in extreme operating conditions without damage to equipment.
- 1.5 PERMITS, FEES AND INSPECTION
  - .1 Furnish Certificates of Acceptance from Authority having Jurisdiction upon completion of work to Consultant. Include copies of certificate in maintenance manuals.
- 1.6 BELL/MTS SERVICE
  - .1 Contact Bell/Manitoba Telephone System, "Neteng Control Centre" to arrange for connection of telephone service demarcation. Contact Telephone number 1-866-756-7642 or (204) 941-4369.
  - .2 Pay all costs to install Bell/MTS Copper and Fibre Optic service for the project.
- 1.7 DEFINITIONS
  - .1 The following are definitions of terms and expressions used in the Specification:
    - .1 Access Floor means a system of completely removable and interchangeable floor panels that are supported on adjustable pedestals or stringers (or both) to allow access to the area beneath.
    - .2 Backbone Pathway means the portion of the pathway system that permits the placing of main and high-volume cables between the entrance location and all cross-connect points within the building and between buildings.
    - .3 Bend Radius means maximum radius that a cable can be bent to avoid physical or electrical damage or cause adverse transmission performance.
    - .4 Bonding means the permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.
    - .5 EMT means Electrical Metallic Tubing, thin wall metal tubing that does not have threaded ends, which is widely used in electrical distribution systems and as a pathway for telecommunications cabling.
    - .6 J-Hook means a supporting device for horizontal cable that is shaped like a J, It is attached to building structures.
    - .7 Ladder Rack means a device similar to a cable tray but more closely resembles a single section of a ladder and is constructed of metal with two sides affixed to horizontal cross members.

- .8 Pull String means a cord or wire placed within a cable pathway and used to pull wire and cable through the pathway.
- .9 Space means an area used for housing the installation and termination of telecommunications equipment and cable.
- .10 Under floor raceway means a pathway placed within the floor and from which wires and cables emerge to a specific floor area.
- .11 Utility Column means an enclosed pathway extending from the ceiling to furniture or to the floor that forms a pathway for telecommunications cable.
- .12 Telecommunications Outlet Box means  
A housing used to hold telecommunications outlet/connectors.
- .13 Electrical Divisions refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and /or on drawings is responsibility of Electrical Contractor, unless otherwise noted.

#### 1.8 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into operation and maintenance manuals. Operation and maintenance manuals shall be submitted to Owner in time to be used in the commissioning of the project.
- .2 Include detail of design elements, construction features, components function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .3 Include technical data, product data; supplement by bulletins, component illustration, exploded views, technical description of items, and parts lists. Advertising or sales literature will not be accepted.
- .4 Include wiring, schematic diagrams and performance curves.
- .5 Include hardware and equipment schedules, verification reports.
- .6 Include name and addresses of local suppliers, vendor representatives, installers and integrators for items included in maintenance manuals.
- .7 Maintenance manuals shall be submitted to Consultant for review. Manuals that are incomplete shall be returned to electrical subcontractor for completion. Completed manuals must be submitted, to the satisfaction of the Consultant, before final payment may be considered to be due.

#### 1.9 SUBMITTALS

- .1 Submit shop drawings, product data and samples for review by Consultant. Manufacturer of equipment must not commence until shop drawings have been reviewed.
- .2 The Contractor shall submit product data sheets for all systems including Sub-contractor manufacturer qualification certificates.

- .3 The Contractor shall provide a list of installation personnel for each system, including vendor and manufacturer training certificates.
- .4 Prior to full scale cable testing, the contractor shall submit the Cable tester calibration certificates indicating the tester(s) have been calibrated within 30 days. The Contractor shall also submit a copy of the Nominal Velocity of Propagation (NVP) calibration test result and a minimum of 10 actual test results in the tester equipment data format and hard copy for approval of actual method of testing.
- .5 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.
- .6 Include wiring, riser, single line and schematic diagrams.
- .7 Include wiring drawings or diagrams showing interconnection with work of other sections.
- .8 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done 'By Others' or 'By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.
- .9 Provide field dimensions required by electrical supplier and sub-subcontractors. In cases where fabrication is required prior to field dimensions being available, check all related drawings and obtain clarification from Engineer if necessary.
- .10 Shop drawing submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing.
- .11 Each drawing submission to bear following signed stamp, and include name of project, equipment supplier and clause number equipment is specified under.

CONTRACTORS CERTIFICATION

This drawing has been reviewed by

(firm name)

All dimensions have been checked and found compatible with the contract

drawings and all capacities, quantities, sizes and other data contained in the

contract documents have been listed by the supplier on this drawing and have

been checked by the undersigned and found correct.

Date

Per

- .12 Review of the shop drawings by the Consultant shall not relieve the Contractor from responsibility for errors and omissions therein.
- .13 Shop drawings reflecting additional design or change in design shall be reviewed by the Consultant.
- 1.10 EQUIVALENT MATERIALS AND EQUIPMENT
  - .1 Bidder shall submit a tender based on the specified materials and equipment only.
  - .2 Bidders may submit a tender based on equivalent material and equipment, only if such items have been approved as equal by the Consultant.
  - .3 Refer to Section 01 23 10 for alternate prices information
  - .4 Request for equal submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing in the left hand margin. Every clause of the applicable specification section must be individually marked indicating details of how compliance is met or, how the non-compliance items should be considered equal.
  - .5 Submittal list will be returned and may be picked up at the Consultant's office when directed by the Consultant. Where submissions are not returned by the Consultant before tender or forty (40) working hours before close of tender, they are considered not approved.
  - .6 The approval of equivalent products will be granted on the basis of general design only. Such approvals will not relieve the electrical trade from providing all necessary components and functions required in the specifications or on the drawings.
  - .7 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done 'By Others' or 'By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.
- 1.11 CASH ALLOWANCES
  - .1 Refer to General Conditions for further requirements under this section.
- 1.12 ALTERNATE PRICES
  - .1 Do not include alternate price in base bid. Refer to Section 01 23 10.
  - .2 Refer to General Conditions for further requirements under this section.
- 1.13 PRICING OF CHANGES AFTER TENDER
  - .1 Within a week of contract award, the Electrical Contractor shall submit an itemized cost breakdown for labour, including an hourly rate for foreman (or journeyman) for all work

to be performed on changes of the Contract (PCNS). Refer to General Conditions for further requirements under this section.

- .2 The Electrical Consultant reserves the right to review costing using acceptable pricing standards based on RSMeans "normal" pricing guide. Refer to Section 27 05 01 "Supplementary Components and Revisions - Communications".

#### 1.14 FIELD QUALITY CONTROL

- .1 The contractor is required to furnish all labor, supervision, tooling, miscellaneous mounting hardware and consumables for each cabling system installed. The contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their manufacturer/warranty contract agreement, to support 15-Year (minimum) Performance Warranty requirements. After installation, the Contractor shall submit all documentation to support the warranty in accordance with the manufacturer's warranty requirements, and to apply for said warranty on behalf of the customer. The warranty will cover the components and labor associated with the repair/replacement of any failed link, within the warranty period.

- .2 Qualifications

- .1 General Requirements:

- .1 Communications, AV and Security Installers must have a minimum of Class M Limited – Voice, Data Video – Electrical License issued by the Government of Manitoba.
    - .2 The Contractor shall comply with all Specifications under Division 27 and Division 28 together with, but not limited to the applicable Codes, Standards, and Guidelines listed in this section.
    - .3 The Contractor shall provide technical services in compliance with the labour standards.
    - .4 The Contractor shall hire sub-contractors that specialize in specific Communication and Security systems.

- .2 Installer – Structured Cabling

- .1 Must be an active member of BICSI (Building Industry Construction Services) with good standing.
    - .2 For the personnel who will be working on-site, a minimum of two (2) technicians with one or more of the following BICSI credentials:
      - .1 Installer 1
      - .2 Installer 2, Copper
      - .3 Installer 2, Optical Fiber
      - .4 Technician
    - .3 The Copper and Optical Fiber Structured Cabling under Division 27 and Division 28 shall be installed by the same Structured Cabling Contractor trained and certified by the approved Manufacturer, unless noted in the

specifications and drawings that it will be provided by other Contractors or by Owner.

.3 Installer – Audiovisual Systems

- .1 Must be an active member of AVIXA (formerly InfoComm) with good standing.
- .2 For the personnel who will be working on-site, a minimum of two (2) technicians with one or more of following AVIXA credentials:
  - .1 CTS
  - .2 CTS-I

1.15 INTERFERENCE DRAWINGS

- .1 The Telecommunication systems drawings are intended to indicate the general extent of the work, arrangement of equipment, sizes of conduits, cable trays, etc.
- .2 The Contractor shall provide interference drawings of congested locations where required by notes on the drawings, and/or where required in order to perform the work efficiently for mechanical and electrical, telecommunication, Security and Safety systems.
- .3 Equipment dimensions shown on the Contract Documents are based upon a selected manufacturer's published data in each case. Ensure that equipment by alternative manufacturers, if selected, will fit within the allotted space with adequate room for access and servicing, and make any required adjustments to conduits, cable trays and/or equipment layouts.

1.16 RECORD DOCUMENTS

- .1 Submit project documents in accordance with Division 01 - General Conditions.
- .2 Allow for computer aided drafting (CAD) of original drawings to show as constructed information. Submit three (3) copies of the maintenance manuals to the owner, in 3-ring binders. Include a copy of all inspection and testing certificates, shop drawings, name/ address/phone # of each supplier, contractor and engineer, table of contents, and a copy of project "as-built" drawings in an envelope at the back of the binder and electronic files on a USB stick. Include all costs in contract. CAD files can be obtained from consultant.
- .3 The Contractor shall keep a set of white prints on the job site at all times on which he shall record all additions or deviations from the contract documents including all changes covered by addenda, change orders, field changes, job conditions, etc. A set of drawings shall be utilized for each system and the contractor shall obtain prints as required. Drawings to include locations of all junction and pull boxes, routing of cables and conduits, and changes to patch panel identification numbers.



- .4 All principle below grade or inaccessible conduits, systems, etc. shall be dimensioned at each change in direction. All conduit routes not shown by the Consultant on original drawing shall be shown including pull boxes, zoned conduit runs, etc.
- .5 The Contractor shall provide one set of clean red line marked-up drawings for approval and a final set with changes as may be requested by the Consultant.
- .6 If corrections are required after the second Consultant review, due to missing information, the Electrical Subcontractor shall be responsible for the Consultant's time to indicate the required corrective measures and all courier and printing costs.
- .7 The Contractor is responsible for the total cost of mylars, and white prints taken from mylars, and electronic files.
- .8 Corrected, revised "Mylars", white prints, electronic files, etc. will be forwarded to the Owner by the Consultant. Final payment on the contract will not be made until correct mylars, and files are prepared and submitted to the Owner.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Contractor shall utilize a manufacturer's end to end solution for structured cabling meaning all components are from a single manufacturer that will warranty the whole Structured Cabling system (i.e., from terminal blocks and patch panels to the work area outlet and equipment outlets, including equipment cords and patch cords) The following manufacturers are approved for the project, additional products may be considered provided it meets the specifications and is approved by the Engineer.
  - .1 Belden (REVConnect 3600)
  - .2 CommScope (Systemax)
  - .3 Leviton (Atlas X1)
  - .4 Panduit (Mini Com)
- .2 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .3 Telecommunication equipment shall be new and of the type and quality specified.
- .4 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .5 Provide labour, materials, transportation, equipment and facilities, etc. required for the complete communication installation as indicated or can be reasonably implied from the drawings and specifications.
- .6 Provide "factory assembled" racks, cabinets and component assemblies.

## 2.2 MAINTENANCE MATERIAL

- .1 Provide all maintenance materials as outlined in Section 27 05 01 "Supplementary Components and Revisions – Communications".

## 2.3 FIRE STOPPING

- .1 Refer to Section 07 84 00 for all fire stopping requirements.
- .2 Provide approved fire stopping systems and smoke seals for all electrical penetrations at all fire rated walls and floors to maintain the integrity of wall/floor fire rating being penetrated.

## Part 3 Execution

### 3.1 PROCEDURE SCHEDULE

- .1 All communication work shall be coordinated with Owner and sub-trades involved. Manner and areas of work shall be pre-arranged prior to proceeding.
- .2 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate and inform Consultant of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### 3.2 INSTALLATION

- .1 Install empty raceway system, including underfloor, overhead, surface distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service raceways, miscellaneous and positioning material to constitute complete system.

### 3.3 INSTALLATION OF VOICE/DATA CABLING

- .1 An authorized telecommunications installer shall be used for the supply, installation, configuration and testing of the cabling system.
- .2 The following sub-contractor is approved for installation of the cabling system;
  - .1 Belden
    - .1 Turnkey Networks Inc.
    - .2 Wescan.
    - .3 Tri-Star.
    - .4 McCaine.

- .5 Exco.
  - .2 CommScope
    - .1 Canem Systems
    - .2 McCaine Electric
    - .3 G.A. Cabling Services
    - .4 Tristar Technical
    - .5 Wescan Electric
    - .6 Exco Electric Ventures
  - .3 Panduit
    - .1 Turnkey Networks Inc.
    - .2 G.A. Cabling Services.
    - .3 Tri-Star.
  - .4 Leviton
    - .1 McCaine.
    - .2 Allco.
- 3.4 INSTALLATION OF ELECTRONIC SECURITY EQUIPMENT/CCVS
  - .1 An authorized Security/CCVS installer shall be used for the supply, installation, configuration and testing of the Security/CCVS system.
  - .2 The following sub-contractor is approved for installation of the Electronic Security and Safety Equipment and CCVS system;
    - .1 The following sub-contractor is approved for installation of the system;
      - .1 PSB Integration.
      - .2 National Industrial Communications.
      - .3 Or approved equal.
- 3.5 INSTALLATION OF CLOCK/PA/INTERCOM
  - .1 An authorized installer shall be used for the supply, installation, configuration and testing of the clock/PA/Intercom system.
  - .2 The following sub-contractor is approved for installation of the Clock/PA/Intercom system;
    - .1 The following sub-contractor is approved for installation of the system;
      - .1 PSB Integration.
      - .2 National Industrial Communications.
      - .3 Or approved equal.
- 3.6 INSTALLATION OF A/V EQUIPMENT
  - .1 An authorized installer shall be used for the supply, installation, configuration and testing of the A/V system.
  - .2 The following sub-contractor is approved for installation of the A/V system;
    - .1 The following sub-contractor is approved for installation of the system;

- .1 PSB Integration.
- .2 National Industrial Communications.
- .3 Or approved equal.

### 3.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver all materials to the site in an orderly fashion.
- .2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials to be left in shipping containers until required for use.
- .3 Provide additional protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment and as directed by the Consultant.

### 3.8 WORKMANSHIP

- .1 Install equipment, conduits and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Consultant. Install conduit and cable runs parallel and perpendicular to building lines, in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.
- .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearance and accessibility for same.
- .3 Include in the work all requirements shown on the shop drawings or manufacturer's installation instructions.
- .4 Replace work unsatisfactory to the Consultant without extra cost.

### 3.9 PROTECTION

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

### 3.10 SEPARATION FROM OTHER SYSTEMS

- .1 Provide the following separation from Electrical Power systems installed in conduits:
  - .1 50mm from circuits of 300Volt and less.
  - .2 600mm from circuits 300Volt and higher.
  - .3 2 Metres from Circuits between 600V and 15KV.
  - .4 3 Metres for circuits above 15KV.
  - .5 300mm clear space above cable trays.
  - .6 600mm access space adjacent to the cable trays.
  - .7 150 mm below cable trays.
  - .8 Electrical systems cannot share the same cable tray or be racked on the same support structure.

3.11 HEIGHTS OF COMMUNICATIONS SYSTEM OUTLET BOXES

- .1 Heights of Communications system Outlet Boxes:
  - .1 Telecommunications outlets, 400mm AFF (same as adjacent receptacles)
  - .2 Telecommunications outlets above counter 150mm
  - .3 Telecommunications outlet above counter back splash 100mm
  - .4 Telecommunications outlet located in Mechanical room 1200mm AFF
  - .5 Wall Mounted Telephones, 1200mm AFF.
  - .6 Standard CATV outlet, 400mm AFF (same as adjacent receptacles)
  - .7 Intercom Sub-stations: 1300 mm AFF

3.12 LOCATION OF OUTLETS

- .1 Locate outlets as indicated. Ensure that floor boxes and conduits are in place and coordinated with other trades prior to concreting.
- .2 Do not install outlets back-to-back in wall, allow minimum 400 mm (16") clearance between boxes.
- .3 Do not share telecommunications device boxes, pull boxes, conduits and cable trays with electrical systems.
- .4 Change location of outlets at no extra cost provided distance does not exceed 3 m (10'-0") in radius and information is provided before drywall has been placed.
- .5 Drawings are schematic only, coordinate mounting height and location of all equipment with architectural, mechanical and structural drawings prior to installation.
- .6 Vertically align outlets of different systems when shown in close proximity to each other and occur at different mounting heights using manufactured mounting brackets.

3.13 SYSTEM IDENTIFICATION LABELING

- .1 Refer to Section 27 05 53 – Identification for communications systems.

3.14 TESTING AND COMMISSIONING

- .1 Refer to the following Specifications and related Contract Documents and comply with the Testing and Commissioning requirements applicable to this Section, but not limited to:
  - .1 Section 27 08 01 - Communications Testing Requirements.

END OF SECTION

- Part 1            General
  - 1.1            RELATED WORK
    - .1            Refer to all Sections of the Specification for related work.
  - 1.2            SECTION INCLUDES
    - .1            Grounding and Bonding for Communications Systems
  - 1.3            SYSTEM DESCRIPTION
    - .1            The Telecommunications grounding and bonding system is to be used for all telecommunications infrastructure. Telecommunications grounding and bonding is additional grounding system installed specifically for telecommunications systems.
    - .2            Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
    - .3            Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
    - .4            Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.
  - 1.4            REFERENCES
    - .1            Building Industry Consulting Services International (BICSI)
      - .1            BICSI TDMM, Telecommunications Distribution Methods Manual, Latest Edition, Volumes I & II
      - .2            BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
    - .2            Canadian Standards Association (CSA)
      - .1            CSA C22.1, Canadian Electrical Code (CEC), Part I,
      - .2            CSA C22.2 No. 0.4, Bonding and Grounding of Electrical Equipment
    - .3            Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
      - .1            TIA-607-B-2011, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
  - 1.5            SUBMITTALS
    - .1            Submit shop drawings and product data in accordance with Section 27 05 00 – Common Work Results for Communications.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

1.7 DEFINITIONS

- .1 TMGB (Telecommunications Main Grounding Busbar). A Copper Ground reference busbar, typically installed in the entrance facility or entrance room, and is bonded to the service equipment ground (power) ground by the interconnecting bonding conductor.
- .2 GE (Grounding Equalizer). The Conductor that interconnects elements of the Telecommunications Grounding Infrastructure.
- .3 TGB (Telecommunications Grounding Busbar). A Copper Ground Reference Busbar, typically installed in Telecommunications Rooms(TR) and is bonded to the TMGB by the TBB. The TGB references metallic entities in the TR space to ground.
- .4 TBB (Telecommunications Bonding Backbone) An insulated copper conductor that interconnects the TMGB to TGB's.
- .5 BCT (Bonding Conductor for Telecommunications): A conductor that interconnects the telecommunications bonding infrastructure to the buildings service equipment ground.
- .6 EC (Equipment Bonding Conductor) A insulated copper conductor that bonds metallic items and equipment to the TMGB and TGB.
- .7 RBC (Raceway Bonding Conductor) A insulated copper conductor that provided a separate bond for the Cable tray System.
- .8 Bonding: The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

Part 2 Products

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBARS (TMGB)

- .1 A Pre-drilled electroplated copper Busbar with holes for use with standard 2 hole lugs with standard NEMA bolt hole sizing and spacing.
- .2 Sized accordance with the immediate connection requirements with a minimum of 4 extra sets of holes.
- .3 Minimum size of 6mm thick, 103mm high and variable in length.
- .4 Include Insulated standoff supports.
- .5 Listed by a nationally recognized testing laboratory.
- .6 Acceptable Products:
  - .1 Panduit GB4B0612TPI-1,
  - .2 Cable-Talk CT-BIBB 4X10-12 T, TMGB-A16L19PT

2.2 TELECOMMUNICATIONS GROUNDING BUSBARS (TGB)

- .1 A Pre-drilled electroplated copper Busbar with holes for use with standard 2 hole lugs with standard NEMA bolt hole sizing and spacing.
- .2 Sized accordance with the immediate connection requirements with a minimum of 4 extra sets of holes.
- .3 Minimum size of 6mm thick, 53mm high and variable in length.
- .4 Include Insulated standoff supports.
- .5 Listed by a nationally recognized testing laboratory.
- .6 Acceptable Products:
  - .1 Panduit GB2B0306TPI-1,
  - .2 Cable-Talk CT-BIBB 2X10-12 T, TMGB-A16L08PT

2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (BCT)

- .1 All bonding conductors shall be stranded Insulated copper, sheath colour green exposed sheaths shall be FT-4 rated, if located in a Plenum space the sheath shall be FT-6 rated, authorization is required for alternate methods.
- .2 The BCT shall be stranded insulated copper, sheath colour green, No. 3/0 AWG.
- .3 The GE shall be stranded insulated copper, sheath colour green, No. 3/0 AWG.
- .4 The TBB shall be stranded insulated copper, sheath colour green, No. 3/0 AWG.



- .5 The EC shall be stranded insulated copper, sheath colour green, No. 6 AWG.
- .6 The RBC shall be stranded insulated copper, sheath colour green, No 6 AWG.
- 2.4 TELECOMMUNICATIONS BONDING BACKBONE (TBB)
  - .1 Minimum of 3/0AWG copper conductor, green insulated, marked to: TIA-607.
- 2.5 GROUNDING EQUALIZER (GE)
  - .1 Minimum of 3/0 AWG copper conductor, green insulated, marked to: TIA-607.
- 2.6 BONDING CONDUCTOR TERMINATIONS
  - .1 Two-Hole compression lugs, long barrel type, sized as per AWG of cable.
  - .2 High conductivity wrought copper.
  - .3 Electro tin plated
  - .4 Hole spacing as per TMGB and TGB.
- 2.7 INSULATED CONDUIT GROUND BUSHINGS
  - .1 Each Metal Conduit originating in the Telecom Entrance Facility, Telecom Room or Equipment Room shall be directly connected to the TMGB or TGB via a compression lug.
  - .2 Each Metal Conduit connected to the device box feed from the cable tray shall be bonded to the cable tray grounding via grounding clamp.
  - .3 Ground bushing shall be insulated.
- 2.8 BONDING AND GROUNDING CLAMPS
  - .1 All ground wires originating at the TMGB or TGB shall be clamped to the plywood backboard "B" ground wire clamps.
  - .2 Shall be mechanically galvanized ASTM B695
  - .3 7/32 hole diameter
- 2.9 CABLE TRAY BONDING CLAMPS
  - .1 Shall be constructed of malleable iron
  - .2 Zinc plated
  - .3 Shall allow for clamping of ground wire of multiple gauges.

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Install all Bonding Conductors as per CEC. And manufacturers recommended installation procedures.

3.2 INSTALLATION OF COMMUNICATIONS GROUNDING SYSTEM.

- .1 Install TMGB or TGB's for each Telecom room.
- .2 Install TMGB and TGB's Adjacent to the Cable Entrance Sleeves, 50mm from the corner and 150mm AFF. Conduits containing Bonding Conductors shall terminate 50mm above or below the finished ceiling.
- .3 Bushings shall be installed at ends of conduit. The TBB shall be clamped at 300mm intervals through the telecom room, routing thru telecom rooms shall be free air but neatly clamped at 300mm intervals attached to the backboard. Routing of bonding conductors shall not impede equipment installation on walls.
- .4 Bonding Conductors shall be continuous unbroken and routed in a direct route to point of termination.
- .5 Bonding conductors shall not be bent less than 10 times the outside diameter of the conductor.
- .6 Clean TMGB and TGB's with a no-ox compound prior to terminating conductors.
- .7 Label all Telecommunications Bonding Conductors as close as possible to their termination point IAW ground bus bar detail and labeling schedule.
- .8 Bond the TMGB to the Service Equipment Ground, using the most direct route to minimize conductor length using conductor size indicated for the BC.
- .9 Bond all TGB's to TMGB using Conductor size indicated for the TBB or GE.
- .10 When Multiple TBB's are used in a multistory building they shall be bonded together on the top floor and at every third floor, at a minimum, using the bonding conductor size indicated for the GE.
- .11 All bonding conductors that originate at the TMGB or TGB shall be connected via a 2-hole compression Lug on each end to ground the metallic parts.
- .12 Bond the following with the conductor size as indicated for EC to the TMGB or TGB located in Telecom Space that the TMGB or TGB is located in:
  - .1 Telecommunications Panel boards directly to the Alternating Current Equipment Ground Bus.
  - .2 Building structural steel
  - .3 Metallic Equipment Racks (can be bonded to Cable tray)
  - .4 Cable Shields

- .5 Primary protection module cases.
  - .6 All Metallic raceways and cable tray for Telecommunications cabling extending from the same room or space where the TMGB or TGB is located.
  - .7 Each Metallic conduit or sleeve individually connecting to the ground bushing with a 2-hole compression lug.
  - .8 Other metallic parts as required by the CEC.
  - .9 Static Dissipative flooring.
  - .13 TBB shall be continuous and unbroken; an irreversible crimp connector shall be used to service TGB's in the vertical plane.
  - .14 Ground Secondary Telecommunications System to TMGB/TGB.
- 3.3 BONDING CONDUCTORS GENERAL
- .1 When placed in ferrous metallic conduit or EMT longer than 1 m but not exceeding 30 m, bond to each end of conduit or EMT using grounding bushing 6 AWG copper conductor. Adjust size longer than 30 m according to Canadian Electrical Code.
- 3.4 BONDING TO TMGB
- .1 Bond all Communications, AV and Security metallic raceways in Main Electrical Room, Telecommunications Entrance Facility, and Main Telecommunications Room to TMGB using a minimum of 6 AWG copper conductor, green insulated.
  - .2 For Communications, AV and Security cables within Main Electrical Room, Telecommunications Entrance Facility, and Main Telecommunications Room having shield or metallic member, bond shield or metallic member to TMGB using a minimum of 6 AWG copper conductor, green insulated
  - .3 Bond equipment cabinets, racks, and metallic enclosures located in Main Electrical Room, Telecommunications Entrance Facility, and Main Telecommunications Room to TMGB using a minimum of 6 AWG copper conductor, green insulated.
- 3.5 BONDING TO TGB
- .1 Bond metallic raceways in Telecommunications Rooms to TGB using a minimum of 6 AWG copper conductor, green insulated.
  - .2 For cables Telecommunications Rooms having shield or metallic member, bond shield or metallic member to TGB using a minimum of 6 AWG copper conductor, green insulated.
  - .3 Bond equipment cabinets, racks, and metallic enclosures located in Telecommunications Rooms to TGB using a minimum of 6 AWG copper conductor, green insulated.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the Specification for related work.

1.2            SECTION INCLUDES

- .1            Hangers and supports for Communications Systems
- .2            Conduit Pull Boxes and Outlet Boxes for Communications Systems
- .3            Cable Trays for Communications Systems
- .4            Non-rated Cable Pass-Through

1.3            SYSTEM DESCRIPTION

- .1            The pathway for inside plant communications systems consists of the hangers, supports, conduit and cable tray infrastructure that comprises the vertical and horizontal route of telecommunications cabling. The pathway provides a facility for the placement of telecommunications cabling.

1.4            REFERENCES

- .1            Building Industry Consulting Services International (BICSI)
  - .1            BICSI TDMM, Telecommunications Distribution Methods Manual, Latest Edition, Volumes I & II
  - .2            BICSI OSPDRM, Outside Plant Design Reference Manual, Latest Edition
- .2            Canadian Standards Association (CSA)
  - .1            CSA C22.1, Canadian Electrical Code (CEC), Part I,
  - .2            CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .3            CSA C22.2 No. 45[M1981 (R2003), Rigid Metal Conduit.
  - .4            CSA C22.2 No. 56-[04], Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .5            CSA C22.2 No. 83-M1985 (R2003), Electrical Metallic Tubing.
  - .6            CSA C22.2 No. 211.2-M1984 (R2003), Rigid PVC (Unplasticized) Conduit.
  - .7            CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).
- .3            National Electrical Manufacturers Association (NEMA)
  - .1            NEMA FG 1, Fibreglass and Cable Tray Systems.
  - .2            NEMA VE 1, Metal Cable Tray Systems.
  - .3            NEMA VE 2, Cable Tray Installation Guidelines.

- .4 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA-569-C-2012, Telecommunications Pathways and Spaces.
  - .2 TIA-606-B-2012, Administration Standard for Commercial Telecommunications Infrastructure.
- 1.5 SUBMITTALS
  - .1 Submit shop drawings and product data in accordance with Section 27 05 00 – Common Work Results for Communications.
  - .2 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6 DELIVERY, STORAGE AND HANDLING
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.
- Part 2 Products
- 2.1 CONDUIT, PULL BOXES AND OUTLET BOXES FOR COMMUNICATIONS SYSTEMS
  - .1 Metallic Conduit
    - .1 Provide EMT conduits for systems listed below for all areas.
    - .2 Hot galvanized with a vibrant top coat for easy identification and durability
    - .3 Excellent mechanical protection for conductors
    - .4 Ductility for faster and easier bending
    - .5 E-Z Pull™ interior finish provides a smooth interior surface for fast, less labor-intensive wire-pulling
    - .6 EMF shielding characteristics
    - .7 Certified to CSA C22.2 No. 83.1 and manufactured in accordance with ANSI C80.3
    - .8 Minimum Sizes:
      - .1 Communications (Voice & Data): 27 mm
      - .2 Copper and Optical Fibre Backbone: 78 mm
      - .3 Public Address: 21 mm

- .4 Intercom: 21 mm
- .5 AV (Audiovisual): 50 mm
- .6 Access Control: 21 mm
- .7 Video Surveillance: 21 mm
- .8 Intrusion: 21 mm
  
- .9 Installed above ceilings under access floors and in walls only, not acceptable for in floor use.
  
- .2 Conduit Fittings
  - .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
  - .2 Ensure factory "ells" where 90 degrees bends for NPS 1], 25 mm and larger conduits.
  - .3 Compression-type and Watertight connectors and couplings.
    - .1 Set-screws are NOT acceptable.
  
- .3 Expansion Fittings for Rigid Conduits and Poured in Concrete
  - .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200, 100 mm linear expansion.
  - .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
  - .3 Weatherproof expansion fittings for linear expansion at entry to panel.
  
- .4 PVC Conduit
  - .1 Is not acceptable unless in slab and in concrete/masonry wall and only with prior written approval of the Engineer.
  
- .5 Flexible Metal Conduit
  - .1 Acceptable for use with Public Address system from Speaker Baffle Box to pull box only.
  - .2 Use minimum 21mm trade size conduit for Public Address system as indicated.
  
- .6 Pull Boxes
  - .1 Shall be made of code gauge steel and shall have a rust resistant finish.
  - .2 Shall be constructed in accordance with Canadian Standards Association.
  - .3 Pull Boxes for Secure and Security systems shall have keyed alike lockable covers and shall not have pre-punched knockouts.
  - .4 Shall NOT be used for splicing cables.
  - .5 Pull box minimum sizes to be as per table below:

MINIMUM PULL BOX SIZES		
Conduit size entering/leaving pull box (mm)	Dimensions (Length, Width, Depth) (mm)	Width increase for additional conduit (mm)
27	103 x 103 x 76	53

35	152 x 152 x 102	76
41	200 x 200 x 103	102
53	305 x 305 x 152	127
63	457 x 457 x 152	152
78	508 x 508 x 200	152
91	610 x 610 x 200	152
103	610 x 914 x 200	200

- .7 Outlet Boxes for Telecommunications systems
  - .1 Shall be a minimum size of 127mm x 127mm x 76mm deep.
  - .2 Shall have a raised Plaster adapter ring sized for a single gang opening for Telecommunications Outlets.
  - .3 Shall have raised plaster adapter ring sized for Access Control devices.
  - .4 Use FS or FD boxes when subject to dust and water.
  - .5 Acceptable Manufacturer: Randl Industries Inc. Part #T-55017 or approved equal,

## 2.2 CABLE TRAY

- .1 Basket Style Cable Tray (horizontal and backbone cabling spaces):
  - .1 Shall be a pre-fabricated structure, minimum 300 mm wide by 103mm tall consisting of a Basket bottom within basket two side rails.
  - .2 Shall be supported as per manufacturer's instruction and applicable codes.
  - .3 Proper manufactured fittings; accessories and fittings such as elbow, reducers, crossovers, tees, water fall or vertical down, L-bracket, shelf support, splice kit, risers will be used for any change of direction, height or size of the basket cable tray.
  - .4 Separate metallic dividers shall be provided to separate Communications Systems in Tray for Telecom Systems.
  - .5 Acceptable Products:
    - .1 Cablofil, Canadian Electrical Raceway (CER),
    - .2 Hubbell, Cooper B-line
- .2 Ladder style cable runway (Telecom rooms):
  - .1 Colour: Shall match the final colour of the ceiling space.
  - .2 Sizing: Size cable tray to maximum cable fill of 25%.
  - .3 Minimum Width: 600 mm (24 in.)
  - .4 Minimum Depth: 100 mm (4 in.)
  - .5 Shall be made up of rigid, prefabricated support structures
  - .6 Shall have a minimum of two (2) grounded metallic barrier to separate voice & data, AV, and security UTP cabling.
  - .7 Shall be free of burrs, sharp edges and projections that can damage the cable's insulation.

- .8 Complete with the following fittings for changing the direction i.e., elbows, reducers, crossovers, and tees.
- .9 Complete with Manufacturer-supplied accessories i.e., covers, hold-down devices, dropouts, conduit adapters, and grounded metallic dividers.
- .10 Support and installation shall be compliant to NEMA VE2
- .11 Acceptable Product:
  - .1 Chatsworth Products (CPI) Cable Runway
  - .2 EATON REDI-RAIL Runway

## 2.3 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

### .1 APPROVED HANGERS AND SUPPORTS

- .1 Cable tray shall be supported by Cantilever brackets, Trapeze Brackets, or individual rod suspension, Supports shall be approved types of wall brackets or trapeze hangers. Additional bracing may be required for seismic restraints.
- .2 Conduits entering a room shall be appropriately racked on a trapeze support suspended from the structure.
- .3 Cable tray shall be supported via Manufactures brackets, or supports manufactured on site using u channel, meeting all the manufacturers' requirements for loading.
- .4 Conduits shall be independently supported, free from any other mechanical system.
- .5 Conduit and cable tray support systems shall be securely and adequately installed to preclude movement of conduit and cable tray during pulling operations.
- .6 J-hooks will be used as secondary pathway for voice and data cabling installation in the accessible raised floor and T-bar ceiling space. J-hooks are to be spaced at a maximum of 500mm in raised floor and 1000mm in T-bar ceiling space. Contractor to ensure cable sag between cable hooks is no more than 150mm at the mid-span for raised floor and 200mm for T-bar ceiling.
- .7 J-Hooks to be as follows:
  - .1 Steel J-Hooks over-molded with 2" wide polypropylene base support for an easy cable slide, burr free surface
  - .2 Snap-lock retainer to firmly secure cables
  - .3 CUL Listed, complies with UL 2043, RoHS Compliant, T1A Compliant
  - .4 Plenum Rated, UV Resistant and Eco Friendly Finish
  - .5 As manufactured by Platinum Tools type HPH series or approved equal

## 2.1 NON-RATED CABLE PASS-THROUGH

- .1 Designed for use in non-fire rated pathway to provide air and smoke sealing, acoustical protection and cable management and aesthetics.
- .2 Acoustical sealing to reduce sound transmission through barriers.
- .3 General sealing for smoke, odor or indoor air quality



- .4 Reduction in movement of particulate air
- .5 Provide infection control
- .6 Two piece design with integrated wall flange is easily installed through a 102mm diameter hole in barriers up to 204mm thick.
- .7 Reference standards:
  - .1 ANSI/TIA-1179-2010 "Healthcare Facility Telecommunications Infrastructure Standards".
  - .2 ANSI/TIA-569 "Commercial Building Standard for Pathway's and Spaces".
- .8 Acceptable product: STI smoke and acoustical EZ-Path series or approved equal.

## 2.2 FIRE-RATED CABLE PASS-THROUGH

- .1 Designed for use in fire rated pathway to provide 1, 2, 3 or 4 hour fire ratings for fire protection, cable management and aesthetics.
- .2 All data, video, and communications cable bundles shall utilize an enclosed fire rated pathway device wherever said cables penetrate rated walls and floors. The fire-rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall firestop materials
- .3 Two piece design with integrated wall flange is easily installed through a 152mm diameter hole in barriers up to 204mm thick.
- .4 Reference standards:
  - .1 ANSI/TIA-1179-2010 "Healthcare Facility Telecommunications Infrastructure Standards".
  - .2 ANSI/TIA-569 "Commercial Building Standard for Pathway's and Spaces".
- .5 Acceptable product: STI fire rated EZ-Path series or approved equal.

## Part 3 Execution

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Install all systems as per the CEC and manufacturers recommended installation procedures.
- .2 Ground and bond all conduits and cable tray in accordance with section 27 05 26.
- .3 Provide separate conduit system for each Telecommunications Systems, but not limited to:
  - .1 Voice & Data Systems
  - .2 Intercom Systems

- .3 Public Address System
  - .4 CATV Systems.
  - .5 Audiovisual Systems
  - .6 Access Control System
  - .7 Video Surveillance System
  - .8 Intrusion Alarm System
- 3.2 INSTALLATION OF HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS.
- .1 Support Cable tray of approved types of wall brackets, trapeze supports. Plumbers perforated straps are not permitted means of supports.
  - .2 Centre hung or spine cable tray is not acceptable for telecommunications cabling.
  - .3 Conduits and equipment shall be independently supported, free from any other mechanical system.
  - .4 Conduit and Cable Tray support systems shall be securely and adequately installed to preclude movement of conduit and cable tray during pulling operations.
  - .5 Telecommunications outlet boxes shall not be placed back to back with another telecommunications outlet box or any other box.
  - .6 Maximum Height for installed telecommunications systems is 3353mm.
  - .7 Only Communications system can be attached to the trapeze supports of the cable tray.
  - .8 Power or mechanical controls shall not be attached to Telecommunications Racking.
- 3.3 INSTALLATION OF J-HOOKS.
- .1 J-hooks shall be installed in a manner in which the J-hooks are installed free of any other systems, such as ceiling suspension system, mechanical or electrical system.
- 3.4 INSTALLATION OF CONDUIT, PULL BOXES AND OUTLET BOXES FOR COMMUNICATIONS SYSTEMS.
- .1 Conduit Installation Requirements
    - .1 All Communications systems shall be installed in conduit or cable tray unless otherwise indicated.
    - .2 The inside radius of a bend in conduit shall be not less than 10 times the internal diameter of the conduit.
    - .3 All Conduits shall be identified and labelled at both ends. Tags shall identify start and finish of conduit.
    - .4 A Maximum of one Telecommunications outlet per 27mm conduit run.
    - .5 Back to back or offset outlets shall not be used.
    - .6 Device box outlets for telecommunications shall not be shared with electrical device box.
    - .7 All Conduits shall originate in the Telecommunications room, pull box or cable tray.
    - .8 Conduits shall be rigidly and adequately fastened to withstand pulling tensions as per manufacturer's recommendations.
    - .9 Conduits must follow building lines.

- .10 90-degree LB, LL, LR, or condulets shall not be used in any instance for telecommunications cabling.
- .11 A pull box shall be installed in conduit runs where:
  - .1 The length of conduit is over 30 metres
  - .2 There are more than two 90-degree bends
- .12 Offsets or kicks are to be considered 90 degree bend for telecommunications
- .13 Conduits protruding through the floor shall be terminated 25-50 mm above the finished floor.
- .14 Riser sleeves protruding through the floor shall be terminated 25-75mm above the finished floor, including sleeve and bonding bushing.
- .15 Conduits entering and exiting through the ceiling of a Telecommunications Room (TR) shall protrude into the room 25-50mm above the 2400mm level.
- .16 All zone conduits entering a TR (unless otherwise stipulated will protrude into the TR from 25-50 mm without a bend.
- .17 The maximum fill rate authorized for conduits is 40 percent.
- .18 Pull boxes shall not be installed higher than 3353mm above finished floor. Approval of this deviation is on a case by case basis.
- .19 Telecommunications conduits shall NEVER be run over:
  - .1 Boilers
  - .2 Incinerators
  - .3 Hot Water lines
  - .4 Steam lines
  - .5 Electrical rooms and Closets
  - .6 Washrooms
- .20 All Conduits shall use the trapeze hanger method to support the conduits, shall us threaded rod not less than 3/8" diameter.
- .21 Install pull string in all conduits and cable tray tied at both ends for installation by Voice data system contractor.
- .22 All conduit shall be reamed to eliminate sharp edges and terminated with insulated bushings.
- .2 Pull Box Installation requirements
  - .1 In all instances pull boxes shall be placed in straight sections of a conduit run and shall NOT be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings shall not be used in place of pull boxes. Conduits shall always protrude in the direction of pull. Conduits shall not exit the sides bottom or back of the pull box.
  - .2 All Communications system conduits including Public Address and Electronic Security and Safety Systems shall follow the requirements of this section.
  - .3 Pull boxes shall be placed in an exposed location, and readily accessible. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged panel. If the pull box is installed above a

- suspended type ceiling a green indicator dot shall be placed on ceiling t-rail to indicate the location of pull box.
- .4 All Boxes shall be adequately secured. They shall not be supported by the conduits entering the box.
- .5 Riser cables and Telecommunications outlet cannot share the same conduit system or pull boxes.
- .3 Outlet Box installation requirements
  - .1 Install Telecommunications Outlet boxes for voice data systems same level as adjacent receptacles and flush to the wall wherever possible.
  - .2 Where Telecommunications Outlets are installed in steel stud type systems, provide additional cross bracing and or straps to make the installation completely rigid prior to the application of the wall facing material.
  - .3 Back to back and offset outlets shall not be used.
  - .4 Apply appropriate acoustic sealing as necessary on back of telecommunications outlet boxes to ensure the STC rating is maintained.
  - .5 Ensure conduits are installed not to de-rate the STC rating of the wall.
  - .6 Ensure Outlet Box is mechanically bonded to the Conduit system.
  - .7 Conduits must enter the outlet box from the top or bottom.

END OF SECTION

- Part 1            General
  - 1.1            RELATED WORK
    - .1            Refer to all Sections of the Specification for related work.
  - 1.2            SECTION INCLUDES
    - .1            Identification of Pathways Systems
    - .2            Identification of Grounding Systems
    - .3            Identification of Racks
    - .4            Identification of Faceplates cables and patch panels
    - .5            Identification of Backbone cabling
    - .6            Identification of Underground Ducts and Raceway systems
  - 1.3            SYSTEM DESCRIPTION
    - .1            The identification and labelling system is crucial for the efficient operation and maintenance of the Telecommunications, AV and Security systems. The system infrastructure elements include spaces, pathways, bonding and grounding, equipment racks, cabinets, cables, and connecting hardware. The system equipment include network switches, servers, routers, service provider equipment, power systems, and a host of peripheral systems equipment.
  - 1.4            SUBMITTALS
    - .1            Submit shop drawings and product data in accordance with Section 27 05 00 – Common Work Results for Communications.
    - .2            Include full size samples of each labelling category for review and approval.
    - .3            Include excel or word document file of all proposed labelling and identification.
  - 1.5            DELIVERY, STORAGE AND HANDLING
    - .1            Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
    - .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
    - .3            Storage and Handling Requirements:

- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PATHWAY SYSTEMS LABELS

- .1 Provide Thomas and Betts stick-on conduit markers for the following systems. Markers to be:

- .1 Style A 57.2 mm x 228.6 mm.
- .2 Style B 28.6 mm x 114.3 mm.
- .3 Style C 12.7 mm x 57.2 mm.

- .2 Space markers 10 metres on centres maximum for exposed conduits and conduits in accessible ceiling spaces and, in addition, attach markers before and after all barriers, where conduits pass through closets, cupboards, stairwells, etc., and adjacent to all panels, cabinets, pullboxes and access fittings. Markers to be laminated mylar with orange background and black letters. Identify systems as follows:

GROUND CONDUCTOR	VOICE/DATA
ACCESS CONTROL	INTRUSION ALARM
DATA PROCESSING	MONITORING SYSTEM
INTERCOM	FIRE ALARM
TELEVISION	CCVS

Others: Check with Consultant. All conduit systems shall be identified.

- .3 All stick-on conduit markers must be installed during installation of related conduit systems, not after installation of complete conduit systems.
- .4 Do not apply stick-on conduit markers onto exposed wiremold raceways.
- .5 Provide stick on markers for the following systems:
  - .1 CABLE TRAY LABELS
    - .1 Style A.
  - .2 CONDUIT LABELS
    - .1 Style B for 25 mm conduit and larger.
    - .2 Style C for conduit under 25 mm.
  - .3 GROUNDING BUSBAR LABELS
    - .1 Style B.

## 2.2 CABLE MARKERS

- .1 Provide Thomas and Betts stick-on vinyl self-laminating cable markers for all horizontal cables. Markers to be machine printed labels 19mm high x 12.7mm long 6.35mm print area c/w white Colour, adhesive backed wraparound text.
- .2 Install markers at ends of cables.

## 2.3 GROUND SAFETY LABELS

- .1 Provide Thomas and Betts yellow colour, green writing, non-adhesive backed, rigid plastic tag .
- .2 Shall be pre-manufactured label 50mm high x 75mm long.
- .3 Printed with the following text in BOLD "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CONTACT THE BUILDING TELECOMMUNICATIONS MANAGER".

## 2.4 TELECOM RACK AND CABINET MARKERS

- .1 Provide Laminated phenolic nameplates with engraved white letters on black.
- .2 Lamacoid nameplates: 3mm (1/8") thick plastic engraving sheet, white faced, black core, mechanically attached with shelf-tapping screws or split rivets, unless otherwise specified.
- .3 Lamacoid 50mm high x 100mm long, white in Colour, with black Text 25mm high.
- .4 Provide Lamacoid nameplates for the following systems:
  - .1 Telecom Rack.
  - .2 Telecom Cabinet.

## Part 3 Execution

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Install all labels to ensure Machine printing does not rub off under normal wear
- .2 Label conduit/cable tray system for the following systems:
  - .1 Voice/Data
  - .2 CATV Systems.
  - .3 Intrusion Alarm Systems
  - .4 Access Control System
  - .5 Clock System
  - .6 Public Address System

- .7 Video Surveillance
  - .8 Underground ducts at maintenance holes and MTR.
- .3 Primary/Secondary Colour for Communications Systems:
  - .1 Voice/Data Conduits and Cable Tray: Colour Green
  - .2 CATV System: Green/White
  - .3 Intrusion Alarm: Green/Grey
  - .4 Access Control: Green/Brown
  - .5 Public Address System: Green/Blue
  - .6 Clock System: Green/Purple
  - .7 Video Surveillance: Green/Black
- .4 Label all conduits at point where visibly where conduit enters wall, at all pull boxes and couplings for each system in the colours indicated.
- .5 Label all Cable tray at 50mm from each connection and transition in the colours indicated for each system
- .6 Wall Mount IDC Colour for Communications Risers and Voice services:
  - .1 Demarcation Point from Service Provider: Orange
  - .2 Owner network connection from Service Provider: Green
  - .3 Termination point from PBX, LAN or MUX: White
  - .4 First Level Backbone: Purple
  - .5 Second Level Backbone: Grey
  - .6 Horizontal Cable: Blue
  - .7 Interbuilding: Brown
  - .8 Auxiliary Circuits, alarms, maintenance, security and misc: Yellow
  - .9 Key Telephone systems: Red
- 3.2 PULL BOX LABELING
  - .1 Label Pull Boxes with Primary and Secondary colouring
- 3.3 CABLE TRAY LABELING
  - .1 Label Cable Tray with Primary and Secondary colouring
- 3.4 TGB/TMGB LABELING
  - .1 Label TMGB/TGB IE: TGB TR-XXX.
- 3.5 COPPER BACKBONE LABELING
  - .1 Label Copper Backbone Cables at point where cable enters the Telecom Room or Main Telecom Room as indicated on Drawings.



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- 3.6            MULTI MODE FIBRE BACKBONE LABELING
- .1        Label Multi Mode Backbone Cables at point where cable enters the Telecom Room or Main Telecom Room as indicated on drawings.
- 3.7            SINGLE MODE FIBRE BACKBONE LABELING
- .1        Label Single Mode Backbone Cables at point where cable enters the Telecom Room or Main Telecom Room as indicated on drawings.
- 3.8            RACK LABELING
- .1        Label Racks in Each Telecom Room or Main Telecom Room. IE: TR-XXX R1, R2, R3.
- 3.9            PATCH PANEL LABELING
- .1        Label patch panels Each Telecom Room or Main Telecom Room. IE: A, B, C, D etc.
- 3.10           PATCH PANEL PORT LABELING
- .1        Label all ports in patch panel for each Telecom Room or Main Telecom Room. 1-X.
- 3.11           HORIZONTAL CABLING LABELING
- .1        Label all horizontal cables 25mm from each end with the patch panel and telecom room designation each Telecom Room or Main Telecom Room. IE: TR-XXX 2E01.
- 3.12           TELECOM OUTLET FACEPLATE LABELING
- .1        Label all faceplates with TR Designator and label each port with Rack/Patch panel Designator patch panel. IE: TR-XXX, Ports 2E01, 2E02, 2E03, 2E04.
- 3.13           GROUND SAFETY LABELING
- .1        Label all Bonding conductor connections to either the TGB or TMGB with Bonding conductor safety label.

END OF SECTION

- Part 1            General
- 1.1            RELATED WORK
- .1          Refer to all Sections of the Specification for related work.
- 1.2            SECTION INCLUDES
- .1          Testing of Grounding and Bonding for Communications Systems
- .2          Testing of Communications Horizontal Cabling.
- .3          Testing of Communications Connecting cords, Devices and Adapters
- 1.3            SYSTEM DESCRIPTION
- .1          Commissioning of Communications Systems shall be conducted with the Engineer for each system listed. Detailed operation and training for each system shall be conducted.
- 1.4            QUALITY ASSURANCE
- .1          Qualifications:
- .1          Installers and Technicians conducting testing and commissioning shall be factory-trained on the use of the Manufacturer's test equipment. The Contractor shall provide proof of this certification ten (10) business days prior to testing method approval.
- .2          Prior to full scale cable testing, the contractor shall submit the Cable tester calibration certificates indicating the tester(s) have been calibrated within 30 days. The Contractor shall also submit a copy of the Nominal Velocity of Propagation (NVP) calibration test result and a minimum of 10 actual test results in the tester equipment data format and hard copy for approval of actual method of testing.
- Part 2           Test Definitions
- 2.1            GENERAL
- .1          Unless otherwise specified herein, all testing definitions, parameters, methods, and practices shall comply with the references listed in section 1.3.
- .2          Unless otherwise indicated, a permanent link test shall be performed on all horizontal cabling installed under the project and on existing cabling that are re-terminated, rerouted, and where the termination is disturbed to perform work under the project.
- .3          A permanent link test shall be performed on all horizontal cabling regardless of those outlets receiving data or voice circuits. Channel tests are not required.

- .4 One week prior to scheduled cutover date the Engineer shall receive from the contractor printed and electronic copper cable test results. Cutover shall not commence unless test results are submitted.

## 2.2 UTP HORIZONTAL LINK DEFINITION FOR THE PROJECT

- .1 A link consists of up to 90 meters of horizontal cabling, a connection at each end, up to 2 meters of test equipment lead from the main unit of the hand-held tester to the local connection, and up to 2 meters of test equipment lead from the remote unit to the remote connection. A total length of up to 94 meters.
- .2 The connection to the equipment at each end of the link is not included in the link definition.

## Part 3 Execution

### 3.1 DOCUMENTATION

- .1 The test reports shall include the information shown below, unless otherwise approved by the Engineer. The italicized information on the report is example information and is variable. Customize the information for the particular installation.
- .2 The following header fields on each test report shall contain the appropriate information. These are minimum requirements.
  - .1 Circuit ID
  - .2 Test Result
  - .3 Owner
  - .4 Serial Number
  - .5 Injector Serial Number
  - .6 Software Version
  - .7 Date
  - .8 Cable Type
  - .9 NVP
  - .10 Building
  - .11 Telecom Room
- .3 The information in each user definable header field on each test report shall contain the information as follows.
  - .1 Circuit ID: Indicate the Pair and patch panel under test
  - .2 Owner: Indicate the owner of the test equipment
  - .3 Date: Indicate the date of the test
  - .4 Cable Type: Indicate the cable type being tested
  - .5 NVP: Indicate the field measured NVP
  - .6 Building: Indicate the building where the cable is being tested

- .7 Telecom Room: Indicate the Telecom Room identifier where the cable is terminated
  - .4 The Contractor shall provide the test data in a complete and consistent format. All results shall be printed from a laser printer. Provide the printed results contained in 3" three-ring notebook binders. The test results shall be three-hole punched and numerically ordered by outlet location number within the notebook. Provide separate notebooks for each telecom room and Link Test results. Multiple volumes may be necessary. Separate all FAIL test results in each notebook from the PASS test results. Provide summary sheet of all results. Provide a separator tab labeled "Fail Results" in front of the sheets of FAIL test results. Provide a separator tab labeled "Pass Results" in front of the sheets of PASS test results.
  - .5 The cover of the notebook shall read (italicized information is variable):
    - "PROJECT NAME"*
    - building name "(BLDG. No. x)"*
    - "(SYSTEM) Test Results"*
    - "Volume No." X*
    - date (month and year)*
  - .6 The contractor shall verify that a report for each jack in the Project is contained in the notebooks.
  - .7 Electronic Copy
    - .1 The electronic copy of the test results shall be on CD and USB Stick.
    - .2 Disks shall be labeled. The label shall read:
      - "PROJECT NAME"*
      - building name (BLDG. No. x)*
      - "(System) Test Results on Disk"*
      - "Disk No." X of x*
      - date (month and year)*
    - .3 The files on disk shall be in Comma Separated Variable (CSV) file format and the Native Tester data file format. PDF's of all test results and a summary shall also be provided.
- 3.2 TESTING - COMMUNICATIONS
- .1 Test horizontal UTP cables as specified below and correct deficiencies:
    - .1 Perform tests for Permanent Link on installed cables, including spares:
      - .1 Category 5e using certified level IIe tester to: TIA/EIA-568-[B.1].
      - .2 Category 6 using certified level III tester to: TIA/EIA-568-[B.2].

- .2 Perform tests for Channel on [20]% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than [5]% of tested cables fail, test remaining cross-connected data cables.
  - .1 Category 5e using certified level IIe tester to: TIA/EIA-568-[B.1].
  - .2 Category 6 using certified level III tester to: TIA/EIA-568-[B.2].
- .2 Test backbone UTP cables as specified below and correct deficiencies:
  - .1 Perform tests for Permanent Link on 4-pair cables:
    - .1 Category 5e using certified level IIe tester to: TIA/EIA-568-[B.1].
    - .2 Category 6 using certified level III tester to: TIA/EIA-568-[B.2].
  - .2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568-[B.1].
- .3 Test Optical-fiber strands for attenuation to: TIA/EIA-568-[B.1] and correct deficiencies:
  - .1 Test horizontal links need at only one wavelength (850 nm or 1300 nm) and in one direction.
    - .1 Attenuation to be less than 2.0 dB, unless consolidation point is used.
    - .2 If consolidation point is used, attenuation test result to be less than 2.75 dB when testing between horizontal cross-connect and telecommunications outlet/connector.
  - .2 Test backbone links in both directions. Backbone links:
    - .1 Test multi-mode fibre at both applicable wavelengths (850 nm and 1300 nm).
    - .2 Test single-mode fibre at both applicable wavelengths (1550 nm and 1310 m).
  - .3 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.
    - .1 Multi-mode-fiber attenuation coefficients:
      - .1 3.5 db/km @ 850 nm; and
      - .2 1.5 db km @ 1300 nm
    - .2 Single-mode fibre attenuation coefficients at both 1310 nm and 1550 nm:
      - .1 1.0 db/km for inside plant cable; and
      - .2 0.5 db/km for outside plant cables.
    - .3 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the Specification for related work.

1.2            SECTION INCLUDES

- .1            Communications Cabinets, Racks, Frames, and Enclosures
- .2            Communications Termination Blocks and Patch Panels
- .3            Riser and Incoming Conduit Seals
- .4            Communications Cable Management and Cable tray
- .5            Communications Rack Mounted Power Protection and Power Strips
- .6            Uninterruptable Power Supply

1.3            REFERENCE STANDARDS

- .1            American National Standards Institute/Telecommunications Industry Association (ANSI/TIA)
  - .1            ANSI/TIA-568-C.0-1-[2010], Generic Telecommunications Cabling for Customer Premises.
  - .2            ANSI/TIA-568-C.1-[2009], Commercial Building Telecommunications Cabling Standard.
  - .3            ANSI/TIA-568-C.3-[2008], Optical Fiber Cabling Components Standard.
  - .4            ANSI/TIA-569-B-[2004], Commercial Building Standard for Telecommunications Pathways and Spaces.
- .2            CSA International
  - .1            CSA C22.2 No.214-[08], Communications Cables (Bi-national standard, with UL 444).

1.4            SYSTEM DESCRIPTION

- .1            The Main Telecom Room (MTR) contains cables, connecting hardware, protection devices and other equipment required to connect the outside plant or Telecom room facilities to premise cabling. The components within this room may be used for public or private network connections. The Demarcation point between service providers and the customer owned premise cabling is located in this room.
- .2            The Telecommunications Spaces will be enclosed spaces consisting of areas and rooms e.g., Entrance Facility (EF), Main Telecommunications Room (MTR), Telecommunications

Rooms (TRs), Telecommunications Enclosures (TEs), and Equipment Rooms that will accommodate telecommunications equipment, cabling system terminations, cross-connections, and interconnections.

- .3 The Telecommunications Spaces contain cables, connecting hardware, protection devices and other equipment required to connect the outside plant or Telecom Room facilities to premise cabling. The components within this room will be used for public and/or private network connections. The Demarcation Point between service providers and the customer owned premise cabling will be located in this room.
- .4 Pathways entering and existing the Telecommunication Spaces will have modular and re-enterable firestop systems.
- .5 Each building to be serviced by at least one (1) Main Telecommunications Room (MTR) and each floor will have at least one (1) Telecommunications Room (TR).

## 1.5 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 27 05 00 – Common Work Results for Communications.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## Part 2 Products

### 2.1 COMMUNICATIONS ENTRANCE PROTECTION

- .1 Building Entrance Terminal
- .2 Comply with CSA C22.2, No 226-92
- .3 Available in 25, 50 and 100 Pair configurations
- .4 Include a integral 26 AWG fusible link

- .5 Compatible with 22, 24 and 26 gauge wiring
- .6 Use 4-pin QMP-type protectors
- .7 Compatible with grease filled cables
- .8 Eliminate the need for incoming splice enclosures
- .9 Outside plant cables shall terminate on UMOXS type connectors and be compatible with 22-26 gauge wiring
- .10 Include Factory installed 8m cable stub, ALPLAST, 22 or 24 gauge
- .11 Provide sufficient protector modules and terminals to completely populate all building entrance terminals.

## 2.2 COMMUNICATIONS CABINETS, RACKS FRAMES, AND ENCLOSURES

- .1 Sectional Medium Size Wall Mount Swing-out Racks
  - .1 559mm (22.3") deep by 711mm (28") wide by 889mm (35.00) high wall mount enclosure, 16RU weight capacity shall be <68Kg.
  - .2 Rack shall swing out open for component cabling access, centre section shall pivot either left or right opening. The rack shall consist of a centre section and back pan.
  - .3 Rack shall have 16mm, 21mm, 27mm, and 43mm electrical knockouts in the top and bottom.
  - .4 Rack shall have vented front door.
  - .5 Threaded 10/32 tapped holes and EIA universal standard hole pattern
  - .6 White powder coat finish.
- .2 Sectional Large Size Wall Mount Swing out Racks
  - .1 821mm (32.34") deep by 598mm (23.56") wide by 2572mm (101.25") high wall mount enclosure, 46RU.
  - .2 227Kg Weight capacity wall and floor mounted
  - .3 Zero clearance latches to accommodate racks installed side by side.
  - .4 Threaded 10/32 tapped holes and EIA universal standard hole pattern.
  - .5 Rack shall have vented front door.
  - .6 16 Gauge steel construction.
  - .7 White powder coat finish.
- .3 Telecommunications Cabinets
  - .1 305mm (12") deep by 1219mm (48") wide by 1219mm (48") High Wall Mounted Telecommunications Cabinet
  - .2 16 gauge steel double hinged doors with pull latch for provision of pad locking
  - .3 CSA type 1 Enclosure



- .4 ANSI 61 grey finish.
- .4 Radio Cabling Termination Cabinet
  - .1 610mm (24") wide by 610mm (24") high by 150mm Deep wall mounted termination cabinet.
  - .2 EEMAC /CEMA Type 3R (Weatherproof)
  - .3 Gasketed hinged cover with keyed L handle.
  - .4 Drip Shield.
  - .5 Plywood backpan
  - .6 Wall mounting ears on top and bottom of enclosure.
  - .7 Mild Steel Construction
  - .8 ASA-61 Grey industrial Powder coat finish.
- .5 Active Equipment Wall Mount Enclosure.
  - .1 Wall Mountable with rotating 3RU path panel bracket. Holds 3RU of active equipment.
  - .2 Conduit Knockouts are for routing cables in and out of the enclosure.
  - .3 977.8mm High X 709.2mm Wide X 218.7mm Deep enclosure.
  - .4 Total weight load 150Lbs
  - .5 16 Gauge steel
  - .6 Provided with Fans and Keyed lock.
  - .7 Nema Type 2, Telcordia GR-487-CORE tamper resistance
- 2.3 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS
  - .1 Telecommunications Entrance and Riser Termination Blocks
    - .1 10 Connector mount to accommodate 250 pair Category 3 cables.
    - .2 Manufacturer recommended Management Rings.
    - .3 Shall utilize 25 Pair connector for copper building entrance cable and risers.
    - .4 Shall utilize designation strips, using machine printed labels in the colours designated in CSA-T528, for labelling of all connectors.
  - .2 Copper Riser Cat3/5E Patch Panels
    - .1 Available in both BIX and 110 Configurations
    - .2 Available in 24, 48, 72 and 96 Port Configurations
    - .3 Meets ANSI/TIA/EIA-568-B Category 5E Cabling standard
    - .4 Shall have Category 5E connections in T568A wiring scheme. With a IDC type connector.
    - .5 Shall be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity.
    - .6 Shall have port identification on front and rear.
    - .7 Shall be mounted in 483mm (19") equipment racks.

- .8 Shall include optional rear cable management bars.
- .3 Copper Category 6 Patch Panels
  - .1 Category 6 patch panels shall be AMP NETCONNECT AMPTRAC Connectivity Management System capable.
  - .2 Shall be 2U in height and provide 48 modular jack ports.
  - .3 Patch panels shall be wired to the T568A wiring pattern, and shall accept RJ-45, 8-Position modular plugs.
  - .4 Patch panels shall be configured as 6-port modules with individually replaceable jacks.
  - .5 The patch panel shall be equipped with integrated sensor contacts to enable the AMPTRAC connectivity management system. The sensor contacts shall allow for IDC termination of the I/O cables.
  - .6 Patch panels shall terminate the building cabling on 110-style insulation displacement connectors.
  - .7 The installed system shall comply with TIA/EIA Category 6 performance Requirements as well as the performance characteristics listed in the following table.

Worst-Case Performance Characteristics

Frequency MHz	Insertion Loss Db	Return Loss Db	NEXT Db	FEXT Db
1	0.10	30	75.0	75.0
4	0.10	30	75.0	71.1
8	0.10	30	75.0	65.0
10	0.10	30	74.0	63.1
16	0.10	30	69.9	59.0
20	0.10	30	68.0	57.1
25	0.10	30	66.0	55.1
31.25	0.11	30	64.1	53.2
62.5	0.16	28	58.1	47.2
100	0.20	24	54.0	43.1
200	0.28	18	48.0	37.1
250	0.32	16	46.0	35.1

- .8 Patch panels must be UL Listed under file number E81956.
- .9 Patch panels shall be AMP NETCONNECT part number 1479327-1.
- .4 Riser Rack Mount Fibre Optic Patch Panels
  - .1 All panels and cable trays shall provide cross-connect, interconnect, splicing capabilities and contain cable management for supporting and routing of the fibre cables/jumpers.
  - .2 Shall be supplied in a 48-port configuration.
  - .3 Shall feature a front access design with a hinged cover.
  - .4 Must have built-in bend radius control.
  - .5 Shall be black in colour.
  - .6 Shall be mounted in 483mm (19") equipment racks.

- .7 Fibre optic patch panels shall be sized to permit the termination of all fibres being installed and allow for future growth.
- .8 Patch panels shall be modular to allow the possibility of changing connector types in the future without replacing the entire unit.
- .9 All fibre optic equipment shall be tested after installation to verify that the system meets the loss limit from patch panel to patch panel.
- .5 High Fibre Count Patch Panels
  - .1 Fibre Distribution Units to accommodate 144 ports
  - .2 Accommodates 72 Splices in rear of unit
  - .3 Has locks on front and rear
  - .4 Has available coupling plates in ST, SC, FC and Keystone openings
- .6 Wall Mount Fibre Optic Patch Panels
  - .1 Includes Fibre optic cable routing kit.
  - .2 Accept different application connectors
  - .3 Holds Fibre Adapter Panels
  - .4 Sized to accommodate either 12, 24 or 48 ports.
- .7 Riser Fibre Optic Connectors
  - .1 Ceramic tipped field installed duplex 568SC connectors, which meet or exceed the performance specifications in ANSI/TIA/EIA-568-B.3.
  - .2 Shall be have 62.5/125 Multi-Mode and 9/125 Single mode connectors as required.
- .8 Horizontal Small Form Factor Fibre Optic Connectors
  - .1 Ceramic split sleeve LC Duplex Connectors which meet or exceed the performance specifications in ANSI/TIA/EIA-568-B.3.
  - .2 TIA/EIA-604 FOCIS-10 compliant connectors
  - .3 RJ-45 small form factor duplex jack module
  - .4 50/125 Multi-Mode compatible
  - .5 Shall use the keystone universal adapters
- .9 Horizontal Keyed Small Form Factor Fibre Optic Connectors
  - .1 Ceramic split sleeve FJ Duplex Connectors which meet or exceed the performance specifications in ANSI/TIA/EIA-568-B.3.
  - .2 TIA/EIA-604 FOCIS-6 compliant connectors
  - .3 RJ-45 small form factor duplex jack module
  - .4 50/125 Multi-Mode compatible
  - .5 Segregated systems should have separate keying.

## 2.4 COMMUNICATIONS RISER AND DUCT SEALS

- .1 A pre-manufactured seal capable of providing fire and weather sealing of conduits or riser cables it can be installed before or after placement of cables.
- .2 Consisting of a rear frame and an inner core which allows for accommodation of different cable sizes determined in the field.
- .3 The Seal uses a compression gasket preventing gas or water to ingress from the conduit.
- .4 Acceptable manufacturer: Roxtec, Tyco, Condux

## 2.5 COMMUNICATIONS CABLE MANAGEMENT AND CABLE TRAY

- .1 Cable Management for Relay Racks:
  - .1 Vertical cable management shall be white powder coated finish with hinged access panel.
  - .2 2.1m (83") high, 150mm (6") deep and 125mm (5") wide.
  - .3 If more than one relay rack is used between each rack the centre vertical cable management shall be 2.1m (83") high, 150mm (6") deep and 196mm (7¾") wide.
  - .4 A 2-RU (Rack Unit) Metal hinged door horizontal cable management shall be used above and below each patch panel and shall be white.
  - .5 At the centre from top to bottom of each relay rack 4-RU(Rack Unit) Metal hinged door horizontal cable management shall be installed and shall be white in colour.

## 2.6 Communication rack mounted power protection and power strips

- .1 15 Amp 2 post-Rack Mounted horizontal power bars
  - .1 Shall be 15 amp, 120 volts.
  - .2 Shall be switched.
  - .3 Provide a minimum of two power bars per rack containing active equipment.
  - .4 Complete with a minimum of six (6) outlets.
  - .5 Complete with 1.8 m (6'-0") cord.

## 2.7 UNINTERRUPTABLE POWER SUPPLY

- .1 User interface: Graphical LCD with blue backlight and text in English, French, German, Russian and Spanish
- .2 LEDs: Four status-indicating LEDs
- .3 Topolog: True online, double-conversion
- .4 Diagnostics: Full system self-test
- .5 UPS bypass: Automatic bypass

- .6 Rail kit 4-post rail kit included with all rack mount units
- .7 Remote Emergency Power-off (REPO)
  - .1 Emergency shutdown control through the REPO port
- .8 Electrical input
  - .1 Nominal voltage 120V, 208V, 220–240V
  - .2 Voltage range 120V: 90–138 Vac 208/230V: 160–276 Vac
  - .3 Power draw 3000VA: 25A @120V, 14.5A @208V, 13A @230V
  - .4 Dedicated circuit 120V:breaker rating 3000 VA: 30A
  - .5 Frequency 50/60 Hz
  - .6 Frequency range 45–65 Hz
  - .7 Connection: Nema L5-30P
- .9 Electrical output
  - .1 Power factor 0.9
  - .2 On utility voltage regulation  $\pm 3\%$  of nominal
  - .3 On battery voltage regulation  $\pm 3\%$  of nominal
  - .4 Efficiency  $>95\%$  in high-efficiency mode;  $>86\%$  in online mode
  - .5 Frequency regulation  $\pm 3\%$  Hz online
  - .6 Load crest factor 3 to 1
  - .7 Voltage waveform; Sine wave
  - .8 Load segments: Two configurable, individually controlled receptacles
  - .9 Output Receptacles: (6) Nema 5-20R, (1) Nema L5-30R
- .10 Battery
  - .1 Battery type; VRLA 12V/9 Ah (both internal and external)
  - .2 Battery runtime:  $>3$  minutes with internal batteries @100% load
  - .3 Battery replacement Hot-swappable internal and external batteries
  - .4 Start-on-battery Allows start of UPS without utility input
- .11 Communications
  - .1 Serial port RS-232 standard, for interface to power management software
  - .2 USB port HID standard, for communicating with Windows 98, XP, ME and Vista computers
  - .3 Relay output Common alarm standard
  - .4 Communications slot Optional communication slots (BD Slot, Mini-Slot)
  - .5 Optional SNMP/Web card for direct control and monitoring communication in SNMP-based networks, monitoring of UPS status cards and meters through Web browser interface Relay card for integration to industrial environment and building management systems, remote shutdown for IBM AS/400 systems
- .12 Environmental

- 
- .13 Safety markings 120/208V: UL, CUL, VCCI 230V: CE, GS
  - .14 EMC markings 120V: FCC Class B, EN55022 Class B (1.5 kVA and below); FCC Class A, EN55022 Class A (2.0 kVA and above) 230V: CE (per IEC/EN62040-2: Emissions, Category C1; Immunity, Category C2)
  - .15 Audible noise <50 dB
  - .16 Ambient operating temperature: 0°C (32°F) to +40°C (104°F)
  - .17 Storage: -20°C to +40°C with batteries and temperature -25°C to +55°C without batteries
  - .18 Relative humidity 5–90% non-condensing
  - .19 Acceptable Product: Eaton Powerware PW9130L3000R-XL2U with additional battery for 15 minutes runtime at full load.
- Part 3 Execution
- 3.1 INSTALLATION
- .1 Install equipment in accordance with manufacturer's instructions.
- 3.2 COMMUNICATIONS CABINETS, RACK FRAMES AND ENCLOSURES
- .1 Install cabinets, racks, frames and enclosures in accordance with manufacturer's instructions, and as indicated.
  - .2 Swing out racks will come complete with vertical cable management.
  - .3 Install Telecom Enclosures on 21 mm void free Plywood backing painted on all six sides with fire-retardant white paint. Install 21 mm void free Plywood backing painted on all six sides with fire-retardant white paint inside cabinet to mount equipment.
- 3.3 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS
- .1 Install termination blocks and patch panels in accordance with manufacturer's instructions, and as indicated.
  - .2 Install Termination Block in Telecommunications Entrance Facility on 21 mm void free Plywood backing painted on all six sides with fire-retardant white paint.
  - .3 Install Wall Mounted Patch Panels on 21 mm void free Plywood backing painted on all six sides with fire-retardant white paint inside cabinet or wall.
  - .4 Install Patch Panels in accordance with manufacturer's instructions including all cable management rails and accessories.

- .5 Install Cat3/5E patch panels for risers in each Telecom Room as indicated on schedules. Extra pairs will be terminated at the last ports for ISDN and multi wire circuits. 1 pair will be connected to Pair 1 of each Rj-45 port for voice applications.
- .6 Install Category 6 Patch panels for all Horizontal cabling to the workstation, voice and data cabling will be completely category 6 cabling at the workstation and all horizontal cabling will be installed on patch panels.
- .7 Install high count fibre patch panels for all incoming and riser terminations in the TR. Provide sufficient connector adapter plates to accommodate all openings in the patch panels. Install 568SC Duplex SC type connectors for all incoming and riser connectors in either multi-mode mated with the particular cable type used.
- .8 Install Rack Mounted Fibre patch panels in Telecom Rooms to accommodate Riser coming from the main telecom room and service provider's primary cable. Provide sufficient Duplex 568LC type adaptors to populate entire patch panel regardless of fibre count.
- .9 Ensure all Fibre optic connectors are properly ordered for the cable type used.

#### 3.4 COMMUNICATIONS RISER AND DUCT SEALS

- .1 Install duct seals in all riser conduits leaving the Main Telecom Room. Install seals after placement of ground bushing and associated conduit work has been completed.

#### 3.5 COMMUNICATIONS CABLE MANAGEMENT AND CABLE TRAY

- .1 Install cable management in accordance with manufacturer's instructions. Use manufacturer's recommended support brackets.
- .2 Install 1 – 2RU rack Unit Horizontal Cable Management between each above and below each patch panel. Provide quantities to cover each rack type that patch panels are used.
- .3 Install Vertical cable management in 2-post relay racks. Provide sufficient vertical single and double Cable Management to cover each side of the rack. If more than one relay rack is used between each rack the centre vertical cable management shall be a double wide vertical cable management.

#### 3.6 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

- .1 Install UPS and Power strips in accordance with manufacturer's instructions.
- .2 Install Rack mounted UPS per Rack as shown on rack layouts.
- .3 Install horizontal rack mounted power bars as shown on rack layouts.

END OF SECTION

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**Part 1** General

**1.1** RELATED WORK

- .1 Refer to all Sections of the Specification for related work.

**1.2** SECTION INCLUDES

- .1 Communications Backbone Cabling – Copper
- .2 Communications Backbone Cabling – Optical Fibre

**1.3** SYSTEM DESCRIPTION

- .1 The Backbone Cabling is a part of the Communications Structured Cabling System that shall link the Telecommunications Entrance Facility (TEF), Telecom service provider spaces, Telecommunications Rooms (TRs), Telecommunications Enclosures (TEs), and Equipment Rooms (ERs).
- .2 The Backbone Cabling shall also allow Telecommunication Space connections between floors in a multiple story building and building connections in in a campus or multi-building setting.

**1.4** REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).
  - .2 CSA-C22.2 No. 232, Optical Fiber Cables.
- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  - .2 TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  - .3 TIA/EIA-568-B.3, Optical Fiber Cabling Components Standard.
  - .4 TIA/EIA-606-A, Administration Standard for the Commercial Telecommunications Infrastructure.
  - .5 TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
  - .6 TIA-598 -C, Optical Fiber Cable Colour Coding.

**1.5** SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 27 05 00 – Common Work Results for Communications.



**1.6** DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2** Products

**2.1** COMMUNICATIONS BACKBONE CABLING – COPPER

- .1 TIA-568 Category: Category 3 or higher
- .2 Frequency: 16 MHz
- .3 Nominal Characteristic Impedance: 100 ohm
- .4 AWG Size: 22-24 AWG
- .5 Stranding: Solid
- .6 Number of Pairs: As indicated in the schedules and drawings
- .7 Shielding: UTP
- .8 CSA Flame Test Rating: FT4
  - .1 Provide FT6 when installed in Plenum space and not contained in conduit.
- .9 Application: Indoor
- .10 Armoring: None
- .11 Sheath Colour: Purple

**2.2** COMMUNICATIONS BACKBONE CABLING – OPTICAL FIBRE

- .1 Optical Mode: Multimode
- .2 Core/Cladding: 50/125 microns
- .3 Wavelength: 850 nm
- .4 Minimum Bandwidth: 4700 MHz
- .5 TIA-568 Category: OM4
- .6 Number of Strands/ Fibres: Twelve (12)
- .7 Flame Test Rating: FT6 or OFNR

- .8 Fibre Cable Buffering: Tight-buffered
- .9 Application: Indoor
- .10 Armoring: None
- .11 Sheath Colour: Aqua

**Part 3** Execution

**3.1** INSTALLATION

- .1 Install all Cable in accordance with CEC and manufacturer's instructions.

**3.2** INSTALLATION OF BACKBONE CABLES

- .1 Install backbone cables from each telecommunications room to main terminal/equipment room (MT/ER) as indicated and according to manufacturers' instructions.
  - .1 Identify and label as indicated to: TIA-606.
- .2 Install backbone cables from MT/ER to carrier demarcation point in [Entrance Room] as indicated and according to manufacturer's instructions.
  - .1 Identify and label as indicated to: TIA-606.

**3.3** INSTALLATION OF COMMUNICATIONS BACKBONE CABLING

- .1 Install all cable in accordance with manufacturer's instructions.
- .2 Install cables as indicated on riser diagrams and schedules.
- .3 Terminate Cabling in TEF on IDC wall mounted distribution with other end terminated on patch panels in each connected telecom room or equipment room.
- .4 If Cabling is installed outside conduit in a plenum space for example an equipment room or TEF with under floor distribution install Plenum cabling is required by authority having jurisdiction or the applicable provincial building code.
- .5 Install CMR type cable where building code permits between TEF and equipment rooms and Telecom Rooms all risers cabling will be installed in EMT Conduits.
- .6 Install CMP type cables where building code requires Plenum rated cables.
- .7 Install Inside armored cable where building uses vertical shafts instead of conduits for telecom room distribution, or where installation requires additional mechanical protection.
- .8 All outside plant cabling from the maintenance hole shall be terminated at the building entrance protection and grounded to the grounding lug at the protection terminal.
- .9 Conduct testing in accordance with Section 27 08 01.

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**3.4** COMMUNICATIONS OPTICAL FIBRE BACKBONE CABLING

- .1 Install fibre optic cables in accordance with manufacturer's instructions.
- .2 Install sufficient fibre optic cabling from the TEF to each telecom room to service equipment and spare capacity. Install in Patch Panels as indicated in section 27 11 00 with connectors.
- .3 Install CMR fibre optic cabling where allowed by the building code. Install Fibre optic cabling in its own EMT Conduit directly from the TEF to the Telecom Room Served.
- .4 Install CMP fibre optic cabling in areas where Plenum cabling is required by building code, IE in Access floors where cooling is done by under floor, or where the ceiling space is used as a return air plenum.
- .5 Install Inside armored fibre cable where building uses vertical shafts instead of conduits for telecom room distribution, or where installation requires additional mechanical protection.
- .6 Install Inside indoor/outdoor fibre optic cable where short durations of cable permit using cable for inside and outside applications
- .7 Fusion splice all loose tube outside fibre optic cable with fan-out kit, with connector and patch panels as per Section 27 11 00.
- .8 Conduct testing in accordance with section 27 08 01.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the Specification for related work.

1.2            SECTION INCLUDES

- .1            Horizontal Distribution Cabling, UTP for Communications
- .2            Horizontal Distribution Cabling, UTP for WAPs
- .3            Horizontal Distribution Cabling, UTP for AV/ HDBaseT
- .4            Horizontal Distribution Cabling, UTP for Security
- .5            Horizontal Distribution Cabling, Optical Fibre for Security
- .6            Wall-mount Faceplate for Voice and Data
- .7            Modular Furniture Faceplate for Voice and Data
- .8            Wall-mount Faceplate for Telephone and TTY
- .9            Modular Jack and Plug for Voice and Data, and WAPs
- .10          Modular Jack and Plug for Security
- .11          Cable Bundling Straps

1.3            SYSTEM DESCRIPTION

- .1            Horizontal Cabling shall be a part of the structured cabling system that connects the work area telecommunications outlets, communications, AV and/or physical security field device to the Main Telecommunications Room (MTR) Telecommunications Room (TR) or Telecommunications Enclosure (TE) on a floor.
- .2            The Horizontal Cabling shall be made up of of horizontal distribution cables, jumpers and equipment patch cords, work area cords, termination blocks and patch panels, telecommunications outlets or connectors, multiuser telecommunication outlet assemblies (MUTOAs), transition points, consolidation points and wireless access points (WAPs).

1.4            REFERENCE STANDARDS

- .1            Canadian Standards Association (CSA International)
  - .1            CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).

- .2 CSA-C22.2 No. 232, Optical Fiber Cables.
- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  - .2 TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  - .3 TIA/EIA-568-B.3, Optical Fiber Cabling Components Standard.
  - .4 TIA/EIA-606-A, Administration Standard for the Commercial Telecommunications Infrastructure.
  - .5 TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
  - .6 TIA-598 -C, Optical Fiber Cable Colour Coding.
- 1.5 SUBMITTALS
  - .1 Submit shop drawings and product data in accordance with Section 27 05 00 – Common Work Results for Communications.
- 1.6 DELIVERY, STORAGE AND HANDLING
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.
- 1.7 DEFINITIONS
  - .1 Telecommunications Outlet Box: A housing used to hold telecommunications outlet/connectors.
  - .2 Telecommunications outlet: A connecting device in the work area on which horizontal cable or outlet cable terminates.
  - .3 Work Area: A Building space where the occupants interface with the telecommunications terminal equipment.
  - .4 Work Area Cable: A Cable connecting the telecommunications outlet/ connector to the terminal equipment.

Part 2            Products

2.1            HORIZONTAL DISTRIBUTION CABLING, UTP FOR COMMUNICATIONS

- .1    TIA Category: Category 6
- .2    Frequency: 250 MHz
- .3    CSA Flame Test Rating: FT6
- .4    Shielding: UTP
- .5    Bonding: Bonded Pair
- .6    Colour: Blue.
- .7    Acceptable Product: BELDEN

2.2            HORIZONTAL DISTRIBUTION CABLING, UTP FOR WAPS

- .1    TIA Category: Category 6A
- .2    Frequency: 500 MHz
- .3    CSA Flame Test Rating: FT6
- .4    Shielding: UTP
- .5    Bonding: Bonded Pair
- .6    Acceptable Product: BELDEN
- .7    Colour: Blue.

2.3            HORIZONTAL DISTRIBUTION CABLING, UTP FOR AV/ HDBASET

- .1    TIA Category: Category 6A
- .2    Frequency: 500 MHz
- .3    CSA Flame Test Rating: FT6
- .4    Shielding: UTP
- .5    Bonding: Bonded Pair
- .6    Colour: Blue.
- .7    Acceptable Product: BELDEN

2.4 HORIZONTAL DISTRIBUTION CABLING, UTP FOR SECURITY

- .1 TIA Category: Category 6
- .2 Frequency: 250 MHz
- .3 CSA Flame Test Rating: FT6
- .4 Shielding: UTP
- .5 Bonding: Bonded Pair
- .6 Colour: Purple.
- .7 Acceptable Product: BELDEN

2.5 HORIZONTAL DISTRIBUTION CABLING, OPTICAL FIBRE FOR SECURITY

- .1 Fibre Category: OM4
- .2 Fibre Core Diameter: 50 µm
- .3 Number of Strands: Two (2)
- .4 Flame Test Rating: OFNP
- .5 Application: Indoor/ Outdoor
- .6 Colour: Aqua
- .7 Acceptable Product: CORNING FREEDM One Tight-Buffered Cable, Riser

2.6 WALL-MOUNT FACEPLATES FOR VOICE AND DATA

- .1 Mounting: Recessed
- .2 Gang Opening Type: Single Gang
- .3 Material: Stainless Steel
- .4 Number of Ports: Maximum of four (4). Unused ports shall be covered with blank covers.
- .5 Sloped to allow proper bend radius.
- .6 With Keystone openings.
- .7 Accepts Keystone 8P8C modular jacks.
- .8 Complete with label options.

2.7 MODULAR FURNITURE FACEPLATES

- .1 Application: For Modular Furniture
- .2 Mounting: Recessed
- .3 Material: Stainless Steel
- .4 Number of Ports: Maximum of four (4). Unused ports shall be covered with blank covers.
- .5 Sloped to allow proper bend radius.
- .6 With Keystone openings.
- .7 Accepts Keystone 8P8C modular jacks.
- .8 Complete with label options.
- .9 Colour: Stainless Steel, if not available use Gray or White

2.8 WALL-MOUNT FACEPLATES FOR TELEPHONE AND TTY

- .1 Mounting: Recessed
- .2 Gang Opening Type: Single Gang
- .3 Material: Stainless Steel
- .4 Number of Ports: Minimum of one (1) for wall-mount or desk-mount telephone or TTY.
- .5 Sloped to allow proper bend radius.
- .6 With Keystone openings.
- .7 Accepts Keystone modular jacks.
- .8 Complete with label options.

2.9 MODULAR JACK AND PLUG FOR VOICE & DATA AND WAPS

- .1 Type: 8P8C
- .2 TIA Category:
  - .1 For Voice and Data: Category 6
  - .2 For WAPs: Category 6A
- .3 Colour:
  - .1 Telephone (Analog): White



- .2 VoIP and Data: Blue
  - .4 PIN/ PAIR Assignments: T568A
- 2.10 MODULAR JACK AND PLUG FOR SECURITY
  - .1 Type: 8P8C
  - .2 TIA Category: Category 6
  - .3 Colour: Purple
  - .4 PIN/ PAIR Assignments: T568A
- 2.11 OPTICAL FIBRE CONNECTOR AT WORK AREA AND FIELD DEVICE
  - .1 Type: LC
  - .2 Colour: Aqua
  - .3 Fits into a Keystone opening.
- 2.12 WEATHERPROOF CONNECTORS/FACEPLATES
  - .1 IP67 sealed industrial Ethernet connectors and faceplates.
  - .2 Faceplate shall be stainless steel with 2 openings. Gasket and seal made of chemically resistant material.
  - .3 Shall allow for 2-RJ-45 jacks wired to T568-A scheme.
  - .4 The voice outlet shall be an 8-pin modular, category 6, pinned to ANSI/TIA/EIA 568A wiring scheme. Includes a bulkhead anti-rotation washer, complete with IP67 tethered cap.
  - .5 The data outlet shall be an 8-pin modular, category 6, pinned to ANSI/TIA,EIA 568A wiring scheme. Includes a bulkhead anti-rotation washer, complete with IP67 tethered cap.
  - .6 Must allow for water jet spray with mated cap.
  - .7 Jack part number CJ1688T, faceplate part number CIFP2S-2G, manufactured by Panduit.
- 2.13 CABLE BUNDLING STRAP
  - .1 Type: Industrial Grade Hook and Loop Velcro Straps
  - .2 Application: Networks, Electrical, Air Conditioning, Ducts
  - .3 Width: Minimum of 25 mm (1 in.)

- .4 Colour: Shall match the colour of the cable(s)
- .5 Operating Temp: -17 deg. C to 50 deg. C
- .6 Plenum-rated
- .7 Acceptable Product: Panduit

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Install all systems as per the CEC and manufacturers recommended installation procedures.
- .2 Label all faceplates cables and connectors in accordance with section 27 05 53.
- .3 Test cable for in accordance with section 27 08 01.
  - .1 Refer to Section 27 05 00 for Separation from Electrical Power system installed in conduits.

3.2 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware on wall, in rack, or in cabinet as indicated and according to manufacturers' instructions.
  - .1 Identify and label as indicated to: TIA/EIA-606.
- .2 Install consolidation points, as indicated according to manufacturer's instructions.
  - .1 Identify and label as indicated to: TIA/EIA-606.

3.3 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables as indicated in conduits, perimeter raceways and cable trays from telecommunication spaces to consolidation points, MUTOAs, and individual work-area outlets.
  - .1 Identify and label as indicated to: TIA -606.
- .2 Terminate horizontal cables in telecommunications spaces and at consolidation points, MUTOAs, and individual work-area outlets.
  - .1 Identify and label as indicated to: TIA -606.
- .3 Coil spare cables and store in ceiling space in zone.
- .4 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

### 3.4 OTHER INSTALLATION REQUIREMENTS

- .1 In order for unshielded twisted-pair cabling infrastructure to deliver high-speed performance, it is manufactured to very tight specifications. Consequently, to maintain the unshielded twisted-pair cabling system performance proper installation practices must be followed. Listed below are some requirements that shall be followed:
- .2 Never crush the cable, velcro ties shall be used as per manufacturer's recommendation.
- .3 Use of Velcro cable ties throughout the installation and in the telecom rooms is required.
- .4 Do not kink, knot or snag the cable while pulling, this will cause damage under the jacket and may alter cable performance.
- .5 Do not to exceed the recommended pulling tension.
- .6 Do not exceed the minimum bend of 4 x Outside Diameter (OD) for 4 pair UTP, 10 x OD for multi pair (more than 4 pair) UTP, 1.18 in. for two fibre cable, and 10 x OD for multi-fibre cable.
- .7 Per TIA/EIA 568-A never untwist the pairs of cable beyond the absolute minimum required for termination.
- .8 The cable jacket on UTP shall only be stripped back the minimum required to terminate to connecting hardware.
- .9 Cable management panels shall be used when terminating cable.
- .10 Use the same performance criteria for both cable and connecting hardware through the entire horizontal run.
- .11 Maximum cable lengths shall not be exceeded.
- .12 A maximum 40% fill ratio for all conduit runs or J-hook runs is authorized.
- .13 All horizontal runs, moves, additions, and changes must be documented.
- .14 A single shared sheath at the outlet is not acceptable.
- .15 Provide service loop at end of conduit and at the telecom room to facilitate relocation within the room.
- .16 Only one pin-out (Diagram 1) throughout the total installation (T568A) is allowed.
- .17 Install all cables through primary and secondary pathways. Unless otherwise specified, installation methods and techniques shall satisfy ANSI/EIA/TIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces.

- .18 Where cables are supported from building structure they shall be adequately supported such that the cable will not be damaged by normal building use.
- .19 Horizontal station cables shall be home-run from the communication outlet box at the work area to the distribution frame serving the area as shown on the Drawings.
- .20 Cables shall not be installed or routed in any manner that violates the manufacturer's specifications. Manufacturer's minimum bend radius for static (post installation) cables is 10 times the cable diameter. Manufacturer's minimum bend radius for cables under strain (pulling tension) is 20 times the cable diameter.
- .21 Unless otherwise specified, terminate cables in accordance with ANSI/TIA/EIA-568-A, Commercial Building Telecommunications Cabling Standard, observing the industry standards for terminating colour-coded cables for premises installation (T568A) is aDo not install damaged or defective cable.
- .22 Installed damaged cable will not be accepted. Unless otherwise allowed by the Owner, damaged cable shall be removed and new cable installed at the expense of the Contractor. Damage includes physical damage to the cable and damage that may affect performance. THE OWNER WILL NOT ACCEPT CABLE OF ANY TYPE UNTIL AFTER IT IS INSTALLED AND PASSES A PHYSICAL INSPECTION AND ALL PERFORMANCE TESTS.
- .23 The Contractor shall field survey and review with the Owner and Designer similar installations on campus that contain the same type of materials that are used for this Project to gain the desired routing and layout, installation techniques, and finished-look prior to start of construction and as often as necessary during the construction process.

### 3.5 CABLE SUPPORT ALONG PRIMARY PATHWAY

- .1 Primary pathways include major pathways for cable routed floor-to-floor, through corridors, and pathways that carry cables feeding multiple areas which are likely to be used to support growth in those areas. Primary pathways carry cable to secondary pathways.
- .2 Cables shall be routed to avoid cable crossover between cable continuing vertically floor-to-floor and cable routed horizontally.
- .3 Cable installation and cable routes shall be planned and cables shall be installed such that the capacity of the conduit, sleeves, and cable tray is used most efficiently.
- .4 Bundle and route cables throughout the building to maintain neat, uniform, and combed bundles. Where cable is exposed in vertical runs, such as utility shafts, provide reusable cable straps to neatly contain cable bundles.
- .5 Provide strain relief for cables routed vertically using mechanical fasteners such as conduit, C-channel, reusable cable straps, other necessary devices to support cables.

### 3.6 CABLE SUPPORT ALONG SECONDARY PATHWAY

- .1 Secondary pathways extend from the primary pathway to the communication outlet box. Secondary pathways carry cable from the primary pathway to the communication outlet box.
- .2 Cable shall be routed parallel and perpendicular to walls and floor from the primary pathway to the outlet box. WHERE MULTIPLE ROUTES ARE POSSIBLE ROUTE CABLE ALONG THE SHORTEST ROUTE TO MINIMIZE CABLE LENGTH AS PRACTICABLE.
- .3 Do not use suspended ceiling support hangers (wires) to support station cables.
- .4 Do not support cable from other mechanical, electrical, or plumbing, systems.
- .5 Station cables shall be supported such that they do not rest on the suspended ceiling system.
- .6 Cables and cable pathways shall be supported from the building structure. Superstructure designed and intended to support multiple utilities may be used as a superstructure for communications cables if the superstructure can physically support the additional load and if the support mechanism for the cable works for supporting the cable from the superstructure.

### 3.7 CABLE BUNDLING HARDWARE

- .1 Cable bundling hardware shall be rated for the environment and application in which used. Applications include, but are not limited to, general purpose, outdoor, chemical resistant, flame retardant, high temperature, and vibration.
- .2 Provide reusable cable management straps for bundling and securing horizontal station cables and equipment jumper cables within entrance facilities and telecommunication closets. Do not use nylon cable ties.
- .3 Provide reusable cable management straps for bundling and securing horizontal station cables at primary vertical pathways. Do not use nylon cable ties.
- .4 Do NOT strap horizontal station cable to cable tray and ladder rack.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the Specification for related work.

1.2            SECTION INCLUDES

- .1            UTP Cross-Connect Wire
- .2            UTP Equipment Cable (e.g., PABX)
- .3            Patch Cord - Voice & Data
- .4            Patch Cord - WAP
- .5            Patch Cord – Security
- .6            Telecom Space Equipment Cord – Voice & Data
- .7            Telecom Space Equipment Cord – WAP
- .8            Telecom Space Equipment Cord - Security
- .9            Work Area Equipment Cord - Voice & Data
- .10          Work Area Equipment Cord - WAP
- .11          Work Area Equipment Cord - Security

1.3            SYSTEM DESCRIPTION

- .1            Communications Connecting Cords, Devices and Adapters are pre-manufactured assemblies that make up the Horizontal Cabling to the Telecommunications Equipment.
- .2            Aside from cables and connecting hardware, the Structured Cabling System shall also be made up of equipment cords and patch cords. Equipment Cords and Patch Cords may have some resemblance but they have well defined functions. Patch Cords are usually used to cross-connect passive (non-powered) infrastructure like a patch panel to another patch panel. Equipment Cords are directly connected to active (powered) equipment like network switch, PoE switch, and computers.

1.4            REFERENCE STANDARDS

- .1            Canadian Standards Association (CSA International)
  - .1            CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).
  - .2            CSA-C22.2 No. 232, Optical Fiber Cables.

- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  - .2 TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  - .3 TIA/EIA-568-B.3, Optical Fiber Cabling Components Standard.
  - .4 TIA/EIA-606-A, Administration Standard for the Commercial Telecommunications Infrastructure.
  - .5 TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
  - .6 TIA-598 -C, Optical Fiber Cable Colour Coding.
- 1.5 SUBMITTALS
  - .1 Submit shop drawings and product data in accordance with Section 27 05 00 – Common Work Results for Communications.
- 1.6 DELIVERY, STORAGE AND HANDLING
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.
- Part 2 Products
  - 2.1 UTP CROSS-CONNECT WIRE
    - .1 TIA Category: Category 3 or greater
    - .2 Number of Pairs: One (1)
    - .3 Gauge: 24 AWG
    - .4 Colour: As indicated in the termination schedule or by Owner
  - 2.2 UTP EQUIPMENT CABLE (E.G., PABX)
    - .1 Number of Pairs: 4-pair

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- .2 TIA Category: Minimum of Category 6
  - .3 Pigtail on one end
  - .4 8P8C on one end.
  - .5 Colour: White or Silver
- 2.3 PATCH CORD - VOICE & DATA
- .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6
  - .3 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .4 CSA Flame Test Rating: Minimum of FT4. Use FT6 if located in plenum space.
  - .5 Plug Type: 8P8C
  - .6 Colour: Blue
  - .7 PIN/ PAIR Assignment: T568A
- 2.4 PATCH CORD - WAP
- .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6A
  - .3 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .4 CSA Flame Test Rating: Minimum of FT4. Use FT6 if located in plenum space.
  - .5 Plug Type: 8P8C
  - .6 Colour: Blue
  - .7 PIN/ PAIR Assignment: T568A
- 2.5 PATCH CORD - SECURITY
- .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6
  - .3 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .4 CSA Flame Test Rating: Minimum of FT4. Use FT6 if located in plenum space.



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- .5 Plug Type: 8P8C
  - .6 Colour: Purple
  - .7 PIN/ PAIR Assignment: T568A
- 2.6 TELECOM SPACE EQUIPMENT CORD - VOICE & DATA
- .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6
  - .3 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .4 CSA Flame Test Rating: Minimum of FT4. Use FT6 if located in plenum space.
  - .5 Plug Type: 8P8C
  - .6 Colour: Blue
  - .7 PIN/ PAIR Assignment: T568A
- 2.7 TELECOM SPACE EQUIPMENT CORD - WAP
- .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6A
  - .3 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .4 CSA Flame Test Rating: Minimum of FT4. Use FT6 if located in plenum space.
  - .5 Plug Type: 8P8C
  - .6 Colour: Blue
  - .7 PIN/ PAIR Assignment: T568A
- 2.8 TELECOM SPACE EQUIPMENT CORD - SECURITY
- .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6
  - .3 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .4 CSA Flame Test Rating: Minimum of FT4. Use FT6 if located in plenum space.
  - .5 Plug Type: 8P8C

- .6 Colour: Purple
- .7 PIN/ PAIR Assignment: T568A
- 2.9 WORK AREA EQUIPMENT CORD - VOICE & DATA
  - .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6
  - .3 Length: Minimum of 2 metres.
  - .4 CSA Flame Test Rating: Minimum of FT4. Use FT6 if located in plenum space.
  - .5 Plug Type: 8P8C
  - .6 Colour: Blue
  - .7 PIN/ PAIR Assignment: T568A
- 2.10 WORK AREA EQUIPMENT CORD - WAP
  - .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6A
  - .3 Length: Minimum of 3 metres
  - .4 CSA Flame Test Rating: FT6
  - .5 Plug Type: 8P8C
  - .6 Colour: Shall match the Horizontal Distribution Cable
  - .7 PIN/ PAIR Assignment: T568A
- 2.11 WORK AREA EQUIPMENT CORD - SECURITY
  - .1 Factory-assembled and tested.
  - .2 TIA Category: Category 6
  - .3 Length: Minimum of 3 metres
  - .4 CSA Flame Test Rating: FT6
  - .5 Plug Type: 8P8C
  - .6 Colour: Shall match the Horizontal Distribution Cable

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- .7 PIN/ PAIR Assignment: T568A
- 2.12 OPTICAL FIBRE PATCH CORD - MULTIMODE
- .1 Fibre Category: OM4
  - .2 Factory-assembled and tested
  - .3 Complete with strain relief and dust boot
  - .4 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .5 Connectors: Minimum of LC-to-LC. Verify on-site and match connector on the equipment.
  - .6 Flame Test Rating: Minimum of OFNR (FT4). Use OFNP (FT6) if located in plenum space.
  - .7 Colour: Aqua
- 2.13 OPTICAL FIBRE TELECOM SPACE EQUIPMENT CORD - MULTIMODE
- .1 Fibre Category: OM4
  - .2 Factory-assembled and tested
  - .3 Complete with strain relief and dust boot
  - .4 Length: Minimum of 3 metres. Verify on site and adjust length as required.
  - .5 Connectors: Minimum of LC-to-LC. Verify on-site and match connector on the equipment.
  - .6 Flame Test Rating: Minimum of OFNR (FT4). Use OFNP (FT6) if located in plenum space.
  - .7 Colour: Aqua
- 2.14 OPTICAL FIBRE WORK AREA EQUIPMENT CORD - MULTIMODE
- .1 Fibre Category: OM4
  - .2 Factory-assembled and tested
  - .3 Complete with strain relief and dust boot
  - .4 Length: Minimum of 2 metres. Verify on site and adjust length as required.
  - .5 Connectors: Minimum of LC-to-LC. Verify on-site and match connector on the equipment.
  - .6 Flame Test Rating: Minimum of OFNR (FT4). Use OFNP (FT6) if located in plenum space.

.7 Colour: Aqua

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Coordinate installation of jumpers with owner prior to starting work.
- .2 Provide 2" minimum and 4" maximum service loop in each cross-connect jumper for voice and data circuits at each end.
- .3 Cross-connect jumpers shall be uniform in shape.
- .4 Plan and route cross-connect jumpers for voice circuits and data circuits through the jumper rings on the frames such that they are not intermixed haphazardly. Keep voice and data cross-connect jumpers segregated as possible.
- .5 Test cable for channel in accordance with section 27 08 01.
- .6 Install Patch cable in vertical and horizontal cable management between telecommunications devices and patch panels.
- .7 Provide 2 Work area cords per Telecommunications Outlet and 2 Patch Cords per Telecommunication Outlet.
- .8 Provide Cross Connects as per Owners direction to connect voice services to the Patch Panel.
- .9 Provide 1 Audio Video Patch cable for each connector type for every faceplate in the system.
- .10 Provide 15% spare patch cable, work area cords and ancillary cables of each cable type to owner upon completion of the testing.
- .11 Only one pin-out for work-area cords and patch cords throughout the total installation (T568A) is allowed.

3.2 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware on wall, in rack, or in cabinet as indicated and according to manufacturers' instructions.
  - .1 Identify and label as indicated to: TIA-606.
- .2 Install consolidation points, as indicated according to manufacturer's instructions.
  - .1 Identify and label as indicated to: TIA -606.

3.3           INSTALLATION OF EQUIPMENT CABLES

.1           Install equipment cables from equipment terminal strips and patch panel as indicated.

.1           Identify and label as indicated to: TIA-606.

3.4           IMPLEMENT CROSS-CONNECTIONS

.1           Implement cross-connections using patch cords as specified.

END OF SECTION

Part 1            General

1.1            GENERAL

- .1            All drawings and all sections of the specifications shall apply to and form an integral part of this section.
- .2            This Section covers items common to Sections of Division 27 and 28 and supplement requirements of Division 01 and 26.

1.2            CODE AND STANDARDS

- .1            Do complete installation in accordance with CSA C22.1, ANSI/TIA/EIA, J-STD, BICSI, except where specified otherwise.
- .2            While not identified and specified by number in these Divisions, comply with CSA, ANSI/TIA, EIA, BICSI Bulletins in force at time of tender submission. Comply with the requirements of all provincial and local laws, rules, ordinances and codes.
- .3            Security and Safety installation shall be in accordance with current edition of above Code and Standards, Provincial and other codes, rules and regulations. It is not the intention of the drawings and specifications to reiterate the Code and Standards. It is expected that the Contractor will be responsible for methods, types of conduit and cable tray support, fire rating of cables, coordination of ancillary devices, specialty ratings for cable for elevators etc. Notify the Consultant of any detected code deficiencies prior to submission of tender. In the absence of such notifications, it will be assumed that the Contractor has accepted responsibility for a complete code-compliant installation, and no additional compensation will be provided for code-related items.
- .4            Supply materials and labour required to meet requirements of codes, rules and regulations, whether or not such work is indicated on the drawings or in specifications.
- .5            Where Divisions 26, 27 and 28 specifies better quality of construction (or materials) than minimum code requirements, the more stringent of the two will be provided.
- .6            Security and Safety installation shall be in accordance with the requirements of the Authority having Jurisdiction and local inspections authority.

1.3            CARE, OPERATION AND START-UP

- .1            Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components. Arrange care and instructional sessions to be provided at a time convenient to the Owner.
- .2            Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.
- 1.4 VOLTAGE RATINGS
  - .1 Power supply and equipment to operate satisfactorily at 120V, 60 Hz within normal operating limits established by above standard.
  - .2 All equipment and devices that are installed outdoors to operate in extreme operating conditions without damage to equipment.
- 1.5 PERMITS, FEES AND INSPECTION
  - .1 Furnish Certificates of Acceptance from Authority having Jurisdiction upon completion of work to Consultant. Include copies of certificate in maintenance manuals.
- 1.6 DEFINITIONS
  - .1 The following are definitions of terms and expressions used in the Specification:
    - .1 Access Floor means a system of completely removable and interchangeable floor panels that are supported on adjustable pedestals or stringers (or both) to allow access to the area beneath.
    - .2 Backbone Pathway means the portion of the pathway system that permits the placing of main and high-volume cables between the entrance location and all cross-connect points within the building and between buildings.
    - .3 Bend Radius means maximum radius that a cable can be bent to avoid physical or electrical damage or cause adverse transmission performance.
    - .4 Bonding means the permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.
    - .5 EMT means Electrical Metallic Tubing, thin wall metal tubing that does not have threaded ends, which is widely used in electrical distribution systems and as a pathway for telecommunications cabling.
    - .6 J-Hook means a supporting device for horizontal cable that is shaped like a J, It is attached to building structures.
    - .7 Ladder Rack means a device similar to a cable tray but more closely resembles a single section of a ladder and is constructed of metal with two sides affixed to horizontal cross members.
    - .8 Pull String means a cord or wire placed within a cable pathway and used to pull wire and cable through the pathway.
    - .9 Space means an area used for housing the installation and termination of telecommunications equipment and cable.
    - .10 Under floor raceway means a pathway placed within the floor and from which wires and cables emerge to a specific floor area.

- .11 Utility Column means an enclosed pathway extending from the ceiling to furniture or to the floor that forms a pathway for telecommunications cable.
- .12 Telecommunications Outlet Box means  
A housing used to hold telecommunications outlet/connectors.
- .13 Electrical Divisions refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and /or on drawings is responsibility of Electrical Contractor, unless otherwise noted.

#### 1.7 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into operation and maintenance manuals. Operation and maintenance manuals shall be submitted to Owner in time to be used in the commissioning of the project.
- .2 Include detail of design elements, construction features, components function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .3 Include technical data, product data; supplement by bulletins, component illustration, exploded views, technical description of items, and parts lists. Advertising or sales literature will not be accepted.
- .4 Include wiring, schematic diagrams and performance curves.
- .5 Include hardware and equipment schedules, verification reports.
- .6 Include name and addresses of local suppliers for items included in maintenance manuals.
- .7 Maintenance manuals shall be submitted to Consultant for review. Manuals that are incomplete shall be returned to electrical subcontractor for completion. Completed manuals must be submitted, to the satisfaction of the Consultant, before final payment may be considered to be due.

#### 1.8 SUBMITTALS

- .1 Submit shop drawings, product data and samples for review by Consultant. Manufacturer of equipment must not commence until shop drawings have been reviewed.
- .2 The Contractor shall submit product data sheets for all systems including Sub-contractor manufacturer qualification certificates.
- .3 The Contractor shall provide a list of installation personnel for each system, including vendor and manufacturer training certificates.
- .4 Prior to full scale cable testing, the contractor shall submit the Cable tester calibration certificates indicating the tester(s) have been calibrated within 30 days. The Contractor shall also submit a copy of the Nominal Velocity of Propagation (NVP) calibration test



result and a minimum of 10 actual test results in the tester equipment data format and hard copy for approval of actual method of testing.

- .5 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.
- .6 Include wiring, single line and schematic diagrams, wherever applicable.
- .7 Include wiring drawings or diagrams showing interconnection with work of other sections.
- .8 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done 'By Others' or 'By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.
- .9 Provide field dimensions required by electrical supplier and sub-subcontractors. In cases where fabrication is required prior to field dimensions being available, check all related drawings and obtain clarification from Engineer if necessary.
- .10 Shop drawing submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing.
- .11 Each drawing submission to bear following signed stamp, and include name of project, equipment supplier and clause number equipment is specified under.

CONTRACTORS CERTIFICATION

This drawing has been reviewed by  
(firm name)

All dimensions have been checked and found compatible with the contract drawings and all capacities, quantities, sizes and other data contained in the contract documents have been listed by the supplier on this drawing and have been checked by the undersigned and found correct.

Date

Per

- .12 Review of the shop drawings by the Consultant shall not relieve the Contractor from responsibility for errors and omissions therein.
- .13 Shop drawings reflecting additional design or change in design shall be reviewed by the Consultant.

1.9 EQUIVALENT MATERIALS AND EQUIPMENT

- .1 Bidder shall submit a tender based on the specified materials and equipment only.
- .2 Bidders may submit a tender based on equivalent material and equipment, only if such items have been approved as equal by the Consultant.
- .3 Refer to Section 01 23 10 for alternate prices information
- .4 Request for equal submissions shall include a photocopy of all applicable specification sections showing a complete compliance/non-compliance listing in the left hand margin. Every clause of the applicable specification section must be individually marked indicating details of how compliance is met or, how the non-compliance items should be considered equal.
- .5 Submittal list will be returned and may be picked up at the Consultant's office when directed by the Consultant. Where submissions are not returned by the Consultant before tender or forty (40) working hours before close of tender, they are considered not approved.
- .6 The approval of equivalent products will be granted on the basis of general design only. Such approvals will not relieve the electrical trade from providing all necessary components and functions required in the specifications or on the drawings.
- .7 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done 'By Others' or 'By Purchaser'. Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to the contrary.

1.10 CASH ALLOWANCES

- .1 Refer to General Conditions for further requirements under this section.

1.11 ALTERNATE PRICES

- .1 Do not include alternate price in base bid. Refer to Section 01 23 10.
- .2 Refer to General Conditions for further requirements under this section.

1.12 PRICING OF CHANGES AFTER TENDER

- .1 Within a week of contract award, the Electrical Contractor shall submit an itemized cost breakdown for labour, including an hourly rate for foreman (or journeyman) for all work to be performed on changes of the Contract (PCNS). Refer to General Conditions for further requirements under this section.
- .2 The Electrical Consultant reserves the right to review costing using acceptable pricing standards based on Means "normal" pricing guide. Refer to Section 28 05 01 "Supplementary Components and Revisions – Electronic Security and Safety".

1.13 FIELD QUALITY CONTROL

- .1 The contractor is required to furnish all labor, supervision, tooling, miscellaneous mounting hardware and consumables for each cabling system installed. The contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their manufacturer/warranty contract agreement, to support 15-Year (minimum) Performance Warranty requirements. After installation, the Contractor shall submit all documentation to support the warranty in accordance with the manufacturer's warranty requirements, and to apply for said warranty on behalf of the customer. The warranty will cover the components and labor associated with the repair/replacement of any failed link, within the warranty period.
- .2 Qualifications
  - .1 General Requirements:
    - .1 Security Installers must have a minimum of Class M Limited – Voice, Data Video – Electrical License issued by the Government of Manitoba.
    - .2 The Contractor shall comply with all Specifications under Division 27 and Division 28 together with, but not limited to the applicable Codes, Standards, and Guidelines listed in this section.
    - .3 The Contractor shall provide technical services in compliance with the labour standards.
    - .4 The Contractor shall hire sub-contractors that specialize in specific Security systems.

1.14 INTERFERENCE DRAWINGS

- .1 The Security and Safety systems drawings are intended to indicate the general extent of the work, arrangement of equipment, sizes of conduits, cable trays, etc.
- .2 The Contractor shall provide interference drawings of congested locations where required by notes on the drawings, and/or where required in order to perform the work efficiently for mechanical and electrical, telecommunication, Security and Safety systems.
- .3 Equipment dimensions shown on the Contract Documents are based upon a selected manufacturer's published data in each case. Ensure that equipment by alternative manufacturers, if selected, will fit within the allotted space with adequate room for access and servicing, and make any required adjustments to conduits, cable trays and/or equipment layouts.

1.15 RECORD DOCUMENTS

- .1 Submit project documents in accordance with Division 01 - General Conditions.
- .2 Allow for computer aided drafting (CAD) of original drawings to show as constructed information. Submit three (3) copies of the maintenance manuals to the owner, in 3-ring binders. Include a copy of all inspection and testing certificates, shop drawings, name/

address/phone # of each supplier, contractor and engineer, table of contents, and a copy of project "as-built" drawings in an envelope at the back of the binder and electronic files on a USB stick. Include all costs in contract. CAD files can be obtained from consultant.

- .3 The Contractor shall keep a set of white prints on the job site at all times on which he shall record all additions or deviations from the contract documents including all changes covered by addenda, change orders, field changes, job conditions, etc. A set of drawings shall be utilized for each system and the contractor shall obtain prints as required. Drawings to include locations of all junction and pull boxes, routing of cables and conduits, and changes to patch panel identification numbers.
- .4 All principle below grade or inaccessible conduits, systems, etc. shall be dimensioned at each change in direction. All conduit routes not shown by the Consultant on original drawing shall be shown including pull boxes, zoned conduit runs, etc.
- .5 The Contractor shall provide one set of clean marked-up drawings for approval and a final set with changes as may be requested by the Consultant.
- .6 If corrections are required after the second Consultant review, due to missing information, the Electrical Subcontractor shall be responsible for the Consultant's time to indicate the required corrective measures and all courier and printing costs.
- .7 The Contractor is responsible for the total cost of mylars, and white prints taken from mylars, and electronic files.
- .8 Corrected, revised "Mylars", white prints, electronic files, etc. will be forwarded to the Owner by the Consultant. Final payment on the contract will not be made until correct mylars, and files are prepared and submitted to the Owner.

## Part 2 Products

### 2.1 MATERIALS AND EQUIPMENT

- .1 Refer to section 27 15 00 for cable specifications for the project, the cabling shall be installed by the Voice Data Cabling Contractor.
- .2 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .3 Security and Safety equipment shall be new and of the type and quality specified.
- .4 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

- .5 Provide labour, materials, transportation, equipment and facilities, etc. required for the complete Security and Safety installation as indicated or can be reasonably implied from the drawings and specifications.
- 2.2 MAINTENANCE MATERIAL
  - .1 Provide all maintenance materials as outlined in Section 28 05 01 "Supplementary Components and Revisions – Electronic Safety and Security".
- 2.3 FIRE STOPPING
  - .1 Refer to Section 07 84 00 for all fire stopping requirements.
  - .2 Provide approved fire stopping systems and smoke seals for all electrical penetrations at all fire rated walls and floors to maintain the integrity of wall/floor fire rating being penetrated.
- Part 3 Execution
  - 3.1 PROCEDURE SCHEDULE
    - .1 All Security and Safety work shall be coordinated with Owner and sub-trades involved. Manner and areas of work shall be pre-arranged prior to proceeding.
    - .2 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for Security and Safety raceway systems installation in accordance with manufacturer's written instructions.
      - .1 Visually inspect substrate and inform Consultant of unacceptable conditions immediately upon discovery.
      - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
  - 3.2 QUALITY ASSURANCE
    - .1 The contractor is required to furnish all labor, supervision, tooling, miscellaneous mounting hardware and consumables for each cabling system installed. The contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their manufacturer/warranty contract agreement, to support a 1-Year warranty. After installation, the Contractor shall submit all documentation to support the warranty in accordance with the manufacturer's warranty requirements, and to apply for said warranty on behalf of the customer. The warranty will cover the components and labor associated with the repair/replacement of any failed link, within the warranty period that is a valid warranty claim.
    - .2 Qualifications

- .1 The Contractor shall have a minimum of two on-site factory trained installers for each of the video surveillance, access control and intrusion alarm system, The contractor shall hire sub-contractors that specifically install video surveillance, access control systems and intrusion alarm systems or specialize in that system.
- .2 The Contractor is responsible to carry out periodic quality control inspections during the conduit and support structure installation. The Contractor shall employ a job superintendent during the course of the installation that shall be responsible for quality control.
- .3 The Contractor shall provide references of the type of installation provided for in this specification.

### 3.3 INSTALLATION

- .1 Install empty raceway system, including underfloor, overhead, surface distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service raceways, miscellaneous and positioning material to constitute complete system.

### 3.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver all materials to the site in an orderly fashion.
- .2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials to be left in shipping containers until required for use.
- .3 Provide additional protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment and as directed by the Consultant.

### 3.5 WORKMANSHIP

- .1 Install equipment, conduits and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Consultant. Install conduit and cable runs parallel and perpendicular to building lines, in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.
- .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearance and accessibility for same.
- .3 Include in the work all requirements shown on the shop drawings or manufacturer's installation instructions.
- .4 Replace work unsatisfactory to the Consultant without extra cost.

### 3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.

- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

### 3.7 SEPARATION FROM OTHER SYSTEMS

- .1 Provide the following separation from Electrical Power systems installed in conduits:
  - .1 50mm from circuits of 300Volt and less.
  - .2 600mm from circuits 300Volt and higher.
  - .3 2 Metres from Circuits between 600V and 15KV.
  - .4 3 Metres for circuits above 15KV.
  - .5 300mm clear space above cable trays.
  - .6 600mm access space adjacent to the cable trays.
  - .7 150 mm below cable trays.
  - .8 Electrical systems cannot share the same cable tray or be racked on the same support structure.

### 3.8 HEIGHTS OF SAFETY AND SECURITY SYSTEM OUTLET BOXES

- .1 Heights of Electronic Security and Safety System Outlet Boxes:
  - .1 Access Control Card Readers: 1220 mm AFF.
  - .2 Request to Exit PIR Sensors: On hinge side of door frame at top of door frame.
  - .3 Emergency Door Release Pull Stations: 1220 mm AFF.
  - .4 Secure Corridor Lights Card Readers: 1220 mm AFF.
  - .5 Secure Corridor Notification Lights: 2300 mm AFF.
  - .6 Wall Mount Duress Pushbutton (Panic Alarm): 1220 mm AFF.
  - .7 Duress Alarm Annunciator Panel: 1400 mm AFF.
  - .8 Intrusion Alarm Keypads: 1400 mm AFF.
  - .9 Door Contacts: On leading edge of door frame at top of frame.
  - .10 Wall Mounted Motion Detector: 2400 mm AFF.
  - .11 Wall Mounted Indoor Cameras: 2400 mm AFF.

### 3.9 LOCATION OF OUTLETS

- .1 Locate outlets as indicated. Ensure that floor boxes and conduits are in place and coordinated with other trades prior to concreting.
- .2 Do not install outlets back-to-back in wall, allow minimum 400 mm (16") clearance between boxes.
- .3 Do not share telecommunications device boxes, pull boxes, conduits and cable trays with electrical systems.
- .4 Change location of outlets at no extra cost provided distance does not exceed 3 m (10'-0") in radius and information is provided before drywall has been placed.
- .5 Drawings are schematic only, coordinate mounting height and location of all equipment with architectural, mechanical and structural drawings prior to installation.

- .6 Vertically align outlets of different systems when shown in close proximity to each other and occur at different mounting heights using manufactured mounting brackets.
- 3.10 SYSTEM IDENTIFICATION LABELING
  - .1 Refer to Section 27 05 53 – Identification for communications systems.
- 3.11 ELECTROMAGNETIC LOCK SEQUENCE OF OPERATIONS
  - .1 General Requirements:
    - .1 Electromagnetic locks shall release upon Single Stage (alarm) signal.
    - .2 Electromagnetic locks shall release if normal and emergency supplies Fire Alarm signal are removed or the power to electromagnetic locking mechanism is removed.
    - .3 No Batteries are allowed to be installed in the Electromagnetic lock power supply.
    - .4 A single manual key switch with status light indicators switch shall be provided in the Security Office that will release all electromagnetic locks in the building. The switch shall be only accessible to authorized personnel.
    - .5 A single manual key switch shall be provided to reset all electromagnetic locks in the building.
    - .6 When electromagnetic locks are released by fire alarm, electromagnetic locks are reset by the manual switch only.
  - .2 Hardware Release
    - .1 Door Releases within 15 Seconds of 90 Newton of pressure being applied to the opening hardware.
    - .2 Upon initiation, opening process is irreversible; constant pressure on the opening hardware is not required.
    - .3 Door does not re-lock until opened.
    - .4 Provide a lamacoid sign colour red posted on the door stating "FOR EMERGENCY EXIT, THE LOCKING DEVICE WILL RELEASE WITHIN 15 SECONDS OF APPLYING PRESSURE TO THE DOOR OPENING HARDWARE" minimum lettering size 25mm high with 5mm stroke.
    - .5 The cumulative delay on emergency operation of the series of doors is to be no more than 15 seconds total.
  - .3 Fire Alarm Verification
    - .1 All connections to the fire alarm system to be verified
    - .2 Release on signal from fire alarm system verified.
- 3.12 TESTING AND COMMISSIONING
  - .1 Refer to the following Specifications and related Contract Documents and comply with the Testing and Commissioning requirements applicable to this Section, but not limited to:



.1 Section 28 08 01 – Electronic Safety and Security Testing Requirements.

END OF SECTION

Part 1            General

1.1            RELATED WORK

- .1            Refer to all Sections of the Specification for related work.

1.2            SECTION INCLUDES

- .1            Testing of Grounding and Bonding for Communications Systems
- .2            Testing of Communications Horizontal Cabling.
- .3            Testing of Communications Connecting cords, Devices and Adapters
- .4            Testing of Fire Alarm.

1.3            SYSTEM DESCRIPTION

- .1            Commissioning of Communications Systems shall be conducted with the Engineer for each system listed. Detailed operation and training for each system shall be conducted.

1.4            REFERENCE STANDARDS

- .1            Refer to the following Specifications and related Procurement Documents for the reference standards applicable to this Section, but not limited to:
  - .1            CAN/ULC-60839-11-1, Alarm and Electronic Security Systems - Part 11-1: Electronic Access Control Systems - System and Components Requirements
  - .2            CAN/ULC-S302, Standard for the Installation, Inspection and Testing of Intrusion Alarm Systems
  - .3            CAN/ULC-S316, Standard for Performance of Video Surveillance Systems

1.5            QUALITY ASSURANCE

- .1            Qualifications:
  - .1            Installers and Technicians conducting testing and commissioning shall be factory-trained on the use of the Manufacturer's test equipment. The Contractor shall provide proof of this certification ten (10) business days prior to testing method approval.
  - .2            Prior to full scale cable testing, the contractor shall submit the Cable tester calibration certificates indicating the tester(s) have been calibrated within 30 days. The Contractor shall also submit a copy of the Nominal Velocity of Propagation (NVP) calibration test result and a minimum of 10 actual test results in the tester equipment data format and hard copy for approval of actual method of testing.

Part 2 Test Definitions

2.1 GENERAL

- .1 Unless otherwise specified herein, all testing definitions, parameters, methods, and practices shall comply with the references listed in section 1.4.

Part 3 Execution

3.1 DOCUMENTATION

- .1 The test reports shall include the information shown below, unless otherwise approved by the Engineer. The italicized information on the report is example information and is variable. Customize the information for the particular installation.
- .2 The following header fields on each test report shall contain the appropriate information. These are minimum requirements.
  - .1 Circuit ID
  - .2 Test Result
  - .3 Owner
  - .4 Serial Number
  - .5 Injector Serial Number
  - .6 Software Version
  - .7 Date
  - .8 Cable Type
  - .9 NVP
  - .10 Building
  - .11 Telecom Room
- .3 The information in each user definable header field on each test report shall contain the information as follows.
  - .1 Circuit ID: Indicate the Pair and patch panel under test
  - .2 Owner: Indicate the owner of the test equipment
  - .3 Date: Indicate the date of the test
  - .4 Cable Type: Indicate the cable type being tested
  - .5 NVP: Indicate the field measured NVP
  - .6 Building: Indicate the building where the cable is being tested
  - .7 Telecom Room: Indicate the Telecom Room identifier where the cable is terminated
- .4 The Contractor shall provide the test data in a complete and consistent format. All results shall be printed from a laser printer. Provide the printed results contained in 3" three-ring notebook binders. The test results shall be three-hole punched and

numerically ordered by outlet location number within the notebook. Provide separate notebooks for each telecom room and Link Test results. Multiple volumes may be necessary. Separate all FAIL test results in each notebook from the PASS test results. Provide summary sheet of all results. Provide a separator tab labeled "Fail Results" in front of the sheets of FAIL test results. Provide a separator tab labeled "Pass Results" in front of the sheets of PASS test results.

- .5 The cover of the notebook shall read (italicized information is variable):

*"PROJECT NAME"*  
*building name* "(BLDG. No. x)"  
*"(SYSTEM) Test Results"*  
*"Volume No." X*  
*date (month and year)*

- .6 The contractor shall verify that a report for each jack in the Project is contained in the notebooks.

- .7 Electronic Copy

- .1 The electronic copy of the test results shall be on CD and USB Stick.

- .2 Disks shall be labeled. The label shall read:

*"PROJECT NAME"*  
*building name* (BLDG. No. x)  
*"(System) Test Results on Disk"*  
*"Disk No." X of x*  
*date (month and year)*

- .3 The files on disk shall be in Comma Separated Variable (CSV) file format and the Native Tester data file format. PDF's of all test results and a summary shall also be provided.

### 3.2 TESTING – SECURITY

- .1 Manufacturer's Field Services:

- .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
- .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits to review Work at stages listed:
- .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

- .2 [Twice]during progress of Work at [25%]and [60%]complete.
- .3 Upon completion of Work, after cleaning is carried out.

### 3.3 TESTING – ACCESS CONTROL

- .1 Perform verification inspections and test in presence of Consultant.
  - .1 Provide all necessary tools, ladders and equipment.
  - .2 Ensure appropriate subcontractors and manufacturer's representatives and security specialists are present for verification.
- .2 Pretesting procedure:
  - .1 Verify (utilizing an approved spectrum analyzer and test equipment) that system is fully operational and meets all system performance requirements of this specification.
  - .2 Measure and record, control (and/or voice) carrier levels of every system channel at each of following points in the system:
    - .1 Door located actuating devices.
    - .2 Door control panel functions.
    - .3 Electronic supervisory control units inputs and outputs.
    - .4 Distribution system input and output.
    - .5 Telephone system interface input and output.
  - .3 Submit to Consultant 2 copies of recorded system pretest measurements, along with pretest certification.
- .3 Performance testing:
  - .1 Test procedure: perform test on a "go-no-go" basis.
    - .1 Make only operator adjustments required to show proof of performance.
    - .2 Test to demonstrate and verify that installed system complies with installation and technical requirements of this specification under operating conditions.
    - .3 Test results to be evaluated by Consultant as either acceptable or unacceptable using following procedures.
  - .2 Documentation review:
    - .1 This review will determine if information provided is sufficient to meet requirements of this specification.
    - .2 Provide for review all System manuals, as installed drawings, pretest form, antenna radiation patterns, equipment cabinet pictorials, antenna pictorial, antenna mount pictorial, video and audio equipment details.
  - .3 Mechanical inspection:
    - .1 Consultant and Contractor to tour areas to insure that Systems and Subsystems are installed in place for proof of performance testing.

- .2 Take system inventory at this time. Verify following items before beginning proof of performance tests:
  - .1 Electrical power circuits designated for system equipment are properly labelled, wired, phased, protected and grounded.
  - .2 Conductor ends are protected by heat shrink wrap; audio spade lugs, barrier strips and punch blocks are used.
  - .3 Dust, debris, solder splatter, etc. are cleaned and removed from site.
  - .4 Equipment is properly labelled.
  - .5 Equipment identified in system's equipment lists are in-place and properly installed.
  - .6 Each lightning and System ground method are installed in accordance with manufacturer's instructions and this specification.
- .4 Subsystem functional test:
  - .1 Conduct operational testing after review of documentation and mechanical inspection completed. Proceed as follows.
    - .1 Perform operational test of each Subsystem to verify that all equipment is properly connected, interfaced and is functionally operational to meet requirements of this specification.
  - .2 Control units:
    - .1 Take S/N readings from control unit's input and output in manual (and/or automatic) mode. Check output of DC/Data converter for S/N. Evaluate entire signal quality at baseband connector output of control unit and remote equipment.
  - .3 Audio:
    - .1 Take S/N readings from transmitter input and receiver output with equipment placed in manual gain mode. Check output of the audio converter, modulator or demodulator for S/N. Evaluate entire audio signal at baseband connector input and output of control unit.
  - .4 Distribution (or interface) system:
    - .1 Check each door utilizing a volt/ohm (or signal level) metre to confirm each function and to insure that system meets all performance requirements.
    - .2 Test each interconnection point (i.e.: door unit, junction box "cross connection", control unit, etc.) to ensure compliance with this specification.
  - .5 Total system test:
    - .1 Proceed with testing when system and subsystems are functionally tested and accepted. Total system tests to verify that requirements have been met for DC (and/or audio), sub carrier, and control signals in accordance with this specification.
  - .6 Safety:

- .1 Demonstrate with documentation that access control system meets safety requirements specified in [UL 294].
- .5 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
  - .1 Sturdiness of equipment fastening.
  - .2 Non-existence of installation related damages.
  - .3 Compliance of device locations with reviewed shop drawings.
  - .4 Compatibility of equipment installation with physical environment.
  - .5 Inclusion of all accessories.
  - .6 Device and cabling identification.
  - .7 Application and location of ULC approval decals.
- .6 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
  - .1 Validate sensitivity of readers and applicability and application of cards.
  - .2 Connecting joints and equipment fastening.
  - .3 Compliance with manufacturer's specification, product literature and installation instructions.
- .7 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
  - .1 Operation of each device individually and within its environment.
  - .2 Operation of each device in relation with programmable schedule and or/specific functions.
- 3.4 TESTING – VIDEO SURVEILLANCE
  - .1 Perform verification inspections and test in the presence of Consultant.
    - .1 Provide all necessary tools, ladders and equipment.
    - .2 Ensure appropriate subcontractors, manufacturer's representatives, system integrators are present for verification.
  - .2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
    - .1 Sturdiness of equipment fastening.
    - .2 Non-existence of installation related damages.
    - .3 Compliance of device locations with reviewed shop drawings.
    - .4 Compatibility of equipment installation with physical environment.
    - .5 Inclusion of all accessories.
    - .6 Device and cabling identification.

- .7 Application and location of ULC approval decals.
  - .3 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
    - .1 Measurements of tension and power.
    - .2 Connecting joints and equipment fastening.
    - .3 Measurements of signals (dB, lux, baud rate, etc).
    - .4 Compliance with manufacturer's specification, product literature and installation instructions.
  - .4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
    - .1 Operation of each device individually and within its environment.
    - .2 Operation of each device in relation with programmable schedule and or/specific functions.
    - .3 Operation control of camera lens, pan, tilt and zoom.
    - .4 Switching of camera to any monitor.
    - .5 Switching of system video recorder to selective monitor.
    - .6 Set dwell times.
    - .7 Demonstrate:
      - .1 Sequence viewing of cameras on each monitor.
      - .2 Bypass capability.
      - .3 Display of stored image to cardholder.
- 3.5 TESTING – INTRUSION DETECTION
  - .1 Perform verification inspections and test in the presence of Consultant.
    - .1 Provide necessary tools, ladders and equipment.
    - .2 Ensure appropriate subcontractors and manufacturer's representatives and security specialists are present for verification.
  - .2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
    - .1 Sturdiness of equipment fastening.
    - .2 Non-existence of installation related damages.
    - .3 Compliance of device locations with reviewed shop drawings.
    - .4 Compatibility of equipment installation with physical environment.
    - .5 Inclusion of all accessories.
    - .6 Device and cabling identification.
    - .7 Application and location of ULC approval decals.



- .3 Technical verification: purpose to ensure that all systems and devices are properly install and free of defects and damage. Technical verification includes:
  - .1 Measurements of coverage patterns
  - .2 Connecting joints and equipment fastening.
  - .3 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
  - .1 Operation of each device individually and within its environment.
  - .2 Operation of each device in relation with programmable schedule and or/specific functions.

### 3.6 FIRE ALARM SYSTEM TESTING AND ADJUSTING

- .1 Ensure an inspection of the fire alarm system and equipment including those components necessary to the direct operation of the system such as manual stations, heat detectors, smoke detectors and controls is performed. The inspection tests to conform to CAN/ULC-S537-04 Verification of Fire Alarm Systems and also comprise an examination of such equipment for the following:
  - .1 Type of equipment installed is as described by these electrical specifications.
  - .2 Wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.
  - .3 Equipment has been installed in accordance with the equipment installation recommendations and that all signaling devices have been operated or tested to verify their operation.
  - .4 Supervisory wiring of those items of equipment connected to a supervised circuit is operating and governmental regulations, if any, concerning such supervisory wiring have been met to the satisfaction of Engineer.
- .2 To assist the Contractor in preparing his bid, the equipment supplier shall indicate the number of hours necessary to complete the inspection described, prior to closing of tenders.
- .3 On completion of the inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the consultant the following, in accordance with CAN/ULC-S537-04:
  - .1 A copy of the inspecting report showing the location of each device and certifying the test results of each device.
  - .2 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.
  - .3 Proof of liability insurance for the inspection.
- .4 All costs involved in the inspection described herein, shall be included in the Contractor's total tender price.

- .5 Verification procedures, testing requirements, documentation required, etc. shall be in accordance with the requirement of ULC Standard CAN/ULC-S537-04.
- .6 Re-testing:
  - .1 Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the specifications and complies with applicable standards.
- .7 Report of tests and inspections:
  - .1 Provide a written record of inspections, test, and detailed test results in the form of a test log.
- .8 Final Test, Certificate of Completion, and Certificate of Occupancy:
  - .1 Test the system as required by the Consultant in order to obtain a certificate of occupancy.

### 3.7 DEMONSTRATION AND TRAINING

- .1 Refer to the following Section for Demonstration and Training of Division 28 – Electronic Security and Safety:
  - .1 [Section 07 79 00 – Demonstration and Training]
- .2 Notify the Owner, End-users and Maintenance Personnel a minimum of [4] weeks in advance prior to conducting the training
- .3 Schedule the demonstration and training at least [10] business days prior to substantial completion, building occupancy or as per Owner's suggested date whichever comes first.
- .4 Provide visual aids including projectors.
- .5 Provide hard copy of training materials and user guides compiled in folders or binders for each participant.
- .6 Provide Attendance Sheets signed both by the trainer and trainees with time and date. Contractor to submit this document as part of the O&M Manuals and Closeout Submittals and Procedures.

### 3.8 SYSTEM CONFIGURATION & COMMISSIONING SERVICE – ACCESS CONTROL

- .1 The System Configuration and Commissioning service from the Access Control Software Manufacturer shall include a Field Engineer/ Technician who will be responsible for:
  - .1 Assisting the Contractor's or Subcontractor's on-site/ remote technicians with the configuration and commissioning of the Manufacturer's PACS at the Client site.
  - .2 Conducting a test of the PACS following the deployment of the system using real-world operator scenarios to ensure optimal system performance.
  - .3 Providing the Contractor with a Service Report detailing the tasks completed during the deployment of the PACS at the Client site, as well as any

recommendations for improving the performance of the Access Control System that must be implemented by the contractor.

- .4 Providing a knowledge transfer of the Manufacturer's PACS to the Contractor following the deployment of the PACS at the client site.

3.9 SYSTEM CONFIGURATION & COMMISSIONING SERVICE – VIDEO MANAGEMENT SYSTEM (CCTV)

- .1 The System Configuration and Commissioning service from the vendor shall include a Field Engineer/ Technician who will be responsible for:
  - .1 Assisting the contractor's or subcontractor's onsite/remote technicians with the configuration and commissioning of the vendor's USP at the client site.
  - .2 Conducting a test of the USP following the deployment of the system using real-world operator scenarios to ensure optimal system performance.
  - .3 Providing the contractor with a Service Report detailing the tasks completed during the deployment of the USP at the client site, as well as any recommendations for improving the performance of the USP that must be implemented by the contractor.
  - .4 Providing a knowledge transfer of the vendor's USP to the contractor following the deployment of the USP at the client site.

END OF SECTION

Part 1            General

1.1            SECTION INCLUDES

- .1      General requirements
- .2      Access control software and database management
- .3      Access control system hardware
- .4      Card/Keypad Readers
- .5      Contactless Access Cards/Fobs
- .6      Request to Exit detector
- .7      Magnetic Door Contact
- .8      Power Supplies
- .9      Network Switch, PoE Switch and Power Supply
- .10     Monitoring workstation.
- .11     Automatic door controls for restrooms.
- .12     Emergency call systems for universal and barrier free restrooms.

1.2            REFERENCES

- .1      Refer to Section 27 05 00 for references applicable to this project.

1.3            SYSTEM DESCRIPTION

- .1      An Access control system is an Electronic System, or network of integrated systems designed to control access and monitor events in a facility or campus. Access control is the physical process of controlling who can access an area and when determined by what they have (an Access card), what they know (a PIN), and/ or something they are (biometrics).
- .2      An Access Control system involves the control of people through entrances and exits of a controlled area. An aspect of security that utilizes hardware systems and specialized procedures to control and monitor movements into, out of, or within a controlled area. Access to various areas may be a function of authorized level or time or a combination or both.
- .3      Each component of the system must be non-proprietary and not exclusive to any installing dealer
- .4      All components must be off the shelf and available through at-least four full service dealers

- .5 The Access Control and Security Management System (ACSMS) shall function as an electronic physical access and situational control system. The ACSMS shall function as the primary means of controlling all access and situational control needs. A scalable, open architecture and network ready solution shall allow for an assured access and alarm monitoring solution.
- 1.4 ACTION AND INFORMATIONAL SUBMITTALS
  - .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for access control systems and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Indicate on drawings:
      - .1 Riser diagram, block diagram of complete system.
      - .2 Access control system design criteria.
- 1.5 CLOSEOUT SUBMITTALS
  - .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
  - .2 Operation and Maintenance Data: submit operation and maintenance data for public address systems for incorporation into manual.
  - .3 Include in manual:
    - .1 Operation instructions.
    - .2 Description of system operation.
    - .3 Description of each subsystem operation.
    - .4 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.
    - .5 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.
- 1.6 QUALITY ASSURANCE
  - .1 Qualifications
    - .1 Contractor shall have a minimum of two on-site Manufacturer factory trained and certified installers during the course of the installation
    - .2 A Factory Trained Site Superintendent shall be on site for the duration of the installation and testing and all communication shall be thru the site Superintendent
    - .3 The Site Superintendent shall ensure the installation is conducted in a neat and professional manner and ensure the highest level of quality is maintained.
    - .4 The Contractor shall visit the site during the pathway installation to ensure the conduit and wiring is installed as per manufacturer's requirements.

- .5 Manufactures shall have minimum of 15 years' experience in manufacturing and design of access control systems.
- .2 Pre-Installation Meetings
  - .1 The Access Control Contractor shall arrange a meeting 7 business days prior to installation or configuration of devices with the Consultant.
  - .2 All operation modes of the system shall be discussed and approved to the satisfaction of the owner.

## 1.7 WARRANTY

- .1 The system and equipment will be warranted for a period of one year from final acceptance of the system.
- .2 The Contractor will maintain sufficient parts in stock to replace items found faulty during the warranty period
- .3 The contractor shall submit a warranty certificate covering all manufacturers' components and the contractor installation. dated on the day final acceptance and all deficiencies have been corrected to the satisfaction of the owner, with the following information:
  - .1 Name and Address of Project
  - .2 Name and Address of the Contractor
  - .3 Warranty Commencement Date
  - .4 Duration of Warranty
  - .5 Clear definition of all included devices in system and indicating what remedial action will be taken under the warranty.
  - .6 Signature and seal of Warrant.
- .4 The access control system shall be warranted for a period of one (1) year from the date of acceptance.
- .5 The supplier shall provide all services required to maintain the system in an operational state as specified by the manufacturer for a period of one (1) year after acceptance.
- .6 The system supplier shall include a line item bill of materials included in the project and the warranty associated with each.
- .7 The system supplier shall maintain equipment stock for any high usage equipment.

## 1.8 DEFINITIONS

- .1 Access Card: A coded employee card, usually the size of a credit card, recognizable to the access control system and read by a reader to allow access. It can be used for photo identification of the cardholder and for other data collection purposes. Card technologies include magnetic strips, Wiegand-effect, proximity (active/passive), barium ferrite, smart/intelligent cards, and NFC enable applications on mobile devices.
- .2 Access Control System: An interconnected set of controllers, managing the entrance and exit of people through secure areas.
- .3 Access Level: The door or combination of doors and/or barriers an individual is authorized to pass through.
- .4 Anti-Pass back (Anti-Tailgating): This feature protects against more than one person using the same card or number. It defines each system card reader and card ID number as IN, OUT or other. Once a card is granted access to an IN reader, it must be presented to an OUT reader before another IN reader access is granted. Cards will continue to have access to all authorized OTHER readers.
- .5 Alarm: A signal that indicates a problem.
- .6 Alarm input: A device that is monitored by the access control panel. An alarm signal will be generated if the device is activated.
- .7 Badge: Badge is a template or a design for creating a card. Badge design includes magnetic stripe encoding, bar coding, signatures, and so on.
- .8 Bar Code: A method of encoding information using lines and blank spaces of varying size and thickness to represent alphanumeric characters.
- .9 Biometrics: A general term for the verification of individuals using unique biological characteristics (i.e. fingerprints, hand geometry, voice analysis, the retinal pattern in the eye).
- .10 Card and Card Holder: A card is an identity proof of a person and a card holder is a person who holds the card. Multiple cards can be assigned to a single card holder to provide different access.
- .11 Controller: A microprocessor-based circuit board that manages access to a secure area. The controller receives information that it uses to determine through which doors and at what times cardholders are granted access to secure areas. Based on that information, the controller can lock/unlock doors, sound alarms, and communicate status to a host computer.
- .12 Card Reader: A device that retrieves information stored on an access card and transmits that information to a controller.
- .13 Digital Video Recorder (DVR): A security system device that records the video from the surveillance cameras (IP and Analog) on a hard disk.
- .14 Door: A generic term for a securable entry way. In many access control applications, a "door" may be a gate, turnstile, elevator door, or similar device.

- .15 Duress: Forcing a person to provide access to a secure area against that person's wishes.
- .16 Input: An electronic sensor on a controller that detects a change of state in a device outside the controller.
- .17 Integrated lockset: An integrated, intelligent locking solution that typically runs on batteries, but can be externally powered, that contains most of the door components, i.e. reader, door contact, and request to exit in a single, mountable unit.
- .18 Keypad: An alphanumeric grid which allows a user to enter an identification code. A flat device which has buttons that may be pressed in a sequence to send data to a controller, and which differs from a typewriter-like computer board.
- .19 Output Relay: A device that changes its state upon receiving a signal from a controller. Typically, the state change prompts an action outside of the controller such as activating or inactivating a device. The auxiliary relays found in access control panels or NODES that control external devices.
- .20 Shunt Time: The length of time a door open alarm is suppressed (shunted) after a valid card access or free egress request. This time should be just enough to allow a card user to open a door or gate, pass through, and then close it.
- .21 Time Schedules: Schedules that allow cards to function or not function depending on the time of day. This is used to limit access to the facility. The schedule may include not only time but which days of the week a card is valid.
- .22 Video Management System (VMS): An enterprise-class video management and storage solution.

## Part 2 Products

### 2.1 MANUFACTURER

- .1 Acceptable access control system manufacturer includes:
  - .1 Gallagher (Basis of Design)
  - .2 Open Options
  - .3 Genetec.
- .2 All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- .3 The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications.
- .4 Restroom control Acceptable Manufacturer: Camden Door Controls



## 2.2 GENERAL REQUIREMENTS FOR ACCESS CONTROL SYSTEM

- .1 The ACSMS shall be a highly scalable, robust access control and security management system developed using the latest in development technology. The ACSMS shall provide a singular interface capable of controlling multiple, geographically independent sites and provide alarm monitoring, video management integration, ID badging, personnel and cardholder management, and situational control of all connected devices from a single application.
- .2 The ACSMS must fully support the hardware controllers and sub-controllers.
- .3 The ACSMS must support credential readers that communicate via Wiegand, RS-485, or clock and data communications formats.
- .4 The ACSMS must support the Open Supervised Device Protocol (OSDP).
- .5 A sufficient number of controllers and sub-controllers will be provided to monitor all credential reader, monitor point, and relay point locations shown on plan.
- .6 The ACSMS shall be capable of the following features:
  - .1 Multi-User/Network Capabilities: The ACSMS shall support multiple operator workstations via local area network/wide area network (LAN/WAN). The communications between the workstations and the server computer shall utilize the TCP/IP standard over industry standard IEEE 802.3 (Ethernet). The communications between the server and workstations shall be supervised, and shall provide the ability to generate alarm messages when the server is unable to communicate with a workstation.
  - .2 Operating Environment: The ACSMS shall be a 3-tier client/server, ODBC-compliant application based on Microsoft tools and standards. The ACSMS application shall operate in the following environments: Microsoft Windows® Server 2008 R2 SP1, Microsoft Windows® 7 Professional SP1 (64-bit), Windows Server 2012 R2, Windows 8.1 Enterprise/Professional, and Windows 10 Enterprise/Professional.
  - .3 Multi-level Password Protection: The ACSMS application shall provide multi-level password protection, with user-defined operator name/password combinations. Name/password log-on shall restrict operators to selected areas of the program. The application shall allow the assignment of operator levels to define the system components that each operator has access to view, operate, change, or delete.
  - .4 Graphical User Interface: The ACSMS shall be fully compliant with Microsoft Graphical User Interface (GUI) standards, with the look and feel of the software being that of a standard Windows application, including hardware tree-based system configuration.
  - .5 Concurrent Licensing: The ACSMS shall support concurrent client workstation licensing. The ACSMS application shall be installed on any number of client workstations, and shall provide the ability for any of the client workstations to connect to the application server as long as the maximum number of concurrent connections purchased has not been exceeded.

- .6 Access Control Software Suite: The ACSMS shall be a scalable application such that there is no requirement for separate tiers or editions of software. The same code set used for smaller, more localized installations, shall be the same code set used for enterprise system deployments.
  - .7 Supervised Alarm Points: The ACSMS shall provide both supervised and non-supervised alarm point monitoring with the ability to specify custom values of resistance. On recognition of an alarm, the ACSMS shall be capable of switching and displaying the video from the camera connected to the video management system that is associated with the alarm point.
  - .8 Video Management System Support: The ACSMS shall integrate with no less than 10 brands of video management systems (VMS).
  - .9 Display Live Video: The ACSMS shall support to view live video from a camera connected to an integrated VMS. The cameras from the integrated VMS shall be able to be associated with any hardware device programmed in the ACSMS and opened automatically on any system event or operator-initiated command sequence.
  - .10 Alarm Events: The ACSMS shall include a feature where alarm events with defined priorities shall be able to pop-up automatically in an Alarm event window for operator attention. The pop-up shall display the following information: description of the event, time, date, point description, if a card event the card number, type of event and cardholder name. An event counter shall also display the number of times the event was reported to the Alarm event monitor prior to Acknowledgement or Clearing the event. Event instructions shall be made available by double clicking on the event. The Alarm shall also display an icon to indicate that a camera is associated to the device. The Alarm event window shall allow the operator to initiate a physical response to the event as well as a written response. Responses shall include but not be limited to: acknowledge, clear, open a pre-programmed floor plan, activate, deactivate, pulse, time pulse, add comment, retrieve archived video, and bring up live video, disarm, or arm.
- .7 Personnel and Cardholder Management
- .1 Shall provide a personnel browser method of managing personnel data in a hierarchical tree. The personnel browser shall be sortable by any field of data stored in the personnel record.
  - .2 Shall have the ability to create unlimited custom personnel groups that personnel records can be assigned to where by personnel records can be assigned to one or more personnel groups.
  - .3 Shall support an activation and deactivation date and time of a credential down to the minute within a day.
  - .4 Shall support the ability to assign/re-assign credentials to personnel records by way of a drag and drop convention.
- .8 Hardware

- .1 Shall support a browser-based, hierarchical tree structure that displays the programmed hardware with current states and provides command and control capabilities based on operator privileges.
  - .2 The tree structure shall be developed in such a way that it is intuitive for the operator to navigate by providing common groupings of like devices and supports scrolling within the window by a scrollbar or mouse scroll wheel.
  - .3 The tree structure shall provide, based on operator privileges, the ability to group edit and control similar devices.
  - .4 The tree structure shall have an option to display a tooltip upon hovering over a specific device to obtain detailed status information. Tooltips will be configurable as to size, duration, and content presented when displayed.
- .9 Integrated Graphics Maps
- .1 Shall provide, with no additional licensing fees required, an integrated and robust graphical map module allowing for the importation of CAD floor plans and other .JPG or .BMP files for use in plotting hardware and other connected devices programmed in the system onto the graphic layouts.
  - .2 Shall support a graphic map as a homepage of any point in the system, thereby linking that device to that map and allowing the system to automatically load the graphic upon an alarm condition from any point that is plotted on it.
- .10 Integrated Intrusion Detection Systems
- .1 Shall support an integration with the Intrusion Detection Systems by providing real-time event reporting and control capabilities:

## 2.3 VIDEO MANAGEMENT SYSTEM INTEGRATION

- .1 The ISMS shall concurrently interfacing with VMS from multiple vendors.
- .2 It shall be possible for the ISMS to view live video from multiple cameras within its interface.
- .3 The ISMS shall be capable of viewing stored (archived) video from the VMS within its interface.
- .4 Where supported by the integrated VMS, it shall be possible to operate camera controls such as:
  - .1 PTZ.
  - .2 Pause.
  - .3 Forward.
  - .4 Rewind.
  - .5 It shall be possible to maximize a camera window:
- .5 While a camera window is maximized, the other camera windows should be changed to live thumbnail images to ensure the operator is able to see activity in all cameras.
- .6 It shall be possible to drag a camera icon from a site plan into a video view to dynamically be able to view cameras in an ad hoc manner.

- .7 It shall be possible to drag a camera icon from a list into a video view to dynamically be able to view cameras in an ad hoc manner.
- .8 It shall be possible to find a camera from a search box.
- .9 Where supported by the integrated VMS, it shall be possible for the ISMS to send a message to the VMS to move cameras to priests.
- .10 Where supported by the integrated VMS, it shall be possible for the ISMS to receive motion detection and video analytic events from the VMS.

## 2.4 ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT

- .1 The ISMS shall employ a high quality computer incorporating current generation design and components. It shall be of a Microsoft approved model for operation with current versions of Microsoft Windows operating systems. The hardware specification, including processor speed, internal memory and hard disk size shall be specified by the supplier and must be sufficient to meet or exceed the capacity and throughput of the specified system.
- .2 Command Centre Gallagher C201311.
- .3 Door license 2A8943.
- .4 Photo ID and Encoding 2A8071.

## 2.5 ACCESS CONTROL SYSTEM HARDWARE

- .1 The server shall use a Microsoft Windows operating system. Operating systems such as Linux, Unix, and OS X shall not be acceptable.
- .2 The operating system used by the system server shall be one of the following:
  - .1 1. Microsoft Windows Server 2016 (64 bit).
  - .2 2. Microsoft Windows Server 2012/R2 (64 bit).
  - .3 3. Windows 10 Pro / Enterprise (64 bit).
- .3 The operating system used by workstations shall be Microsoft Windows 10 Professional (64 bit).
- .4 Workstations shall support multi-monitor operation, allowing an operator to set up one or more monitors for each workstation.
- .5 Workstation display resolution shall be a minimum of 1280 x 720 pixels.
- .6 It shall be possible for an operator to run a workstation solely from files stored on and run from a USB memory device and without requiring any pre-installation of vendor software on the computer hardware
- .7 System to include the following Gallagher equipment:
  - .8 C300100, Controller 6000.
  - .9 C300182, 8H Module
  - .10 C300660, Gallagher HBUS 8 In 2 Out Door Module

- .11 C300688, Gallagher HBUS 16 In 16 Out Board
- .12 C200001, Full Footprint Mounting Plate
- .13 C305720, LSP E2 Cabinet 6A PSU

## 2.6 CARD READERS

- .1 Gallagher T15 Multi Tech Reader includes MIFARE smart card technology support and also includes additional support for 125 kHz credentials and the Gallagher Mobile Connect solution via Bluetooth wireless technology. Colour Black.

## 2.7 CONTACTLESS ACCESS CARDS/FOBS

- .1 Provide an initial shipment of 200 fobs.
- .2 2A8571, Mobile Connect Credential.
- .3 C297404, Mifare DESFIRE Keyfob 4K EV2\
- .4 C41007, Encoder Unit
- .5 C196501, Encoding single technology ISO Card

## 2.8 MAGNETIC DOOR CONTACTS

- .1 Standard doors
  - .1 Provide 1 inch Rare earth magnet, wide gap
  - .2 Colour to match door frames, and identical throughout the installation.
  - .3 Provide connection to access control system
  - .4 Provide one magnetic door contact per leaf
  - .5 All End-of line resistors to be installed in at the field device
  - .6 Acceptable Products: GE Sentrol 1076, GE Sentrol 1078 series
- .2 Overhead doors
  - .1 Miniature, low-profile design
  - .2 Stainless steel armored cable for added security, reliability
  - .3 Wide working gap for overhead doors
  - .4 Small size less likely to be damaged by forklifts
  - .5 Aluminum bar stock resists corrosion in harsh environments
  - .6 Mounting hardware included
  - .7 ULC listed model
  - .8 Acceptable product: Sentrol 2200 Series

## 2.9 REQUEST TO EXIT DETECTOR

- .1 Detector Type: Passive infrared
- .2 Filter Technology: Digital Signal Processing (DSP)
- .3 Detector Lens: Curtain-type Fresnel lens

- 
- .4 Detection Range
    - .1 Narrow Targeting Area . . . 3 m (10 ft)
    - .2 Whole Body . . . . . 6 m (20 ft)
    - .3 Piezo Buzzer . . . . . 90 dB at 28 VDC, 5-28 VDC,
    - .4 20 mA (XL & XL2 only)
  - .5 Main Relay Contacts: SPDT, 1A max @ 30 VDC max
  - .6 Main Relay Timer : Adjustable, 0.5 to 60 seconds
  - .7 Main Relay Recycle Timer : Fixed, 0.75 seconds off
  - .8 Lock Control Relay: solid-state relay, N.C.,
  - .9 2A max @ 30 VDC, timed at
  - .10 2 seconds fixed
  - .11 Tamper Switch N.C., 100 mA max @ 30 VDC max
  - .12 Indicator Light: Red/Green LED
  - .13 Mounting Optional backplate available for mounting the T.REX on a standard single-gang electrical box
  - .14 Physical
  - .15 Dimensions (H x W x D). . . 4.5 x 19 x 4.75 cm
  - .16 Electrical
  - .17 Power Consumption: 12-28 VDC, 50 mA
  - .18 Regulatory Certifications UL294, CE, FCC, ULC
  - .19 Model Numbers
  - .20 Acceptable Product: KanTech T.REX-XL2 with T.REX-PLATE
- 2.10 POWER SUPPLIES
- .1 Provide all necessary power supplies as required.
- 2.11 POWER OVER ETHERNET NETWORK SWITCH
- .1 Refer to 272021 Data Communications Network Equipment for switch specification.
- 2.12 MONITORING WORK STATION
- .1 Provide workstation PC for access control. Refer to 272021 Data Communications Network Equipment for additional information.
- 2.13 AUTOMATIC DOOR CONTROLS FOR RESTROOMS
- .1 Performance:
    - .1 Automatic door controls shall comply with Americans with Disability Act.

- .1 Regulatory compliance with Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standard (UFAS) as required by Authority Having Jurisdiction (AHJ).
- .2 Automatic door controls shall comply with National Building Code of Canada.
- .3 Automatic door controls shall comply with NFPA National Fire Code or International Fire Code for restroom doors acting as egress doors as required by Authority Having Jurisdiction (AHJ).
- .2 Product: Low-Touch Restroom Control System - CX-WC17-PS as manufactured by Camden Door Controls.
  - .1 Operation:
    - .1 The door is normally closed and either locked or unlocked. Pressing the exterior push plate unlocks and opens the door. Once inside and the door is closed, pressing the 'Push to Lock' mushroom pushbutton, locks the door, disables the exterior 'Push to Open' push plate switch and illuminates the exterior annunciator to show 'Occupied when Lit'. Pressing the interior push plate switch unlocks the door, deactivates the illuminated annunciator and resets the system. If the door is opened manually to exit the restroom, the overhead magnetic contact switch resets the system.
    - .2 Status: Normally locked. Fail secure electric strike.
    - .3 Status: Normally unlocked. Fail safe electric strike.
  - .2 Components:
    - .1 The following items are part of the CX-WC17-PS equipment package:
      - .1 CX-33PS includes Advanced Logic Control Relay and 2 Amp Power Supply in pre-wired metal cabinet.
      - .2 CM-7536/4 36" tall 'Push to Open' push plate activation (wall) switch (2 required), extruded aluminum, N/O contacts rated 15 Amps @ 30VDC and 'wheelchair symbol & 'Push To Open' graphics (blue). Surface mount.
      - .3 CM-7536/8B 'Push to Lock' push plate activation (wall) switch (2 required), extruded aluminum, N/O contacts rated 15 Amps @ 30VDC and 'lock' symbol & 'Push To Lock' graphics (red). Surface mount.
      - .4 CM-AF503 Single Gang LED Annunciator, with heavy duty 18 gauge, vandal resistant stainless steel faceplate, to match CM-7536 series switches. 'Occupied When Lit' and 'Locked' text with white out' illumination and super-bright LEDs. Flush mount on single gang in-wall box.
      - .5 CX-MDA surface mount SPST N/C Magnetic Door Contact.
      - .6 CX-ED2079 Electric Strike, grade 2 'universal' strike for cylindrical locksets c/w 3 faceplates, 12/24V AC/DC, selectable fail safe/fail secure. The strike shall have horizontal faceplate adjustment.

.2 Automatic Door Operator by others

2.14 EMERGENCY CALL SYSTEM FOR RESTROOM

.1 Performance:

- .1 Emergency Call System shall comply with the latest requirements of the National Building Code (NBC).
- .2 Emergency Call System shall be designed to provide a washroom occupant with the ability to request emergency assistance, to receive visual and audible confirmation that their request has been made, and visual and audible notification to building staff and occupants outside the restroom of an emergency condition.

.2 Product: Emergency Call Systems For Universal & Barrier Free Restrooms - CX-WEC series System as manufactured by Camden Door Controls.

- .1 Operation: The 'Press For Emergency Assistance' mushroom push button is activated by the occupant. This energizes the LED annunciator and sounder within the washroom, and the dome light with sounder outside the washroom. Both annunciators will be energized until the latching mushroom push button switch is pulled out.
- .2 Components:
  - CM-AF54OSO Double gang 'Press for Emergency Assistance' switch, 'Push/Pull' operation with heavy gauge stainless steel faceplate, 1-5/8" (41.27mm) vandal resistant red button, N/O and N/C contacts, rated 10 Amp @ 30VDC and permanently laser etched graphics (black) c/w LED annunciator with adjustable sounder, rated 85dB at 4 inches, weather and vandal resistant construction, with 'ASSISTANCE REQUESTED'. 'White Out' text shall not be legible unless the annunciator is energized.
  - .1 CM-AF141SO: Single gang LED dome light with adjustable piezo sounder, rated 93dB at 3 feet (1 meter), weather (indoor/outdoor) and vandal resistant construction, white. 180 degree visibility with 'ASSISTANCE REQUIRED' text printed on two sides of lens.
  - .2 CM-SE21A: sign, to be located above the activation switch, 1/16 inch (1.6 mm), 6 inches H x 10-5/8 inches W, (152 mm x 270 mm), fire rated expanded PVC white with, 1 inch (25 mm) red lettering. Text shall be; 'IN THE EVENT OF AN EMERGENCY PUSH EMERGENCY BUTTON AND AUDIBLE AND VISUAL SIGNAL WILL ACTIVATE'.
- .3 Refer to drawing schedule for additional details.

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Provide all necessary interconnections, services and adjustments required for a complete and operable access control system.



- .2 Install control signal, communications and line grounding as necessary to preclude ground loops, noise, and surges from adversely affecting systems operations.
- .3 Coordinate all work with elevator supplier/installer for integration of the access control system with the elevator controls as required for a complete and operating system.
- .4 Enter the system parameters including floor plans and icons as per existing system configuration or as per the pre-installation meeting. Upon Final Acceptance the Contractor shall not remove or retain copies of any site specific data.
- .5 The Contractor shall turn over all keys, access cards/fobs and authorization medium to the owner upon completion of the project.
- .6 Install Bonding and Grounding in accordance with section 27 05 26.
- .7 Provide As-built drawings AutoCAD format

### 3.2 SITE VERIFICATION OF CONDITIONS

- .1 Contactor shall include all programming necessary to integrate all devices into the system
- .2 All Database programming for new installation to be supplied by the contractor
- .3 Configure gates to ensure all access requirements and groups required by the Owner are addressed

### 3.3 SEQUENCE OF OPERATIONS

- .1 Configuration of the system shall be in consultation with the Security operations centre and how each door operates including scheduling, the contractor shall program the system to meet the criteria contained herein.
- .2 Card Reader/Keypad Disable Feature
  - .1 The Operator via the Access control workstation shall have the ability to disable card readers, keypads and egress devices and either allow free access/egress or inhibit access/egress during defined time periods. These defined times shall be assigned through the system parameters.
  - .2 Access and egress attempts during free access periods shall be ignored by the system
  - .3 Access and egress attempts during inhibit periods shall be recorded in the event logger.
  - .4 During the construction phase the free egress can be set to construction site work hours, upon acceptance of the system, the card readers shall be set to the normal operation sequence and all contractors shall follow site security requirements for access to the site
- .3 Event Logger Messages
  - .1 Event logger messages shall contain at a minimum the following information
    - .1 Event number
    - .2 Time of Day for each event in hours minutes and seconds.

- .3 Date of each event in days months and years
  - .4 Type of event, entry, exit.
  - .5 Event action -active, acknowledged, cancelled or masked.
  - .6 User name on valid entry
  - .7 Location and Name, gate number.
  - .8 Each Alarm event shall be graphically represented on the site plan and a audible alarm at the access control operator station allow for system administrator to silence alarms.
  - .9 All messages can be exported via a CSV format or printed using a report from any operator workstation.
  - .10 Contractor will program the logger messages to integrate with security personnel requirements and existing system functionality.
  - .11 All Event log information shall be archived in a format that can be easily exported to other applications.
- .4 Programming of the system
- .1 The contractor shall program the system to include all operational parameters as required by Owner.
  - .2 The software options for schedules, software anti-pass back, and time delay options shall be programmed as per Consultants requirements

END OF SECTION

Part 1            General

1.1            SECTION INCLUDES

- .1      Security Control Cabinet
- .2      Intrusion Alarm Panel
- .3      Power Supply Relay Output Module
- .4      Addressable Module /Zone Expansion Module
- .5      Intrusion Alarm Numeric Keypads
- .6      Magnetic Door Contacts
- .7      Motion Detectors
- .8      Glass Break Detectors
- .9      Tamper Alarms
- .10     Panic Alarms
- .11     End of Line devices
- .12     Power Supply
- .13     Telephone Voice Dialer
- .14     Keypad Enclosure
- .15     Heated Keypad Enclosure
- .16     Indoor/Outdoor Siren

1.2            RELATED SECTIONS

- .1      Refer to Section 27 05 00 for related sections applicable to project.
- .2      Refer to Section 28 31 01 Fire Detection and Alarm
- .3      Refer to Section 27 05 00 for references applicable to the project.

1.3            DEFINITIONS

- .1      SCU (Security Control Unit): An Electronic Control Panel to which and alarm and detection devices are wired. The SCU is wired to a Central Monitoring.

- .2 Disarm: The act of disabling or shunting a security system or portions of the system to ignore input signals that normally result in alarms. Disarming can occur with user intervention, such as pass codes entered into a keypad
- .3 Door Forced: A door forced alarm is the resulting logical alarm that occurs at a portal when the door is sensed to be in an open state without an associated valid access card transaction or an associated REX signal.
- .4 Door Held: A door held alarm is the resulting logical alarm that occurs at a portal when the door was opened after a valid access transaction or a valid.
- .5 Dual Technology: Utilization of two different technologies in one device to increase reliability and functionality. Dual technology motion sensors, for example, use both passive infrared and microwave technology in order to reduce false alarms and increase detection.
- .6 Duress Alarm: A device, such as a push button or pull station, connected to a security system to signal an alarm when an individual is threatened or forced to do something. Bank Clerks typically have a duress alarm installed beneath their counter to signal robbery attempts.
- .7 End of Line Device: An End of line resistor used as a supervisory device at the end of the zone.
- .8 Host Security Control Unit: In a security system, an Security Control Unit (SCU) that primarily provides services such as decision making, data base access, and communicates with the Central Monitoring Station; the primary or controlling panel in a multiple SCU installation.
- .9 Isolation Relay: A relay used to isolate two different systems that must integrate with one another through contact closures, or when the controlling systems relays are underrated for the load.
- .10 Keypad: A device that provides a localized user interface to control a security system or subsystem. Typically includes a numerical 10-key touchpad to allow entering of pass codes and commands.
- .11 Local Audible Alarm (LAL): A device used to annunciate locally an alarm condition or security violation.
- .12 Magnetic Door Contact: A device used to generate a alarm when the magnet between the door and the frame is broken.
- .13 Glass Break Sensor: A device that detects the unique sound and or pressure change in the room should a window be broken to generate alarm to the central monitoring station
- .14 Passive Infrared (PIR): Typically, a sensor device that can sense movement within a specific area and change the state of a set of internal contacts as a result. These

contacts are wired to Security Control System to generate an alarm at the central monitoring station.

- .15 Security Equipment Enclosure (SEC): A cabinet or enclosure containing security equipment or controls.
- .16 Security Operations Center (SOC): The central commanded center location where security personnel monitor and respond to security and safety related incidents.
- .17 Supervision: The electronic process of continually metering the integrity of an electrical circuit connects signaling devices to a processing host panel. Supervision can measure 5 conditions and typically checks for shorts, open loops, and power failures.
- .18 Tamper Alarm, a contact that is installed in enclosures to detect opening and generate a alarm to the central monitoring station.

#### 1.4 SYSTEM DESCRIPTION

- .1 An Intrusion Alarm system is an Electronic System, or network of integrated systems designed to monitor alarms in a facility or campus. Intrusion alarm is the process of providing security and safety and generating alarms and audible devices to a central monitoring system.
- .2 The Intrusion Alarm will consist of a perimeter security system covering all exterior doors which can be disabled during occupancy times and enabled during quiet hours, and a number of 24hour and secure areas within each facility that will be monitored by a central monitoring station by means of a continuously supervised communications link
- .3 The Intrusion Alarm system shall monitor for intrusion attempts only and operate completely separate from all other system, including access control, Fire Alarm, Energy management systems, and Emergency Communications systems.
- .4 The Intrusion Alarm system shall have a separate independent conduit system.
- .5 Each component of the system must be non-proprietary and not exclusive to any installing dealer.
- .6 All components must be off the shelf and available through at-least four full service dealers.
- .7 All components and central monitoring station must comply with latest edition of CAN/ULC-S304, Contractor will ensure installation will ensure compliance with monitoring agency.
- .8 Use all new material and conform to the latest editions of the codes and standards identified above. In case of a conflict or discrepancy, the most stringent requirement applies.

- .9 A functionally complete, integrated Digital Alarm Communicator System (DACS) per manufacturer's guidelines, codes and specification requirements as follows:
- .1 The DACS shall include a Control Panel with built-in Ethernet jack for event communication and remote services.
  - .2 The DACS shall include a Control Panel with an optional, supervised telephone line interface module.
  - .3 The DACS shall include recording and retention of event information in a dedicated event log.
  - .4 The DACS shall incorporate an integral real-time clock, calendar, and a test timer.
  - .5 The DACS shall incorporate battery charging capabilities with supervision of battery voltage and battery leads.
  - .6 The DACS shall accommodate a time / event-based scheduling system.
  - .7 The DACS shall be capable of supervision of peripheral devices and communications interfaces.
  - .8 The DACS shall accommodate configuration and operation of separate, independent areas.
  - .9 The DACS shall accommodate hard-wired or wireless point expansion via eight-point interface modules and RF receivers.
  - .10 The DACS shall accommodate addressable expansion utilizing a 2-wire bus
  - .11 the DACS incorporate removable terminal strips for wiring connection to facilitate simple service and replacement
  - .12 The DACS shall have electrically supervised detection loops and power supplies with battery(s) maintenance. This supervision shall be programmable for the purposes of reporting this information to the DACR.
  - .13 The DACS shall be capable of sending (manually or automatically) test and status reports to remote DACRs.
  - .14 The DACS shall be able to accommodate test, diagnostics, and configuration programming functions locally or remotely via a portable programmer or a computer running the Remote Programming Software (RPS).
  - .15 The DACS shall annunciate alarm, trouble, service reminders, and other relevant system status messages in custom English, Latin American Spanish, Portuguese, Canadian French, Hungarian, Greek, Italian, Polish, German, Dutch, Swedish and/or Chinese text at the ACC.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit to the Consultant shop drawings, product data (including cut sheets and catalog information). Submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the work or in the activities of separate Contractors. The Consultant will indicate approval of shop drawings, and product data.

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- .3 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for access control systems and include product characteristics, performance criteria, physical size, finish and limitations.
  - .4 Shop Drawings:
    - .1 Indicate on drawings:
      - .1 Riser diagram, block diagram of complete system.
      - .2 Security system design criteria.
- 1.6 CLOSEOUT SUBMITTALS
- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
  - .2 Operation and Maintenance Data: submit operation and maintenance data for public address systems for incorporation into manual.
  - .3 Include in manual:
    - .1 Operation instructions.
    - .2 Description of system operation.
    - .3 Description of each subsystem operation.
    - .4 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.
    - .5 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.
- 1.7 QUALITY ASSURANCE
- .1 Qualifications
    - .1 Contractor shall have a minimum of two on-site Manufacturer factory trained and ULC certified installers during the course of the installation
    - .2 A Factory Trained ULC Certified Site Superintendent shall be on site for the duration of the installation and testing and all communication shall be thru the site Superintendent
    - .3 The Site Superintendent shall ensure the installation is conducted in a neat and professional manner and ensure the highest level of quality is maintained.
    - .4 The Contractor shall visit the site during the pathway installation to ensure the conduit and wiring is installed as per ULC and manufacturer's requirements.
  - .2 Pre-Installation Meetings
    - .1 The Intrusion Alarm Contractor shall arrange a meeting 7 business days prior to installation or configuration of devices with the Consultant, Owner's Representatives.
    - .2 All operation modes of the system shall be discussed and approved to the satisfaction of the Owner and in Accordance with ULC.

## 1.8 WARRANTY

- .1 The system and equipment will be warranted for a period of one year from final acceptance of the system.
- .2 During the course of installation and the one year warranty period, warranty work on the system shall be available 24 hours a day 7 days a week on site and the warranty shall be at no additional cost to the Owner. The Owner will not be responsible for any costs associated with travel parts or labour to fulfill the warranty work.
- .3 The Contractor will maintain sufficient parts in stock to replace items found faulty during the warranty period
- .4 The Contractor shall submit a warranty certificate covering all manufacturers' components and the Contractor installation. Dated on the day final acceptance and all deficiencies have been corrected to the satisfaction of the Owner, with the following information:
  - .1 Name and Address of Project
  - .2 Name and Address of the Contractor
  - .3 Warranty Commencement Date
  - .4 Duration of Warranty
  - .5 Clear definition of all included devices in system and indicating what remedial action will be taken under the warranty.
  - .6 Signature and seal of Warrant.

## 1.9 TRAINING

- .1 Refer to Section 01 79 00 and 27 05 00 for additional training requirements.

## Part 2 Products

### 2.1 INTRUSION ALARM CONTROLLER UNIT

- .1 The DACS control panel shall be Bosch Security Systems, Inc. model B9512G comprising a fully integrated intrusion and residential fire control system.
- .2 The control panel shall support the following:
  - .1 The DACS system is capable of being utilized as a combination Intrusion and Commercial Fire system per code. Fully integrated intrusion and fire functions allow users to interface with 1 system instead of 2
  - .2 Optional Telephone Line Module, programmable for signaling and supervision.
  - .3 Integrated Conettix IP based communication provides high-speed, secure alarm transport and control.
  - .4 32 programmable areas with perimeter and interior partitioning.



- .5 8 on-board, hardwired points with expansion capability for a total of 599 using a combination of wired or wireless points.
- .6 Compatibility with Color Graphic Touch Screen, 2-line alpha numeric capacitive touch, ATM style LCD or 2-line LCD style Alarm Keypads.
- .7 Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
- .8 The system shall include an integrated USB port for local programming and diagnostics using a computer running Remote Programming Software (RPS) and a male USB2.0 to male USB 2.0 cable with no additional hardware modules required.
- .9 The system shall support the use of an Apple iOS device and/or Android device for control. Functions to include arming, disarming and control of outputs and access door, viewing of connected IP cameras. This application shall connect directly to the DACS using internet, wifi or cellular communications and shall not require a third party server or network operations center (noc).
- .10 The DACS will allow integration with IP video cameras using the built-in Ethernet connection, allowing the cameras to act as inputs and outputs.
- .11 The DACS shall support integration with the Video Management System (BVMs) using the built-in Ethernet adapter.
- .12 The DACS shall support up to thirty-two (32) custom functions allowing the installer to combine up to 6 functions into one command. These custom functions shall be operated by keypad command, point activation, keyfob button, or programmable schedule
- .13 The DACS shall support up to 32 keypad shortcuts which allow the installer to define which commands are available at each keypad.
- .14 The system shall offer multiple language support that can be assigned per keypad. The system shall offer multiple language support that can be assigned per keypad. Languages supported must include English, Latin American Spanish, Portuguese, Canadian French, Hungarian, Greek, Italian, Polish, German, Dutch, Swedish and/or Chinese.
- .15 The DACS shall support flash firmware upgrades of systems firmware for the control panel and peripherals, allowing for future updates.
- .16 Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control and automatic execution of system functions based on a time / event.
- .17 Provide 1.4 amps of power for standby operation and 2.0 amps of alarm power, both rated at 12 VDC.
- .18 3 configurable form 'C' wet or dry-contact relay outputs with expansion capability for up to an additional 472 dry-contact relay outputs.
- .19 Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
- .20 Supervision of peripheral devices and communications interface(s).
- .3 Point Functionality and Expansion:

- .1 Each point in the system shall be programmable to provide the following type of response in the system:
  - .1 Always on (24 hour response).
  - .2 On when the system is Master Armed.
  - .3 Only on when the system is Perimeter Armed.
  - .4 Displays / Does Not Display at the ACC when the point is activated.
  - .5 Provides / Does Not Provide entry warning tone.
  - .6 Sounds / Does Not Sound audible alarm indication.
  - .7 The Point is bypassable / not bypassable.
  - .8 Alarm Verification with programmable verification time.
  - .9 Fire Alarm Point
  - .10 Relay activation by Point.
  - .11 Provides / Does Not Provide "watch point" capability.
  - .12 Provides Swinger Bypass.
  - .13 Defers Bypass Report.
  - .14 Can return to the system after being force armed and then restoring.
  - .15 Can return to the system after being bypassed and then restoring.
  - .16 Keyswitch arming (maintained or momentary)
  - .17 Activate by Custom Function
  - .18 Activate following an output
  - .19 Gas Alarm
- .2 The system shall support a programmable Monitor delay functionality for supervision of points during disarmed periods. These points may be programmed to ignore status from 1 to 60 minutes and will activate only if the point is off-normal for this time period.
- .3 The system shall support a programmable delay response functionality for supervision of points during armed or disarmed periods. These points may be programmed to ignore status from 1 to 60 minutes and will activate only if the point is off-normal for this time period.
- .4 The system shall support virtual points and outputs for customized programming of events
- .5 The DACS shall be capable of supporting "group zoning." Group zoning refers to the combining of points into a separately identifiable and separately annunciated (programmable text) areas.
- .6 The DACS shall be capable of allowing variable point response times via programming. Point response times shall be programmable over a range of 300 milliseconds to 4.5 seconds.
- .7 The DACS shall have the capability to expand up to 599 separately identifiable points, of which 8 are on-board and 472 are off-board wired, addressable or wireless points.
  - .1 The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.

- .2 Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
    - .3 Addressable modules shall be able to be located remote to the panel to a maximum of 500 feet.
  - .8 The DACS shall have the capability to expand up to 99 separately identifiable points, of which 8 are on-board and 91 are off-board addressable points connected to multiplexed backbone trunks via wired modules and/or wireless receivers.
    - .1 The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
    - .2 Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
    - .3 Addressable modules shall be able to be located remote to the panel to a maximum of 500 feet.
- .4 Areas/Accounts:
  - .1 The DACS shall support 32 independent areas. Each of the 32 areas shall have custom text associated with the armed state, disarmed state and point-off-normal state.
  - .2 The DACS shall be capable of assigning 1 to 4 account identifiers to the areas depending on the distribution of areas per account.
  - .3 The DACS shall be capable of assigning 1 to 2 account identifiers to the areas depending on the distribution of areas per account.
  - .4 All of the areas must be capable of Master (All) and/or Perimeter (Part) arming (excluding predefined Interior protection).
  - .5 The DACS shall be capable of logically grouping 1 or more points into an area, or conversely, dividing 2 or more points into two or more areas.
  - .6 Any area shall be configurable to allow arming by specific users when a programmable number of devices are faulted or bypassed.
  - .7 Areas shall be independently controlled by their corresponding ACC.
  - .8 Area(s) shall accommodate assignment of independent account numbers to define annunciation, control, and reporting functions.
  - .9 The DACS shall be capable of linking multiple areas to a shared area which may be automatically controlled (hallway or lobby).
  - .10 The DACS shall accommodate conditional area arming dependant on the state of other areas (master or associate). Any area can be configured for perimeter and interior arming, not requiring a separate area for this function.
- .5 Output Relay Expansion: The DACS shall provide the capability for output relay expansion using relay expansion modules. Independent control of relay functions by area shall be possible through programming assignments.
  - .1 The DACS shall be capable of activating 472 additional relay outputs for auxiliary functions based on its classifications (area vs. panel wide). Output Expansion Modules shall be able to be located remote to the main panel to a maximum distance of 1000 feet. 8 relays (Form C) are to be provided per octo-relay module

- .2 The DACS shall be capable of activating 64 additional relay outputs for auxiliary functions based on its classifications (area vs. panel wide). Output Expansion Modules shall be able to be located remote to the main panel to a maximum distance of 1000 feet. 8 relays (Form C) are to be provided per octo-relay module
- .3 The DACS shall be capable of controlling relays and automatically executing system functions based on a time / event scheduling program. The program can be hour, day of week or day of month based.
- .4 Relays and other outputs may be programmed to follow up to 14 different area conditions or up to 12 panel conditions. Relays may also be programmed to follow individual points or groups of points.
- .5 The DACS shall support 5 different types of alarm output selections: Steady, Pulsed, California Standard, Temporal Code 3 and Temporal Code 4.
- .6 Scheduling: The DACS shall support scheduling capabilities with the following characteristics:
  - .1 Arm / Disarm specific area(s) based on open/close windows.
  - .2 Bypass / Unbypass point(s).
  - .3 Activate / Deactivate relay(s).
  - .4 Send test reports.
  - .5 Up to 4 programmable holiday schedules of 366 days each (includes leap year). Based on the holiday settings, different time windows for open/close and other system functions can be executed.
  - .6 Automatic adjustment of system clock for daylight savings time.

## 2.2 KEYPAD

- .1 The remote keypad node must feature a 2-line by 24 characters, backlit, adjustable LCD display.
- .2 The remote keypad node must have a 20-key backlit keypad for entry of data, including user codes, and for selection of system menus.
- .3 The remote keypad node must provide visual and audible feedback to the user when entering each digit, when signaling an alarm or status alert message, and to signal entry/exit delay times.
- .4 The remote keypad node must have status LED indicators and must have 2 zone inputs (wired in a 2 EOL configuration), and a relay output.
- .5 The remote keypad node must communicate to the controller unit via the RS485 bi-directional Ringnet cable.
- .6 The remote keypad node must have a ULC label.
- .7 The remote keypad node must have an internal tamper switch which activates upon removal of the cover.

- .8 Acceptable Products: Bosch D1255

## 2.3 ADDRESSABLE MODULE (INPUT/OUTPUT NODE)

- .1 The 8-Input to 16-Input/1 Output Node shall be capable of monitoring a minimum of 1 zone input and a maximum of 8 zone inputs. The zone inputs connect to devices such as motion detectors, door contacts, glass break detectors, smoke detectors, etc.
- .2 Each zone input on the 8-Input/1-Output node must be wired in a 2-EOL resistor configuration to guarantee tamper protection at all times.
- .3 The on-board relay shall be assigned to any output number and responds under program control from the control unit.
- .4 The 8-Input/1-Output node must communicate to the controller unit via the RS485 bi-directional Ringnet cable.
- .5 The 8-Input/1-Output node must have an internal tamper switch which activates upon removal of the cover.
- .6 The 8-Input/1-Output node must have a ULC label.
- .7 The 8-Input/1-Output node must have an internal buzzer.
- .8 The 8-Input/1-Output node must have a RS485 activity LED.
- .9 Acceptable Product: Bosch B208

## 2.4 INTRUSION ALARM PANEL PROGRAMMING SOFTWARE

- .1 The upload/download software must be capable of communicating to the controller unit via its RS232 communication port at a speed of 19200 Baud and IP over the network.
- .2 The software must be capable of setting up all zone inputs, relay outputs, and all users.
- .3 The software must be capable of monitoring all nodes, zones, doors, and outputs.
- .4 The software must be capable of sending all programming information to a printer.
- .5 The software must be capable of retrieving the history log from the controller unit.
- .6 The software must be capable of communicating with the controller unit over IP.
- .7 Acceptable Products: The same as Intrusion Alarm manufacturer

## 2.5 MAGNETIC DOOR CONTACTS

- .1 Standard Door Contacts

- .1 Provide 1 inch Rare earth magnet, wide gap
- .2 Colour identical throughout the installation.
- .3 Provide separate and independent contacts for intrusion
- .4 Sensors shall be installed as close as possible to the leading edge of the door, as a minimum an alarm shall be generated when door movement exceeds 25mm
- .5 Acceptable Product: GE 1078 with optional 1840 Rare Earth Magnet, Tane SM35, Honeywell 7939WG
- .2 Surface Mounted Door Contacts
  - .1 Provide 1 inch Rare earth magnet, wide gap
  - .2 Colour identical throughout the installation.
  - .3 The high security magnetic contact and actuating magnet housings measure 10.80 cm x 3.81 cm x 1.91 cm. The housing made of brushed anodized aluminum.
  - .4 Provide separate and independent contacts for intrusion
  - .5 Sensors shall be installed as close as possible to the leading edge of the door, as a minimum an alarm shall be generated when door movement exceeds 25mm
  - .6 Acceptable Product: Sentrol 2707, Ademco 968XTP, Honeywell 968XTP
- .3 Overhead Door Contacts
  - .1 Provide industrial wide gap Stainless steel armored cable door contacts
  - .2 Armored cable must be a minimum of 600mm long and with stainless steel coating.
  - .3 Sensors shall be installed parallel to the door track and above the floor, provide appropriate mounting brackets.
  - .4 Acceptable Products: Sentrol 2202AU-L, Sentrol 2207AH, Tane ODC59A, Honeywell 958.

## 2.6 DUAL TECHNOLOGY INDOOR MOTION DETECTORS

- .1 Acceptable sensor technologies include passive infrared (PIR) and dual technology PIR/microwave.
- .2 Dimensions 7.1cm W x 5.8cm D x 13cm H
- .3 Color White
- .4 Detection range 10.7m x 90°
- .5 Microwave Frequency 5.8GHz
- .6 Mounting height: 2.1-2.7m
- .7 Field wiring 12-24AWG
- .8 Target velocity 0.5 ft/sec to 5 ft/sec

- .9 Alarm hold time 5 sec  $\pm$  10%
  - .10 Environmental
    - .1 Operating temperature 32° to 122°F (0° to 50°C)
    - .2 Relative humidity 5-93% non-condensing
  - .11 Electrical
    - .1 Input voltage 8.5-18VDC (10-16VOL)
    - .2 Typical current 27mA
    - .3 Max current 35mA
    - .4 Relay rating 28VDC, 100mA max
  - .12 Range Settings: 30ft
  - .13 Detectors shall offer immunity to other types of signals including radio frequency interference (RFI), electromagnetic interference (EMI) voltage spikes, static discharge, etc.
  - .14 Should the contractor install devices that do not cover the complete area, they will relocate or provide additional devices at no cost to the Departmental Representative.
  - .15 Acceptable Products: Bosch DS835
- 2.7 360 DEGREE MOTION DETECTORS
- .1 Physical Dimensions
    - .1 12.7cm H x 12.7cm W x 5.8cm D
  - .2 Weight: 397 g
  - .3 Power Requirements
    - .1 10 - 14.5VDC
    - .2 40mA, 12VDC typical
  - .4 Trouble Output
    - .1 Open collector: voltage between collector and emitter (Vce) is 0.3V @ 50mA
  - .5 Alarm Relay
    - .1 Energized Form C: (N.O./N.C.) reed relay rated 125mA at 25VDC
  - .6 Command Output
    - .1 Self-test initiate
    - .2 Active: 0 – 1.5V (low)
    - .3 Inactive: 6 – V+ (high)
    - .4 Impedance: 110K (minimum)

- 
- .7 Microwave Frequencies
    - .1 10.525 GHz
  - .8 Tamper Switch
  - .9 Ceiling and cover tamper switches; Form A (N.C.) switch rated 25mA,30VDC
  - .10 Operating Temperature
  - .11 – 32° – 120° F (0° – 49° C); 5% to 95% relative humidity, non condensing
  - .12 RFI Immunity
    - .1 30 Vm, from 10 MHz – 1000 MHz
  - .13 PIR White Light Immunity
    - .1 900 LUX
  - .14 Detection Range
    - .1 7.6m radius
  - .15 PIR Fields of View
    - .1 8'–11' mirror assembly (three 360° fields)
    - .2 Long range: 36 Lower: 16
    - .3 Intermediate: 24 Look-down: 1
    - .4 12'–16' mirror assembly (two 360° fields)
    - .5 Intermediate: 20
    - .6 Look-down: 1
  - .16 Sensitivity
    - .1 2–4 steps within field of view
  - .17 Approvals/Listings
    - .1 FCC certified, UL listed, ULC, IC certified, C-Tick
  - .18 Acceptable products: Bosch DS9360
- 2.8 GLASSBREAK DETECTORS
- .1 White high impact ABS plastic housing
  - .2 Acceptable sensor based on “Tru Dual” Technology, superior combination of acoustic and seismic detection.
  - .3 Physical Dimensions
    - .1 98mm H x 62mm W x 21.8mm D



- 
- .4 Weight
    - .1 90g
  - .5 Range
    - .1 25' (7.6 m) maximum, omnidirectional. Range is adjustable; no minimum range
  - .6 Alarm Relay
    - .1 Form C, 125mA max, 25VDC max
  - .7 Tamper Switch
    - .1 Combination cover/wall tamper
  - .8 25mA max, 24VDC max
  - .9 Alarm Duration
    - .1 Five seconds (unaffected by alarm LED latching)
  - .10 ESD Immunity
    - .1 10kV discharges of either polarity to exposed surfaces
  - .11 Power Requirements
    - .1 6 - 18VDC, 12mA typical at 12VDC; 22mA max (Latched LED) AC ripple: 4V peak-to-peak at nominal 12VDC
  - .12 RFI Immunity
    - .1 30V/m, 10MHz - 1000MHz
  - .13 Operating Temperature
    - .1 -10° to 50° C
  - .14 Approvals and Listings
    - .1 FCC and IC verified
    - .2 CE
    - .3 C-Tick
    - .4 UL Listed
    - .5 ULC Listed
- 2.9 POWER SUPPLY CHARGER
- .1 12VDC or 24VDC selectable output.
  - .2 12VDC @ 4 amp or 24VDC @ 3 amp supply current.
  - .3 Class 2 Rated power limited output.
  - .4 Input 120VAC / 60Hz, 1.45 amp.

- .5 Input fuse rated @ 3.5 amp/250V.
- .6 Filtered and electronically regulated output.
- .7 Short circuit and thermal overload protection.
- .8 Built-in charger for sealed lead acid or gel type batteries.
- .9 Maximum charge current .7 amp.
- .10 Automatic switch over to stand-by battery when AC fails (zero voltage drop).
- .11 AC fail supervision (form "C" contacts).
- .12 Low battery supervision (form "C" contacts).
- .13 Battery presence supervision (form "C" contacts).
- .14 AC input and DC output LED indicators.
- .15 Enclosure:
  - .1 Combination knockouts are 1/2" and 3/4"
  - .2 Accommodates up to two (2) 12VDC/7AH batteries.
- .16 Acceptable Products: Bosch AL400U

## 2.10 POWER SUPPLY RELAY OUTPUT

- .1 The PC4204 is a dual purpose power supply/output module, providing programmable relay outputs for controlling external devices and power to repower the Combus... to provide additional power as required for downstream devices which are powered off of the Combus :
- .2 Includes 4 fully programmable high current relays with Form 'C' contacts rated 2A @ 30VDC
- .3 Provides 1A @ 12VDC to power direct connected devices or repower the Combus (uses relay #1 when repowering Combus)
- .4 Connect up to 16 modules per system for 64 relays total each relay programmable to activate for any of 59 options.
- .5 Complete with supervised battery charger : 12VDC, 350mA charging current for sealed lead-acid rechargeable batteries
- .6 Fully supervised for low battery, and aux supply and AC power loss connection for external tamper supervised by system
- .7 Connect up to 1,000' (305m) from control panel via COMBUS
- .8 Operating environment - 0 to 50°C- 90% RH non-condensing

- .9 Current draw:30mA (from Combus)
- .10 Acceptable Product: Bosch
- 2.11 TAMPER ALARM
  - .1 All enclosures containing electronic components shall be equipped with a tamper alarm.
- 2.12 PANIC ALARMS
  - .1 General
    - .1 Panic alarms shall be activated by a hardwired pull down type switch which has to be manually reset after activation.
    - .2 All panic buttons shall be clearly identified by a label (Brother P2000 or equivalent).
    - .3 All panic buttons to be located on boarding counters, check-in counters and baggage counter using an RJ 12 wall jack and a telephone patch cord to the jack. The wall jack shall be clearly identified by a label marked "Panic System" (Brother P2000 or equivalent).
    - .4 Provide panic button at GN office and elder lounge.
  - .2 Local Response Systems (Not monitored)
    - .1 Unless specified, the panic alarm system shall be a separate, standalone system and will not be monitored.
    - .2 Local panic systems will not be integrated into the main intrusion alarm panel.
    - .3 When the panic alarm is pulled, a flashing light and chime (or other unique audible signal) shall sound in a remote designated area (signal should not be within sight or hearing of push button location) confirm location with owner.
    - .4 Where multiple panic alarm locations are provided, a standalone panel shall be installed. Each standalone panic alarm panel will be controlled by an LED keypad that will clearly identify the location of each panic button. If more than 16 panic buttons are required then the panic alarm system shall annunciate to appropriately sized LED graphic enunciator panels.
    - .5 Make and model of panic button shall be decided in consultation with a Security Services representative.
    - .6 Standard of Acceptance: Multi-zone non-monitored panel: DSC 5010 or 4020  
Panic button: Potter HUB-M (non-latching), GE Sentrol 3045 (non-latching LED)
  - .3 Monitored Panic Alarm Systems
    - .1 As per above specifications except that each panic button shall be connected to the main intrusion alarm system panel and each panic button shall be identified as an individual zone. If more than 16 panic buttons are required then the panic alarm system shall annunciate to appropriately sized LED graphic enunciator panel(s).

- .2 Security Services is to be consulted as to whether or not monitored panic buttons will also report locally. (Note that most monitored panic alarms do not report locally - either audibly or with a strobe).
- .4 Wireless Panic Alarm Systems
  - .1 Provide ten (1) wireless Pendants.
  - .2 All wireless panic alarms must be tested throughout the entire protected area so as to ensure that the panic buttons work in all locations
  - .3 Standard of Acceptance DSC WS 4945/ DSC 4938 Pendant
- 2.13 END OF LINE DEVICES
  - .1 End of line supervisory devices to be mounted on a plate complete with a nameplate identifying appropriate zone/circuit identification at a control unit.
  - .2 Suitable for single gang standard electrical box mounting.
  - .3 Steel construction with lamacoid label.
- 2.14 INDOOR/OUTDOOR SIREN
  - .1 The siren is a dual tone notification device with patented piezo dynamic technology.
  - .2 Primary Power : 6 – 14VDC
  - .3 Current Draw: 125mA
  - .4 Wattage: 15 Watt Dualtone Siren
  - .5 Decibel Rating: 110 dB ( $\pm$  3 dB)
  - .6 Decibel Output: 108  $\pm$ 2 dB at 12 VDC / 3 feet
  - .7 Operating Temp. -40°C to 70°C
  - .8 Dimensions: 4" W x 4" H x 1" D
  - .9 Material White ABS Plastic Housing
  - .10 Weather Resistant Suitable for indoor/outdoor use
  - .11 Allow for a quantity of 3 to be located as directed by owner.
  - .12 Acceptable Product: Amseco SSX-52SB with Blue Strobe (For Indoor/Outdoor installation)

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Install Intrusion Alarm system in a completely independent conduit system from other Communications Systems
  - .1 Primary/Secondary Colour for Intrusion alarm system Green/Grey
- .2 Label all conduits cabinets and pull boxes in accordance with section 27 05 53.
- .3 Provide all necessary interconnections, services and adjustments required for a complete and operable intrusion alarm system.
- .4 Enter the system parameters and initial training to coincide with existing system configuration or as per the pre-installation meeting. Upon Final Acceptance the Contractor shall not remove or retain copies of any site specific data and passwords.
- .5 The Contractor shall turn over all keys, codes and authorization medium to the Owner upon completion of the project.
- .6 Install Bonding and Grounding in accordance with section 27 05 26.
- .7 Provide As-built drawings AutoCAD format

3.2 SITE VERIFICATION OF CONDITIONS

- .1 Contactor shall include all programming necessary to integrate all devices into any existing system
- .2 All programming for new installation, integration, or migration to existing system to be supplied by the Contractor
- .3 Configure devices to ensure all requirements and password groups required by the Owner Security are addressed

3.3 SEQUENCE OF OPERATIONS

- .1 Alarm Arm/Disarm
  - .1 Upon entering an "armed" area through a designated access point, the local audible alert signal and an entry delay period timer shall be initiated.
  - .2 Entry into an "armed" area through non-designated access points shall generate an immediate intrusion alarm at the Central monitoring station.
  - .3 If the entry delay period expires before a valid code is entered, an intrusion alarm shall be generated at the Central monitoring station and recorded in the event logger.
  - .4 At the keypad, the user shall be given 3 (three) opportunities to enter a valid PIN during the entry delay period before an intrusion alarm is generated at the Central monitoring station.

- .5 The sensors shall remain disarmed until a subsequent PIN entry operation.
  - .6 The Control Unit shall ignore area alarm and sensor activation during the exit delay period.
  - .7 It shall be possible for the system administrator to independently adjust the entry and exit alert time period.
  - .8 It shall be possible to set entry/exit delay up to 2 (two) minutes.
  - .9 It shall be possible to assign specific alarm points to each keypad within the same Control Unit. Arming and disarming alarm points assigned to one keypad shall have no effect on the alarm points assigned to another keypad.
- .2 Event Logger Messages
- .1 Event logger messages shall contain at a minimum the following information
    - .1 Event number
    - .2 Time of Day for each event in hours minutes and seconds.
    - .3 Date of each event in days months and years
    - .4 Type of event, entry, exit.
    - .5 Event action -.
    - .6 Building Location and Name, Door number or Room Number and display and sensor type
    - .7 Contractor will program the logger messages to integrate with security personnel requirements and existing system functionality.
- .3 Programming of the system
- .1 The Contractor shall program the system to include all operational parameters as required by the Monitoring Agency.
  - .2 The messages displayed at central monitoring Station should be plain text readable, for example Owner Building... Address, Door Number X Room XX.

END OF SECTION

Part 1            General

1.1            SECTION INCLUDES

- .1      Network Video Recorder
- .2      Video Management Software
- .3      Type "A" – 8MP Exterior Pan/Tilt/Zoom Network Camera.
- .4      Type "B" – 12MP Indoor Ceiling Mounted 360° Network Camera.
- .5      Type "C" – 6MP Indoor Fixed Ceiling Mounted Network Camera.
- .6      Type "D" - 6MP Indoor Fixed Wall Mounted Network Camera.
- .7      Type "E" – 3MP Indoor Dual Head Wall Mounted Network Camera.
- .8      PTZ Controller.
- .9      KVM Rack Switch.
- .10     Outdoor POE PTZ Injector.
- .11     Network Switch, PoE Switch and Power Supply
- .12     Personal Computer and Monitor for Video Surveillance and Access Control

1.2            RELATED SECTIONS

- .1      Refer to Section 27 05 00 for related sections applicable to project.

1.3            REFERENCES

- .1      Refer to Section 27 05 00 for references applicable to this project.

1.4            ACTION AND INFORMATIONAL SUBMITTALS

- .1      Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2      Submit to the Consultant shop drawings, product data (including cut sheets and catalog information). Submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the work or in the activities of separate Contractors. The Consultant will indicate approval of shop drawings, and product data.
- .3      Product Data:
  - .1      Submit manufacturer's instructions, printed product literature and data sheets for access control systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .4      Shop Drawings:

- 
- .1 Indicate on drawings:
      - .1 Riser diagram, block diagram of complete system.
      - .2 Security system design criteria.
  - 1.5 CLOSEOUT SUBMITTALS
    - .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
    - .2 Operation and Maintenance Data: submit operation and maintenance data for public address systems for incorporation into manual.
    - .3 Include in manual:
      - .1 Operation instructions.
      - .2 Description of system operation.
      - .3 Description of each subsystem operation.
      - .4 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.
      - .5 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.
  - 1.6 QUALITY ASSURANCE
    - .1 Qualifications
      - .1 Contractor shall have a minimum of two on-site Manufacturer factory trained installers during the course of the installation.
      - .2 A Factory Trained Site Superintendent shall be on site for the duration of the installation and testing and all communication shall be thru the site Superintendent.
      - .3 The Site Superintendent shall ensure the installation is conducted in a neat and professional manner and ensure the highest level of quality is maintained.
      - .4 The Contractor shall visit the site during the pathway installation to ensure the conduit and wiring is installed as per manufacturer's requirements.
    - .2 Pre-Installation Meetings
      - .1 The Video Surveillance Contractor shall arrange a meeting 7 business days prior to installation or configuration of devices with the Engineer.
      - .2 All operation modes of the system shall be discussed and approved to the satisfaction of the Consultant and owner.
  - 1.7 WARRANTY
    - .1 The system and equipment will be warranted for a period of one year from final acceptance of the system.
    - .2 The Contractor will maintain sufficient parts in stock to replace items found faulty during the warranty period.



- .3 The contractor shall submit a warranty certificate covering all manufacturers' components and the contractor installation. Dated on the day final acceptance and all deficiencies have been corrected to the satisfaction of the Consultant, with the following information:
  - .1 Name and Address of Project
  - .2 Name and Address of the Contractor
  - .3 Warranty Commencement Date
  - .4 Duration of Warranty
  - .5 Clear definition of all included devices in system and indicating what remedial action will be taken under the warranty.
  - .6 Signature and seal of Warrant.

## 1.8 TRAINING

- .1 Provide 8 hours of on-site operator and maintenance training. The training schedule shall be determined by the owner. Refer to Section 01 79 00 for additional requirements.

## 1.9 SYSTEM DESCRIPTION

- .1 A Video Surveillance (CCVS) system is an arrangement comprising of cameras and lenses with all ancillary equipment required for the surveillance of a specific area. The CCVS system to be integrated with access control and intrusion alarm for a unified system.
- .2 The system is required to provide surveillance and monitoring to all areas listed in the drawings.
- .3 All components must be off the shelf and available through at-least four full service dealers.
- .4 Use all new material and conform to the latest editions of the codes and standards identified above. In case of a conflict or discrepancy, the most stringent requirement applies.
- .5 All equipment to be of one manufacturer.

## Part 2 Products

### 2.1 MANUFACTURER

- .1 Acceptable video surveillance camera manufacturer include:
  - .1 Avigilon (Basis of Design)
  - .2 Axis
  - .3 Pelco
  - .4 Genetec

- .2 All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
  - .3 The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components for a complete and fully operational system, which comply with the requirements of these specifications and are to include, but not be limited to the equipment in this specification.
  - .4 All surveillance camera system components shall be NDAA compliant.
- 2.2 NETWORK VIDEO RECORDER (NVR)
- .1 NVR to be rack mount as manufactured by Avigilon cat.# NVR4-Premium-128TB-HDD
  - .2 Failover unit Avigilon cat.#NVR4-Standard-32 TB-HDD (Failover)
  - .3 NVR to be c/w 60 days recording time.
- 2.3 VIDEO MANAGEMENT SOFTWARE
- .1 Network security recorders to have Avigilon Control Center (ACC) and Avigilon Appearance Search™ technology preloaded and configured for plug-and-play network video recording and management of multimegapixel IP cameras.
  - .2 Include ACC7 Enterprise Edition Camera License.
  - .3 Include ACC7 failover License.
  - .4 Include Avigilon to Gallagher integration license.
- 2.4 TYPE "A" – 8MP EXTERIOR PAN/TILT/ZOOM NETWORK CAMERA.
- .1 Camera to be 8.0 megapixel PTZ type.
  - .2 -40° C rating minimum.
  - .3 Min. 36x zoom capability.
  - .4 PoE (IEEE802.3af compliant) Device.
  - .5 C/w wall or corner mounting bracket as required.
  - .6 Acceptable Product: Avigilon Cat.# 8.0C-H5A-PTZ-DP36.
- 2.5 TYPE "B" – 12MP INDOOR CEILING MOUNTED 360° NETWORK CAMERA.
- .1 Camera to be 12.0 megapixel, 360° type.

- 
- .2 PoE (IEEE802.3af compliant) Device.
  - .3 Acceptable Product: Avigilon Cat.# 12.0W-H5A-FE-DO1.
  - 2.6 TYPE "C" – 6MP INDOOR FIXED CEILING MOUNTED NETWORK CAMERA.
    - .1 Camera to be 6.0 megapixel.
    - .2 PoE (IEEE802.3af compliant) Device.
    - .3 Acceptable Product: Avigilon Cat.# 6.0C-H5A-D1.
  - 2.7 TYPE "D" – 6MP INDOOR FIXED WALL MOUNTED NETWORK CAMERA.
    - .1 Camera to be 6.0 megapixel.
    - .2 PoE (IEEE802.3af compliant) Device.
    - .3 Acceptable Product: Avigilon Cat.# 6.0C-H5A-D1.
  - 2.8 TYPE "E" – 3MP INDOOR DUAL HEAD WALL MOUNTED NETWORK CAMERA.
    - .1 Camera to be 3.0 megapixel dual head camera type.
    - .2 PoE (IEEE802.3af compliant) Device.
    - .3 Acceptable Product: Avigilon Cat.# 6.0C-H5DH-D1-IR.
  - 2.9 PTZ CONTROLLER
    - .1 Avigilon USB Professional Joystick PTZ controller Cat.# ACC-USB-JOY
  - 2.10 KVM RACK SWITCH
    - .1 KVM Switch for rack-mountable keyboard, LCD and touchpad in a single console that occupies only 1U of rack space c/w built-in 19" LCD screen that supports video resolutions up to 1366 x 768 and Password protection prohibits unauthorized users from accessing the connected computers.
    - .2 Unit to be as manufactured by Tripp Lite Cat.# B040-008-19.
  - 2.11 OUTDOOR POE PTZ CAMERA INJECTOR
    - .1 Provide Altronix NetWay1DWP outdoor single port midspan injector for all outdoor PTZ cameras.
    - .2 Injector to be c/w camera mount and provide Hi-PoE (60W), PoE+ c/w NEMA 4/4X IP66-11 rated enclosure that can be wall mounted. The unit operates at 115VAC.

- 
- 2.12 POWER OVER ETHERNET MIDSPAN POWER SUPPLY AND POE NETWORK SWITCH
- .1 For hardware specification, refer to section 27 20 21 Data Communications Network Equipment.
- 2.1 PERSONAL COMPUTER AND MONITOR FOR VIDEO SURVEILLANCE AND ACCESS CONTROL
- .1 Video Surveillance contractor to provide and install personal computer and monitor. For hardware specification, refer to section 27 20 21 Data Communications Network Equipment.
- Part 3 Installation
- 3.1 GENERAL INSTALLATION REQUIREMENTS
- .1 Install all outdoor, indoor cameras, DVR, monitors and software as per manufactures recommendations.
- .2 Label all conduits cabinets and pull boxes. All conduit to be Purple in color.
- .3 Provide all necessary interconnections, services and adjustments required for a complete and operable Video Surveillance system.
- .4 Confirm final location and mounting heights of monitors with owner and engineer prior to roughing-in.
- .5 All system components to be fully integrated in the system.
- .6 Install control signal, communications and line grounding as necessary to preclude ground loops, noise, and surges from adversely affecting systems operations.
- .7 Provide all necessary domes, housings, or pre-manufactured brackets to complete installation.
- .8 Upon Final Acceptance the Contractor shall not remove or retain copies of any site specific data and passwords.
- .9 The Contractor shall turn over all keys, codes and authorization medium to the Engineer upon completion of the project.
- .10 Install Bonding and Grounding in accordance with section 27 05 26.
- .11 Use wire to connect all devices as recommended by the manufacturer of the hardware.
- .12 Provide As-built drawings AutoCAD format.
- 3.2 SITE VERIFICATION OF CONDITIONS
- .1 Contractor to visit site to review connection to infrastructure, all equipment shall be rack mounted.

- .2 All Database programming for new installation to be supplied by the contractor.
- .3 Configure devices to ensure all requirements and password groups required by the Engineer are addressed.

### 3.3 SEQUENCE OF OPERATIONS

- .1 Configuration of the system to be in consultation with the Consultant and how each device is displayed or alarmed including scheduling, the contractor to program the system to meet the criteria requested by the Consultant.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Refer to all sections of the specification for related work.

1.2 SECTION INCLUDES

- .1 This specification provides the minimum requirements for the Life Safety System. The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system.

1.3 SYSTEM DESCRIPTION

.1 General – Fire

- .1 The Contractor shall furnish all labor, services and materials necessary to furnish and install a complete, functional integrated life safety fire system. The System shall comply in all respects with all pertinent codes, rules, regulations and laws of the local jurisdiction. The System shall comply in all respects with the requirements of the specifications, manufacturer's recommendations and Underwriters Laboratories of Canada (ULC) listings.
- .2 It is further intended that upon completion of this work, the Owner be provided with:
  - .1 Complete information and drawings describing and depicting the entire system(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the system(s) at a future date.
  - .2 Complete documentation of system(s) testing.
  - .3 Certification that the entire system(s) has/have been inspected and tested, is/are installed entirely in accordance with the applicable codes, standards, manufacturer's recommendations and ULC listings, and is/are in proper working order.

.2 Description – Fire

- .1 Provide and install a new fire detection and alarm system consisting of:
- .2 LCD annunciator shall be located as shown on the drawings.
- .3 Provide a printer.
- .4 Manual pull stations shall be located as shown on the drawings.
- .5 Area smoke detection shall be provided as shown on drawings.
- .6 Area heat detection shall be provided as shown on drawings.
- .7 Duct smoke detection shall be provided as shown on the drawings.
- .8 Provide audible appliances located throughout the building, as shown on the drawings.

- .9 Provide synchronized visual appliances located throughout the building, as shown on the drawings.
- .10 Provide fan shutdown controls.
- .11 Passive graphic display.
- .3 Sequence of Operation
  - .1 Alarm Operation
    - .1 Upon the alarm activation of any area smoke detector, heat detector, manual pull station, the following functions shall automatically occur:
      - .1 The internal audible device shall sound at the control panel.
      - .2 The LCD display shall indicate all applicable information associated with the alarm condition including; zone, device type, device location and time/date.
      - .3 All system activity/events shall be documented on the system printer.
      - .4 Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
      - .5 Activate notification audible appliances.
      - .6 Activate visual strobes notification appliances.
      - .7 Transmit signal to the building automation system.
      - .8 All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
      - .9 All stairwell/exit doors shall unlock throughout the building.
      - .10 All self-closing fire/smoke doors held open shall be released.
      - .11 Notifying the local fire department via a remote dialer supplied and installed by the owners monitoring agency. Coordinate all work with Owner.
  - .2 Duct Smoke Activation – Alarm
    - .1 Upon alarm activation of any duct smoke detector, the following functions shall automatically occur:
      - .1 The internal audible device shall sound at the control panel or command center.
      - .2 The LCD display shall indicate all applicable information associated with the alarm condition including;
        - .3 zone, device type, device location and time/date.
      - .4 All system activity/events shall be documented on the system printer.
      - .5 Any remote or local annunciator LED's associated with the alarm zone shall be illuminated.
      - .6 Transmit signal to the building automation system.
      - .7 Shutdown the local air handling unit.

- .8 All automatic events programmed to the alarm point shall be executed and the associated outputs activated. Trouble Operation
  - .2 Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur:
    - .1 The internal audible device shall sound at the control panel.
    - .2 The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
    - .3 All system activity/events shall be documented on the system printer.
    - .4 Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
    - .5 Transmit signal to the central station with point identification.
- .3 Monitor Activation
  - .1 Upon activation of any device connected to a monitor circuit, the following functions shall automatically occur:
    - .1 The internal audible device shall sound at the control panel.
    - .2 The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.
    - .3 All system activity/events shall be documented on the system printer.
    - .4 Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.
- .4 System Configuration
  - .1 General
    - .1 All Life Safety System equipment shall be arranged and programmed to provide the early detection of fire, the notification of building occupants, the automatic summoning of the local fire department, the override of the HVAC system operation, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants.
  - .2 Power Supply
    - .1 Standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for 24 hours and capable of operating the system for 5 minutes in the alarm mode at 100% load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.



- .3 Display
  - .1 The main display interface shall show the first and most recent highest priority system events without any operator intervention. All system events shall be directed to one of four message queues. Messages of different types shall never intermixed to eliminate operator confusion. A "Details" switch shall provide additional information about any device highlighted by the operator.
- .4 Initiating Device Circuits
  - .1 Initiating device circuits monitoring manual fire alarm stations, smoke and heat detectors, waterflow switches, valve supervisory switches, fire pump functions, and air pressure supervisory switches shall be Class A.
- .5 Notification Appliance Circuits
  - .1 All notification appliance circuits shall be Class B. All notification appliance circuits shall have a minimum circuit output rating of: 2 amps @ 24 vdc; 50 watts @ 25V audio, and 35 watts @ 70V audio. The notification circuits shall be power limited. Non-power limited circuits are not acceptable.
- .6 Data Communications Link
  - .1 When a data communications link (DCL) covers more than one fire/smoke compartment, a wire-to-wire short shall not affect the operation of the circuit from the other fire/smoke compartments. The DCL connecting network panel/nodes, annunciators, command centers, shall be Class A.
  - .2 When a network is wired in a Class B configuration, a single break or short on the network wiring isolates the system into two groups of panels. Each group continues to function as a peer-to-peer network working with their combined databases.
  - .3 When wired using a Class A configuration, a single break or short on the network wiring causes the system to isolate the fault, and network communication continues uninterrupted, without any loss of function. Should multiple wiring faults occur, the network re-configures into many sub-networks and continues to respond to alarm events from every panel that can transmit and receive network messages.

#### 1.4 REFERENCES

- .1 CAN/ULC-S524 Installation of Fire Alarm Systems.
- .2 CAN/ULC-S525 Audible Signal Appliances, Fire Alarm.
- .3 CAN/ULC-S526 Visual Signal Appliances, Fire Alarm.
- .4 ULC-S528 Manually Activated Signaling Boxes, Fire Alarm.
- .5 CAN/ULC-S529 Smoke Detectors, Fire Alarm.

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- .6 CAN/ULC-S530 Heat Actuated Fire Detectors, Fire Alarm.
  - .7 CAN/ULC-S536 Inspection and Testing of Fire Alarm Systems.
  - .8 CAN/ULC-S537 Verification of Fire Alarm Systems.
  - .9 NBC National Building Code of Canada.
- 1.5 SUBMITTALS
- .1 Submit shop drawings and product data in accordance with Section 28 05 00 – Common Work Results for Electronic Safety and Security.
  - .2 General:
    - .1 Submit the following according to Conditions of Contract and Division 1 Specification Sections.
      - .1 Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
      - .2 Wiring diagrams from manufacturer.
      - .3 Shop drawings showing system details including location of FACP, all devices, circuiting and details of graphic annunciator.
      - .4 System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per all applicable standards.
      - .5 System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of SLC, NAC, RAC, Sensor, and auxiliary control circuits.
      - .6 Operating instructions for FACP.
      - .7 Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
      - .8 Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
      - .9 Record of field tests of system.
    - .2 Submission to Authority Having Jurisdiction:

- .1 In addition to routine submission of the above material, make an identical submission to the Authority Having Jurisdiction through the Engineer. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions if required to make clarifications or revisions to obtain approval.
- .2 Provide shop drawings to Engineer for review and approval prior to commencement of installation.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

#### 1.7 QUALITY ASSURANCE

- .1 Installer Qualifications:
  - .1 A factory-authorized installer is to perform the work of this section.
  - .2 Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories of Canada, Inc. (ULC), and shall bear the "ULC" label.
- .2 Qualifications of Manufacturer
  - .1 Equipment and materials shall be provided by an experienced reputable manufacturer to ensure proper specification adherence, final connection, test, turnover, warranty compliance, and service. The manufacturer is required to have been in the fire alarm industry (service and installation) for a minimum of ten (10) years.
  - .2 The manufacturer shall have in-house engineering and project management capability consistent with the requirements of this project. Qualified and approved representatives of the system manufacturer shall perform the detailed engineering design of central and remote control equipment.

#### 1.8 MAINTENANCE SERVICE

- .1 Maintenance Service Contract:
  - .1 Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives.

.2 Basic Services:

- .1 Systematic, routine maintenance visits on an annual basis at times scheduled with the Engineer. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

.3 Additional Services:

- .1 Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

.4 Renewal of Maintenance Service Contract:

- .1 No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

1.9 VERIFICATION

- .1 The complete system shall be tested and verified in accordance with latest edition of Standard CAN/ULC-S537, Standard for the Verification of Fire Alarm System Installation. Upon completion, a Certificate of Verification and a copy of the Verification Report shall be submitted to the Engineer.

1.10 WARRANTY AND MAINTENANCE

- .1 The Fire Alarm / Life Safety System manufacturer shall supply a one (1) year warranty from date of verification for all control system, field devices, and appliances.
- .2 Contractor shall warrant the installed system to be free from any defects of material and installation for a period of one (1) year from acceptance by the engineer. Any deficiencies shall be immediately corrected at no additional cost to the owner.
- .3 The Fire Alarm Manufacturer's authorized service organization shall provide a separate maintenance contract for a period of 1 year from the date of system commissioning. As part of the systems maintenance, the service company will provide printed reports which detail the sensitivity of each smoke detector installed in the system, and the date of the report.

Part 2 Products

2.1 MANUFACTURER

- .1 Acceptable fire alarm system manufacturer include:
- .1 Edwards.
- .2 Notifier.

.3 Simplex.

.2 All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) and smoke control system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

.3 The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications.

## 2.2 MATERIALS

.1 Equipment and Devices: ULC listed and labelled and supplied by single manufacturer.

.2 Power Supply: to CAN/ULC-S524.

.3 Audible Signal Devices: to CAN/ULC-S525.

.4 Visual Signal Devices: to CAN/ULC-S526.

.5 Control Unit: to CAN/ULC-S527.

.6 Manual Fire Alarm Stations: to CAN/ULC-S528.

.7 Smoke Detectors: to CAN/ULC-S529.

.8 Thermal Detectors: to CAN/ULC-S530.

.9 All components and systems shall be designed for uninterrupted duty.

.10 All equipment, materials, accessories, devices and other facilities covered by this specification or noted on contract drawings and installation specification shall be the best suited for the intended use and shall be provided by a single manufacturer or if provided by different manufacturers, recognized as compatible by both manufacturers.

## 2.3 PANEL COMPONENTS & FUNCTIONS

.1 General

.1 The control panel(s) shall be a single stage, multi-processor based networked system designed specifically for fire. The control panel shall be listed and approved as one system for the application standard(s) as listed under the General section.

- .2 The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any application can be configured, and modified using software provided by a single supplier. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.
- .3 Each node of the control panel shall include the following capacities:
  - .1 Support up to 2500 analog/addressable points.
  - .2 Support up to 1740 chronological events.
  - .3 Support up to 124 keypad displays
  - .4 Support digital dialers and modems
  - .5 Support multiple communication ports and protocols
- .4 Up to 64 control panels may be networked together for increased capacity up to a total of 160,000 addressable devices. The network of control panels shall include the following features:
  - .1 Ability to download all network applications and firmware from the configuration computer from the configuration computer from a single location on the system.
  - .2 Provide electronic addressing of analog/addressable devices.
  - .3 Provide an operator interface control/display that shall annunciate, command and control system functions.
  - .4 Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
  - .5 Provide a discreet system control switch provided for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch and details switch.
  - .6 Provide system reports that provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.
  - .7 Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
  - .8 Provide an authorized operator to perform test functions within the installed system.
  - .9 The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.
- .5 All surface mounted fire alarm control cabinets to be complete with sprinkler-proof hood. All cabinets to be Red in color complete with door and keylock. Confirm final finish with engineer prior to ordering of cabinet.

.2 Power Supply

- .1 System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by the panel.
- .2 Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.
- .3 Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.
- .4 All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply affected.

.3 Reports

- .1 The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, and shall be capable of being printed on any system printer.
- .2 The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
- .3 The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.
- .4 The system shall provide a report that gives a chronological listing of up to the last 1740 system events.
- .5 The system shall provide a listing of all of the firmware revision listings for all of the installed network components in the system.

2.4 OPERATOR'S INTERFACE

.1 Annunciation

- .1 The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the building. Standard LED annunciators may be combined in common enclosures provided that the groups of LED's comprising each of the required annunciators are separated from one another (Detection, Supervisory, Status, and Security) and clearly labeled.
- .2 Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device.
- .3 The annunciator shall contain the following system status indicators:
  - .1 168 character Backlit Liquid Crystal Display
  - .2 System Normal Indicator
  - .3 System Common Alarm Indicator

- .4 System Common Trouble Indicator
- .5 System Common Supervisory Indicator
- .6 System Ground Fault Indicator
- .7 System Common Security Indicator
- .8 System Disabled Point(s) Indicator
- .9 System Reset Switch with Indicator
- .10 System Alarm Silence Switch with Indicator
- .11 System Trouble Silence Switch with Indicator
- .12 System Message Queue Scroll Switches.
- .13 10-Digit Keypad to Enable/Disable System and Functions.
- .4 The LED Annunciator rows shall contain the following format:
  - .1 Provide one row of red (alarm) and yellow (trouble) LED's. LED's in each row shall be arranged in columns, one column per type of alarm initiating device, and shall illuminate upon receipt of an alarm signal from the associated device(s) (i.e., electrical room smoke detector).
  - .2 Provide one row of red (alarm) LED's. LED's in each row shall be arranged in columns, one column per type of alarm initiating device, and shall illuminate upon receipt of an alarm signal from the associated device(s) (i.e., electrical room smoke detector).
  - .3 Provide one row of yellow (supervisory) LED's. LED's in each row shall be arranged in columns, one column per type of supervisory type device, and shall illuminate upon receipt of an supervisory signal from the associated device(s) (i.e., 2nd floor sprinkler valve supervisory switch)
- .5 The LED annunciator shall be provided with <25> % spare LED's minimum. Each pair of LED's shall be labeled "Spare".
- .6 The LED Annunciator shall contain the following switches:
  - .1 Provide two-position switch to manually unlock all stairwell doors.
  - .2 Provide eight (8) two position switches for system by-pass functions. Actual switch function shall be determined by the owner.

## 2.5 FIRE INITIATING DEVICES

- .1 Smoke Detectors & Accessories
  - .1 Intelligent Detectors - General Operation
    - .1 Early warning analog addressable detectors shall use state-of-the-art multi-sensor technology. Each detector shall incorporate a microprocessor capable of making alarm decisions based on fire parameter algorithms stored in the detectors head. The microprocessor shall evaluate all sensing elements simultaneously and take into account real-time environmental conditions and the duration of an event, resulting in reliable and accurate decisions that distinguish real fire conditions from unwanted deceptive nuisance alarms. Digital filters shall eliminate signal patterns that are not typical of fires. Detectors that use the control panel processor to make alarm decisions are not acceptable.



- .2 Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value.
- .3 An alternate alarm sensitivity level shall be provided for each detector, which can be set to any of the five (5) sensitivity settings manually or automatically using a time of day event. In addition to the five alternate sensitivity levels the detector shall provide an alternate pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alternate alarm sensitivity value.
- .4 Addressable detectors shall be capable of full digital communications using both broadcast and polling protocols. The maximum total analog loop response time for detectors shall be 750ms.. The maximum alarm response time for the system to sound an alarm shall not be more than 3-seconds regardless of the detector location or the number of detectors on the addressable loop. The analog loop controller shall support up to 250 devices including 125 modules, 125 detectors and 125 isolator bases. The analog loop must not require shielded wire and shall be capable of a total distance of 4000 feet minimum using #18AWG twisted pair when 100 addressable detectors and 100 addressable modules are connected. The analog loop shall support up to 124 wiring T-taps.
- .5 The analog loop controller shall be able to "map" and supervise the location of each addressable device installed on the loop. Device supervision shall be provided for any device that is missing, added or changes to the device type, alarm settings, features, location or changes to the wiring layout or detector bases. It shall be possible to display or print the device "map" from a laptop.
- .6 Each detector shall have the ability to learn its environment and automatically adjust its reference value for changes in its environment. Detectors that require adjustments to their sensitivity settings months after they are installed are not acceptable. Environmental compensation shall allow each sensing element to adapt to short and long term changes caused by dirt, dust, humidity, temperature and ageing. The detector shall adjust and update its sensitivity (% obscuration) and ambient temperature baselines for each sensing element approximately six times per hour. The detector shall utilise a 4-hour rolling average of the environmental information and for verification purposes also maintain a 24-hour average of the analog values, both of which may be taken into account in the alarm decision making process.
- .7 The detector shall be capable of identifying up to 32 self-diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

- .8 The early warning analog addressable detectors and the analog loop controller shall provide increased reliability and inherent survivability through intelligent analog conventional operation. Detectors shall automatically change to stand alone, conventional device operation in the event of a loop controller polling communications failure. In the analog conventional detector mode, each detector shall continue to operate using its programmed sensitivity and "learned" environmental information stored in the detector's memory at the time of communication failure. The analog loop controller shall be capable of monitoring the loop and activating a loop alarm, without communicating to the devices, if any detector reaches its alarm sensitivity threshold.
- .9 Each Signature Series device shall be capable of automatic electronic addressing and/or custom addressing without the use of DIP or rotary switches. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.
- .10 Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm normal status communication with the analog loop controller. A red LED shall flash to display alarm status. Both LED's on steady shall indicate an alarm in the conventional stand-alone mode status. The LEDs shall be visible through a full 360 degree viewing angle.
- .2 Smoke Detector - Multi-Sensor Ion Photo Thermal
  - .1 Provide intelligent multi-sensor smoke detectors. The multi-sensor smoke detector shall detect the broadest range of fire types without having to pre-determine the environment contents or possible types of smoke and fire. Detectors that must have their environment type predefined are not acceptable since environment contents are continually changing. The multi-sensor analog detector shall gather analog information from each of its three sensors: a light scattering type photoelectric sensor for visible smoke, a unipolar ionization sensor for invisible particles of combustion and an ambient temperature sensor for monitoring the amount of heat. Separately mounted photoelectric detectors, ionization detectors and heat detectors in the same location are not acceptable alternatives. Detectors that do not operate in unison are not acceptable.
  - .2 Each detector shall be capable of adapting to ambient environmental conditions. The temperature sensor shall self-adjust to the ambient temperature of its environment. In addition to contributing to the algorithm based alarm decision, the integral heat sensor shall cause an alarm when it senses a change in ambient temperature of 65°F (35°C) or reaches its fixed temperature alarm set point of 135°F (57°C) nominal. Only detectors with heat elements that operate independently and contribute to the smoke alarm algorithm decision are acceptable.
  - .3 The detector shall have a ULC Smoke Sensitivity Range of 0.67-3.7% obscuration/ft (305mm). The alarm smoke obscuration per foot setting

- shall be field selectable to any one of five sensitivity settings ranging from 1.0% to 3.5%. The pre-alarm smoke obscuration per foot setting shall be field selectable in .05% increments for a total of 10 selections per sensitivity setting starting at 0.5% smoke obscuration per foot. Multi-sensor analog detectors shall be capable of an automatic day/night alternate sensitivity adjustment for both alarm and pre-alarm thresholds. Alarm and pre-alarm events shall have independent programmable responses. The pre-alarm message shall display in the monitor queue and the alarm message in the alarm queue.
- .4 The multi-sensor detectors shall be rated for ceiling or wall mount applications and for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide and low air velocities up to 500 ft/min. (2.54 m/sec) without requiring specific duct detector housings or supply tubes. The multi-sensor detector shall be rated for ceiling installation with maximum 30-foot (9.1m) centers. For clean room applications requiring very early warning pre-alarm sensitivities, recommended area coverage is 200 square feet.
- .5 The detector shall be protected by a ULC listed protective guard in areas where subjected to mechanical damage or abuse. The design must be 100% compatible with the detector and must not affect the detector sensitivity or reduce detector spacing. The guard shall be low profile and suitable for flush or surface mounted detectors.
- .6 The multi-sensor detector shall be suitable for operation in the following environment:
- .1 Temperature: 32oF to 100oF (0oC to 38oC)
  - .2 Humidity: 0-93% RH, non-condensing
  - .3 Elevation : Up to 6,000 ft (1828 m)
- .3 Smoke Detector – Photoelectric
- .1 Photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to detect visible particulates produced by combustion. The integral microprocessor shall dynamically examine values from the sensor and initiate a system alarm based on the analysis of data.
  - .2 The alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5% smoke obscuration per foot. The photo detector shall be suitable for operation in the following environment:
    - .1 Temperature: 32oF to 120oF (0oC to 49oC)
    - .2 Humidity: 0-93% RH, non-condensing
    - .3 Elevation: no limit
- .4 Duct Detector Housing
- .1 The Analytical Microprocessor-based photoelectric smoke detector shall be readily adaptable for use in air duct smoke detection applications, using a housing that mounts to the outside of the duct. When used for

- duct smoke detection, the smoke detectors will not forfeit any of the system functionality that they have when used as area smoke detectors.
  - .2 The duct smoke detection housing shall allow the detector to sample and compensate for, variations in duct air velocity between 300 and 4,000 feet per minute.
  - .3 Remote alarm LEDs and Remote Test Stations shall be supported by the duct smoke detector and provided where indicated.
- .2 Heat Detectors
- .1 Detector - Fixed Heat Detector
    - .1 Heat detector shall have a solid-state heat sensor, and shall transmit an alarm at a fixed temperature of 135° F. Detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
    - .2 Heat detector shall be rated for ceiling installation at 70 ft (21.3m) centers and be suitable for wall mount applications.
  - .2 Fixed Temperature-ROR Heat Detector
    - .1 Provide analog/addressable combination fixed temperature / rate-of-rise detectors at the locations shown on the drawings. The heat detector shall have a nominal fixed temperature alarm point rating of 135°F and a rate of rise alarm point of 15°F per minute. The heat detector shall be rated for ceiling installation at a minimum of 21.3m centers and be suitable for wall mount applications.
- .3 Detector Bases
- .1 Detector Base - Isolator
    - .1 The isolator base shall support all Addressable Detector types and have the following requirements:
      - .1 The isolator shall operate within a minimum of 23msec of a short circuit condition on the analog communication wiring.
      - .2 An analog addressable detector mounted with an isolator base shall only use 1 address on the loop. It shall be possible to provide one isolator for every detector to achieve the highest level of survivability possible. The analog loop controller shall support up to 250 devices including 125 modules and 125 detectors with 125 isolator bases.
      - .3 In a Class A configuration, the analog loop controller shall identify an isolated circuit condition and provide communications to all non-isolated analog devices. Isolators are required between all Floor Areas as defined in the NBC.
  - .2 Detector Base - Standard
    - .1 Mounting bases shall support all microprocessor-based detector types detailed in this specification
    - .2 Removal of the respective detector shall not affect communications with other addressable devices.

- .3 Field wiring connections shall be made to the room side of the base, so that wiring connections can be made or disconnected by the contractor without the need for remove the mounting base from the electrical box.
  - .4 Bases will have the option of external LED operation, Relay Base or Data Line Isolator Base.
- .4 Manual Stations
  - .1 Manual Station - Addressable
    - .1 Fire Alarm / Life Safety System shall incorporate single stage microprocessor-based addressable Manual Pull Stations connected over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All Manual Pull Stations shall display communications and alarm status via LED's mounted on their integral, factory assembled module.
    - .2 All addressing of the Manual Pull Stations shall be done electronically, and the electrical location of each station shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the Manual Pull Station will not be dependent on their electrical location on the circuit.
    - .3 Provide intelligent single action single-stage fire alarm stations where shown on plans. The fire alarm station shall be of metal construction with an integral toggle switch to activate alarm signals. Stations shall be finished in red with silver "PULL IN CASE OF FIRE" lettering. The manual station shall be suitable for mounting on a North American 64mm deep, single-gang electrical box.

## 2.6 INITIATION & CONTROL MODULES

- .1 General
  - .1 Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable modules for the monitoring and control of system Input and Output functions over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators.
  - .2 The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code.
  - .3 All addressing of the Microprocessor-based Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be dependent on their electrical location on the circuit.
  - .4 All field wiring to the Microprocessor-based Addressable Modules shall be supervised for opens and ground faults and shall be location identified to the module of incidence.

- .2 Single Input Module
  - .1 Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class B (style B) input circuit capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.
- .3 Dual Input Module
  - .1 Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class B (style B) input circuits capable of operation with contact devices. Both of the input circuits shall be terminated to, and operated from, the same microprocessor-based addressable module.
  - .2 Modules configured for Waterflow operation shall have an automatic delay of 15 seconds before reporting the Waterflow alarm condition to the Fire Alarm Control Panel. The module shall monitor sprinkler supervisory switches and shall automatically report the supervisory function to the Fire Alarm Control Panel each time the associated dry contact closes.
- .4 Relay Module
  - .1 Provide addressable control relay circuit modules at the locations shown on the drawings. The module shall provide one (1) form C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) to control external appliances or equipment. The position of the relay contact shall be confirmed by the system firmware.
- .5 Isolation Module
  - .1 Provide addressable fault isolator circuit modules at the locations shown on the drawings. The module shall be capable of isolating and removing a fault from a Class A data circuit while allowing the remaining data loop to continue operating.

## 2.7 NOTIFICATION APPLIANCES

- .1 Horn-Strobes
  - .1 Output Settings
    - .1 The horn shall provide a selectable high/low dB output with a maximum of 99.5 dB peak and a minimum of 86.3 dB peak using a multiple frequency tone for superior wall penetration. The strobe output shall be synchronized and switch selectable for 15, 30, 60 and 110 candela as listed on the plans. The multi candela selector switch shall be located beneath the outer housing of the Horn/Strobe device to ensure it is tamper proof. The selected candela level shall be visible after installation without removing the outer housing of the device. The light output shall be an even "Full Light" pattern throughout the strobes protected area. Strobes utilizing a traditional specular reflector with uneven light distribution are not acceptable
  - .2 Self-Synchronized Horns and Strobes
    - .1 Provide electronic horn/strobes. Horn and strobe power shall be provided on one pair of wires. It shall be possible to control the horn (on, off and coded) independently from the strobe. The horn shall be

selectable for continuous or synchronized temporal operation. The strobe shall be selectable for a continuous or temporal synchronized flash rate to match the horn and meet the intent of the National Building Code, Appendix Clause 3.2.4.20 (1).

- .2 The horn shall provide an output of 94 dB peak using a low frequency tone for superior wall penetration. The strobe output shall be synchronized and available in 15, 30, 60, 75 & 110 candela (cd) as listed on the plans. The light output shall be an even "Full Light" pattern throughout the strobes protected area. Strobes utilizing a traditional specular reflector with uneven light distribution are not acceptable.
- .3 The horn/strobe shall be an ultra low profile single gang design, finished in UV stable neutral white and shall not protrude more than 1" from the wall. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed. Confirm with Owner/Consultant before ordering devices.
- .4 The devices shall mount to a standard single gang electrical box and have an optional trim ring for 2-gang, octagonal or 4" square boxes. The signalling device series shall share a common appearance and be available in a horn, strobe or combination horn/strobe unit as listed on the plans.

.3 Wall Mount

- .1 The horn/strobe shall be a low profile single gang design, finished in UV stable textured red. The strobe shall use a mask and cavity ultra low profile design and shall not protrude more than 1" from the wall. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed. The devices shall mount to a standard single gang electrical box and have an optional trim ring for 2-gang, octagonal or 4" square boxes. All signaling devices installed shall share a common single gang appearance and be available in a horn, strobe or combination horn/strobe unit as listed on the plans.

2.8 SYSTEM WIRING

- .1 Refer to Section 26 05 21 – Wire and Cables (0-1000V).
- .2 All signal circuit wiring is to be Class A. All initiating circuit wiring, where not a DCL, is to be Class A. All data communication links to be DCLA.
- .3 The size of conductor shall be such that the voltage drop on any signal does not exceed 5% or less where required by the manufacturer.
- .4 The joints in junction boxes are to be labeled.
- .5 The colour scheme for the wiring is based on Canada Wire 6, 12 and 20 conductor cables and shall be used for single conductors in conduit.
  - .1 Signal circuits - 1 black, 1 red
  - .2 Zone circuits (manual or automatic) - 1 green, 1 yellow
- .6 Wire to have an FT-4 and FT-2 CSA approved rating stamped on the jacket.

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- .7 No circuit is to be loaded to more than 80% capacity.
- 2.9 SPARE PARTS
- .1 Refer to Section 28 05 01.
- 2.10 FIRE ALARM BREAKER LOCKING DEVICE AND IDENTIFICATION TAG
- .1 Provide "Red" color circuit breaker in panelboard
  - .2 Provide Elock-FA, E series circuit breaker lock device as manufactured by "Space Age Electronics" c/w red identification tags.
- Part 3 Execution
- 3.1 INSTALLATION - GENERAL
- .1 Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
    - .1 Factory trained and certified personnel.
    - .2 Canadian Fire Alarm Association (CFAA) fire alarm certified personnel.
    - .3 Personnel licensed or certified by provincial or local authority.
  - .2 The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labelled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.
  - .3 Provide on-off locking device for circuit breaker.
  - .4 Insta red circuit breaker, lockout device and nameplates.
  - .5 Coordinate all work with owners monitoring agency for remote dialer connection to monitoring agency. Dialer and connection by monitoring company. Coordinate all work with Owner.
- 3.2 EQUIPMENT INSTALLATION
- .1 Furnish and install a complete Fire Alarm System. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.
  - .2 Water-Flow and Valve Supervisory Switches:
    - .1 Connect for each sprinkler valve required to be supervised.
  - .3 Device Location-Indicating Lights:
    - .1 Locate in the public space immediately adjacent to the device they monitor.



### 3.3 WIRING INSTALLATION

- .1 Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of the Canadian Electric Code (CEC).
- .2 Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- .3 Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.
- .4 Refer to Section 26 05 21 – Wire and Cables (0-1000V).
- .5 The size of conductor shall be such that the voltage drop on any signal does not exceed 5% or less where required by the manufacturer.
- .6 The joints in junction boxes are to be labeled.
- .7 No circuit is to be loaded to more than 80% capacity.

### 3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
  - .2 Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
    - .1 Factory trained and certified.
    - .2 Canadian Fire Alarm Association (CFAA) fire alarm certified.
    - .3 Certified by a provincial or local authority.
    - .4 Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

### 3.5 CLEANING AND ADJUSTING

- .1 Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.
- .2 When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

### 3.6 TRAINING

- .1 The System Supplier shall schedule and present a minimum of 8 hours of documented formalized instruction for the building owner, detailing the proper operation of the installed System.
- .2 The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.
- .3 The instruction shall cover the schedule of maintenance required by ULC and any additional maintenance recommended by the system manufacturer.
- .4 Instruction shall be made available to the Local Fire Department personnel if requested by the Local Authority Having Jurisdiction.

### 3.7 INSTALLATION

- .1 The entire system shall be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer's manuals and wiring diagrams. The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for a complete, functional life safety fire alarm system. Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Canadian Electrical Code and the Inspection Authority.
- .2 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
- .3 End-of-line resistors shall be furnished as required for mounting as directed by the manufacturer.

### 3.8 TEST & INSPECTION

- .1 Perform tests in accordance with Section 28 08 01 Electronic Safety and Security Testing Requirements.
- .2 The manufacturer's representative shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal and smoke actuated detectors and controls, whether or not manufactured by the manufacturer. The inspection shall comprise an examination and test of such equipment for the following:
  - .3 That the type of equipment installed is that designated by the specifications.
  - .4 That the wiring connections to all equipment components show that the installer undertook to have observed ULC requirements.
  - .5 That all products of combustion (smoke) detectors have been properly calibrated and adjustments set correctly.
  - .6 That the representatives equipment has been installed in accordance with the manufacturer's recommendations.

- .7 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring, having been met to the satisfaction of the inspecting officials.
- .8 Testing to be done in the presence of the local building inspector and the local fire Marshall.
- .9 Fire alarm system shall be verified as per the latest issue of CAN-ULCS537 Verification of Fire Alarm Systems standard.

END OF SECTION