

## 1 GENERAL

### 1.1 RELATED SECTIONS & SUMMARY

- .1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01.
- .2 Reference to "Electrical Divisions" shall mean all sections of Divisions 26, 27 and 28 in the Master Format or the Canadian Master Specifications.
- .3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .5 The most stringent requirements of this and other electrical sections shall govern.
- .6 All work shall be in accordance with the PROJECT Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required equipment and wiring systems.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories

### 1.2 REFERENCES

- .1 Install in accordance with CSA C22.1 (current adopted edition) - except where specified otherwise.
- .2 Refer to CSA C22.1 Appendix A "Safety Standards for Electrical Equipment" for applicable codes and the related revisions
- .3 Refer to CSA C22.1 Pages xxix - xxxii for related 'Reference Publications'
- .4 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.
- .5 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.
- .6 Install overhead and underground systems in accordance with CSA C22.3 No.1 (current adopted edition) - except where specified otherwise.
- .7 Preferred Voltage Levels for AC Systems, 0-50,000V in accordance with CAN3-C235 (current adopted edition)

### 1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

#### 1.4 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235- current edition
- .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 SUBMITTALS

- .1 Submittals to be in accordance with Division 01.
- .2 Product Data: submit WHMIS MSDS in accordance with Division 02- Hazardous Materials.
- .3 Single Line Diagram:
  - .1 Provide single line electrical diagrams as follows:
    - .1 Submit full size plot for review prior to installing:
    - .2 Electrical distribution system: locate in main electrical room.
- .4 Shop Drawings:
  - .1 Submit shop drawings, product data and samples in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.
  - .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
  - .3 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
  - .4 Content:
    - .1 Shop drawings submitted title sheet.
    - .2 Data shall be specific and technical.
    - .3 Identify each piece of equipment.
    - .4 Information shall include all scheduled data.
    - .5 Advertising literature will be rejected.
  - .5 The project and equipment designations shall be identified on each document.
  - .6 Information shall be given in S.I. units.
  - .7 The shop drawings/product data shall include:
    - .1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.
    - .2 Mounting arrangements.
    - .3 Detailed drawings of bases, supports and anchor bolts.
    - .4 Control explanation and internal wiring diagrams for packaged equipment.
    - .5 A written description of control sequences relating to the schematic diagrams.
- .5 Format
  - .1 Black line prints 216 mm x 280 mm [8-1/2" x 11"] or 280 mm x 430 mm [11" x 17"].
  - .2 Larger drawings may be submitted on reproducible single sheet media (i.e. not bound) with space for stamps and signatures - master set plus one working copy.

- .3 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.
- .6 Number of copies
  - .1 Provide number of copies indicated in Division 01 Shop Drawings, Product Data and Samples with a minimum of 2 copies to be retained by the Departmental Representative.
- .7 Coordination
  - .1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representatives.
- .8 Keep one [1] copy of shop drawings and product data, on site, available for reference.
- .9 Quality Control: in accordance with Division 01 - Quality Control
  - .1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.
  - .2 Submit test results of installed electrical systems and instrumentation.
  - .3 Submit, upon completion of Work, the electrical "load balance" report.
- .10 Permits and Fees:
  - .1 Submit to Electrical Inspection Department, local fire authorities and supply authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.
  - .2 Arrange for inspection of all Work by the Authorities Having Jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

## 1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Division 01 General Instructions
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings: in accordance with Division 01 General Instructions
  - .1 Site Meetings: as part of Manufacturer's Field Services: schedule site visits, to review Work, at stages listed below:
    - .1 At time of initial shop drawing submission to confirm any existing conditions and to coordinate with the project schedule and any cross discipline requirements.
    - .2 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
    - .3 During progress of Work at key schedule points as determined.
    - .4 At commissioning.
    - .5 Upon completion of Work, after cleaning is carried out.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.

### 1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Division 01 Construction/Demolition Waste Management and Disposal.

### 1.8 SYSTEM START-UP

- .1 Refer to Division 01, and as follows.
- .2 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.
- .3 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

### 1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

### 1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

### 1.11 ASBESTOS REMOVAL

- .1 Refer to specification Division 01 for procedures, removal and disposal of asbestos.
- .2 If during renovations / demolition, asbestos is discovered (or material suspected to be asbestos), all work in that area shall immediately cease and the General Contractor advised. The General Contractor shall take immediate appropriate action to verify presence of friable asbestos and be responsible for the removal of all friable asbestos.
- .3 This division will not be entitled to a claim for any delays resulting from the investigation of or removal of asbestos.

### 1.12 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.
- .4 Where imperial units have been indicated in brackets following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

### 1.13 PROJECT COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Departmental Representative, without the Departmental Representative's written approval.
- .2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental Representative.
- .4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

#### 1.14 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION

- .1 Leave clear spaces designated for future equipment or building expansion where indicated. Plan for the installation under this contract and ensure clear accessible, unhindered access to the space is allowed for.
- .2 Where contract documents do not clearly indicate the future expansion requirements, but known services are required, provide written "request for information" to the Departmental Representative before making assumptions as to intent.

#### 1.15 SPRINKLER PROOF REQUIREMENTS

- .1 All equipment and wiring systems shall be sprinklerproof standard where sprinkler fire protection systems are installed.
- .2 In rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors. Top entry to be avoided where possible
- .3 In particular all unit substations, transformers, switchgear, motor control and panelboard shop drawings shall be certified 'sprinkler proof' design.

#### 1.16 EQUIPMENT RESTRAINT

- .1 Related Section: 26 05 05 Seismic Restraint.
- .2 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

#### 1.17 REUSED EQUIPMENT

- .1 Where existing equipment is being relocated and re-used, check and report on the condition to the Departmental Representative before reinstallation. Protect and carefully store equipment designated for reuse.

#### 1.18 PHASED CONSTRUCTION

- .1 See Architectural specifications and drawings for construction phasing. Make all allowances to phase the work in accordance with the project phasing.
- .2 All existing services and the existing building(s) must be maintained in operation. Provide and install temporary services as required.
- .3 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

#### 1.19 SEQUENCE OF WORK

- .1 Before interrupting major services notify the Departmental Representative well in advance and arrange an acceptable schedule for the interruptions.
- .2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.
- .3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.
- .4 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

## 1.20 BUILDING OPERATION DURING CONSTRUCTION

- .1 In order to minimize operational difficulties for the existing building staff, the various trades must cooperate with the Departmental Representative throughout the entire construction period and particularly ensure that noise is minimized.
- .2 Convenient access for the staff and public to the building must be maintained at all times. Minor inconvenience and interruption of services will be tolerated, provided advance notice is given, but the Contractor will be expected to coordinate his work, in consultation with the Departmental Representative, so the operation of the facility can be maintained as nearly normal as possible.

## 1.21 EXISTING SERVICES

- .1 Protect all existing services encountered. Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services. Work with the Departmental Representative's staff to trace the originating source and points served. Obtain instructions from the Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.
- .2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative's approval of the timing, and work to minimize any interruptions.
- .3 Shutdowns, to permit connections, to be coordinated with the maintenance staff.
- .4 In order to maintain existing services in operation, temporary relocations and wiring may be required.
- .5 Be responsible for any damages to existing systems by this work.
- .6 The interruption of utility services to permit tie-ins shall be arranged through the Departmental Representative's representative. Application must be received in writing at least seven (7) calendar days prior to the date required for the shutdown. Service shutdowns shall only be carried out by the Building Management and will normally be scheduled to occur during evenings or weekends. The Departmental Representative reserves the right to withhold permission for a reasonable period with respect to any shutdown, if the shutting-off of a service interferes with essential building operations.

## 1.22 SALVAGE

- .1 All conduit, wiring and equipment which becomes redundant and is no longer required due to the work in this Contract shall be completely removed.
- .2 All existing items which need to be removed, and which have a reasonable salvage value, shall be carefully removed and handed over to the Departmental Representative. Handing over to the Departmental Representative includes moving to Departmental Representative's designated storage place on site. These items shall not become the property of the Contractor. Obtain a written receipt from the Departmental Representative detailing each of the items handed over.
- .3 Remove all redundant material not required by the Departmental Representative from the site.

## 1.23 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.
- .2 Take note of any extended warranties specified.

- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.
- .4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

#### **1.24 TENDER INQUIRIES**

- .1 All contractor queries during the tender period shall be made in writing to the Departmental Representative. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Departmental Representative's office during tender. All tender queries may be faxed, mailed or couriered to the Departmental Representative's office. No telephone questions will be answered.

#### **1.25 EXAMINATION**

- .1 Visit the site before preparing the tender and examine all existing conditions. No extra cost will be considered for any misunderstanding of work to be done resulting from failure to visit the site.
- .2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. Obtain written clarification from the Departmental Representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

#### **1.26 RESPONSIBILITIES**

- .1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .2 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .3 Protect equipment and material from the weather, moisture, dust and physical damage.
- .4 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.
- .5 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.
- .6 Refinish damaged or marred factory finish to factory finish.
- .7 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

#### **1.27 STANDARD OF ACCEPTANCE**

- .1 Standard of Acceptance means that the item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

- .2 Where two or more manufacturers are listed, the manufacturer's name shown first or underlined or shown with a model name and/or number was used in preparing the base design. Tenders may be based on any one of those named, provided that they meet every aspect of the base design and every aspect of the drawings and specifications.
- .3 Where other than the first named or the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Equipment/materials shall not exceed the available space limitations. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.
- .4 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

#### 1.28 ADDITION OF ACCEPTABLE MANUFACTURERS

- .1 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Departmental Representative for consideration not later than five (5) working days prior to closing of tender or of bid depository subtrade tender whichever is earlier.
- .2 Alternate approvals will be given by written addendum only. No other substitution will be permitted after closing of tenders.
- .3 Alternate approvals granted before the closing of tenders will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a tender on the product
- .4 Where alternate equipment/materials are selected, allow for effects on other parts of the work of this Trade and other Trades. Where substantial changes in arrangement are required, submit shop drawings of the proposed changes with Plan and Section views and show effects on work of other Trades. Alternate equipment/materials shall not exceed the available space limitations. Maintain installation, access and servicing clearances. No extra will be allowed due to the use of alternate equipment/materials.
- .5 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.
- .6 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.

#### 1.29 EQUIPMENT LIST

- .1 Submit a completed Equipment List, showing the make of equipment and material included in the Tender, including the names of the subtrades, 10 days after the award of the Contract. **Form EF110** in Appendix A shall be used for this purpose.
- .2 The equipment list shall be a full list of materials or systems intended for installation.

#### 1.30 PROGRESS CLAIM AND CHANGEORDER BREAKDOWNS

- .1 Ten (10) days after the award of contract, submit price breakdowns on photocopies of the Price Breakdown **Form EF112** included in Appendix A.

- .2 In particular cases more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all sub-contractors when requested by the Departmental Representative. Provide details for each section of the electrical work listed for each separate electrical change order item exceeding \$10,000.00.
- .3 Mark-up information is required for change orders but is optional on the original tender price.
- .4 Progress claims will not be certified nor payment made beyond 90% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

### 1.31 PROJECT CLOSE-OUT REQUIREMENTS

- .1 Refer to detailed specifications in each section for detailed requirements. Also refer to Specification Appendix A **Form EF-142** for list of required substantial completion submissions. Record drawings to be submitted to Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

### 1.32 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:
  - .1 Commission all systems and prove out all components, interlocks and safety devices.
  - .2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed. **Form EF143** in Appendix A should be used for this purpose.
  - .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
  - .1 All reported deficiencies have been corrected.
  - .2 Operating and Maintenance Manuals completed.
  - .3 "As Built" Record Drawing ready for review.
  - .4 Systems Commissioning has been completed and has been verified by Departmental Representative.
  - .5 All demonstrations to the Departmental Representative have been completed.
  - .6 All documents required on **Form EF142** in Appendix A have been submitted.
- .3 Departmental Representatives Letters of Assurance will not be issued until the following requirements have been met:
  - .1 All items listed in .1 above have been completed or addressed.
  - .2 Certificate of Penetrations through separations (**Form EF130**).
  - .3 Provincial or City Electrical Inspection - Certificate of inspection.
  - .4 Seismic Engineers letter of Assurance and final inspection report.
  - .5 Certificate of Substantial Performance (**Form EF143**).
  - .6 Signed off copy of Departmental Representative's final inspection report.
  - .7 Fire alarm verification.

### **1.33 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS**

- .1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26, 27, 28, 33 (electrical) work have been met and verified.

## **2 PRODUCTS**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with Division 01 and as follows.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.
- .3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.
- .4 Factory assemble control panels and component assemblies.

### **2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, motor starters, for all mechanical equipment unless otherwise specified.
- .2 Ground all motors to conduit system with separate grounding conductor in flexible conduit or bonding conductor in the flexible conduit.
- .3 Connections shall be made with watertight flexible conduit with watertight connectors.
- .4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Mechanical Divisions for scope of work and particular details.

### **2.3 WARNING SIGNS**

- .1 Provide warning signs, as specified or to meet the requirements of Inspection Department, Authority having Jurisdiction, and the Departmental Representative.
- .2 Use decal signs, minimum 175 x 250 mm [7" x 10"] size

### **2.4 WIRING TERMINATIONS**

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

### **2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:

- .2 Nameplates:
  - .1 Lamicoid 3 mm [0.125"] thick plastic engraving sheet, white face, black core, self-adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.
  - .2 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
  - .3 Typical Labelling:
    - .1 Panelboard & CDP – 5 lines
      - .1 Line 1 – eg Conditional/Vital – Size 4 lettering
      - .2 Line 2 – Panel/CDP designation – Size 4 lettering
      - .3 Line 3 – eg 225A, 120/208V, 3 phase 4W – Size 2 lettering
      - .4 Line 4 – Feeder: eg 4#3 – 35mm C – Size 2 lettering
      - .5 Line 5 – Origin eg: Main Elect. Room – Size 2 lettering
    - .2 Distribution Circuit Breakers – 4 lines
      - .1 Line 1 – Conditional/Vital – Size 4 lettering
      - .2 Line 2 – Main Circuit Breaker – Size 4 lettering
      - .3 Line 3 – Feeder: eg 4#3 – Size 2 lettering
      - .4 Line 4 – Origin: eg K1 Sub-station – Size 2 lettering
    - .3 Label colours unless otherwise indicated:
      - .1 120/208V labels: white letters on black base.
      - .2 Standby/Emergency Power: white letters on red base.
  - .4 Wording on nameplates to be approved prior to manufacture.
  - .5 Allow for average of twenty-five (25) letters per nameplate.
  - .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
  - .7 Terminal cabinets and pull boxes: indicate system and voltage.
  - .8 Transformers: indicate capacity, primary and secondary voltages.
- .3 Labels:
  - .1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Departmental Representative before installing. Circuit number to agree with Record Drawings.
- .4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

## 2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

## 2.7 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

- .1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.
- .2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.
- .3 Colour coding to be as follows unless otherwise specified:

SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
120/208V Normal	Light Blue		
120/208V Emergency	Light Blue	Red	
Ground	Dark Green		GR
Fire Alarm	Red		FA
Computer/Data	Light Green		COM
Telephone	Light Green	Black	TEL
AV/TV Systems	Light Brown		AV/TV
Security Systems	Purple		SEC
Low Voltage Control	White	Yellow	LVC

- .4 Refer to Specification Appendix A Electrical **Form EF120**. Obtain the Departmental Representatives representative sign off for the colour coding prior to the identification process. Use **Form EF 120** for this purpose.

## 2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.
- .3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.
- .4 Paint outdoor electrical equipment "equipment green" finish.
- .5 Paint indoor switchgear and distribution enclosures light gray unless otherwise indicated in particular specification sections for specialised or emergency power equipment.

## 2.9 ACCESS PANELS (DOORS)

- .1 Unless otherwise noted, access doors shall be minimum: 450mmx450mm [18"x18"] for body entry; 300mmx300mm [12"x 12"] for hand entry.
- .2 Access doors in fire separations of 3/4 hour rating, and higher, and firewalls shall have a compatible fire rating and a ULC label with tamper-proof latch, self closing.

- .3 Minimum Requirements:
  - .1 180 degree door swing, mitred rounded safety corners flush welded, concealed hinges, screwdriver latches, and anchor straps or lugs to suit construction, all steel prime coated.
  - .2 Plaster or wet wall construction: 14 gauge bonderized steel flush with wall or ceiling type with concealed flange.
  - .3 Masonry or drywall construction: 16 gauge for 400 mm [16"] x 400 mm [16"] and smaller, 14 gauge for 450 mm [18"] x 450 mm [18"] and larger bonderized steel face of wall type with exposed flange.
  - .4 Tile, ceramic tile, marble, terrazzo, plaster or wet wall construction in washrooms and other special areas: 14 gauge stainless steel flush with wall or ceiling type with concealed flange.
  - .5 Acoustical tile ceiling and similar block materials: 14 gauge bonderized steel recessed ceiling type.
  - .6 Feature wall construction: Recessed wall type that is selected to complement and conform to the architectural module, treatment, or panelling. The size shall conform to adjacent finishes.
  - .7 Access panels in fire separations and fire walls shall have a compatible fire rating and ULC label.
- .4 Minimum Standards of Acceptance : Zurn, Wade, Acudor, Can-Aqua, Milcor, Maxam, Van-Met.

## 2.10 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other Divisions.

## 2.11 FASTENING TO BUILDING STRUCTURE

- .1 General:
  - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa [2000 psi] [refer to structural drawings].
  - .2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
  - .1 Cast-in-place type:
    - .1 Wedge type galvanized steel concrete insert for up to 200 mm [8"] pipe size.
    - .2 Universal type malleable iron body insert for up to 200 mm [8"] pipe size.
  - .2 Drilled, mechanical expansion type:
    - .1 Heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa [2840 psi].
    - .2 Stud anchor for concrete. (Do not use in seismic restraint applications).
    - .3 Drop-in anchor for concrete.
    - .4 Sleeve anchor (medium and light duty) for concrete and masonry.
    - .5 Pin bolt (light duty) for concrete and masonry.
  - .3 Drilled, adhesive type:
    - .1 Adhesive anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
    - .2 Anchor rod with a 2 part adhesive system.

- .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.
- .4 Rod assemblies shall extend a minimum of 50 mm [2"] into the concrete slab below the housekeeping bases.
- .3 Note:
  - .1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.
  - .2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.
  - .3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System or equal.
- .4 Minimum Standards of Acceptance: Burndy, Canadian Strut, Unistrut, Cantruss, Hilti, UCan.

## 2.12 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.
- .3 Concrete bases shall be a minimum of 100 mm [4"] thick, or as noted and shall project at least 150 mm [6"] outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.
- .4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm [1"] above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout.
- .5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.
- .6 Support ceiling hung equipment with rod hangers and/or structural steel.
- .7 Minimum Standards of Acceptance: Embeco, In-Pakt.

## 2.13 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:
  - .1 Support of equipment .
  - .2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.
  - .3 Earthquake restraint devices - refer also to "Seismic Restraint" sections
  - .4 Bridle rings - secure to structure or steel supports.
- .2 All steel work shall be prime and undercoat painted ready for finish under the related Division.

## 2.14 MAINTENANCE MATERIALS AND CABINET

- .1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.

- .2 Refer to Specification Appendix A Electrical **Form EF140** "Items to be handed to the Departmental Representative". Obtain the Building Departmental Representatives representative sign off. Use **Form EF 140** for this purpose.
- .3 Provide a finished painted sheet steel "spare equipment cabinet". Cabinet to have a continuous hinge and complete with shelves and hasp to suit padlock. Minimum size 600 [24"] x 900 [36"] x 200 [8"] deep. Mount on wall in the Electrical Room. Provide a plastic covered typewritten list of spare parts and affix to the inside of the door.

## **2.15 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows.
- .2 Include in operations and maintenance data:
  - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
  - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
  - .3 Wiring and schematic diagrams.
  - .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .3 Include in the manual the following major sections:
  - .1 Title page (in plastic cover).
  - .2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.
  - .3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.
  - .4 Local source of supply for each item of equipment.
  - .5 Wiring and control diagrams.
  - .6 Spare parts list.
  - .7 Copies of guarantees and certificates.
  - .8 Manufacturer's maintenance brochures and shop drawings.
- .4 The manual information shall be bound in a three "D-ring" hard back reinforced vinyl covered ("bar lock" post type where more than 50mm [2"] rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Departmental Representative before printing.
- .5 Submit a draft copy to the Departmental Representative for review thirty (30) days prior to start up of the systems and equipment.
- .6 Submit three (3) copies in the final approved form.

## **2.16 PROJECT RECORD DRAWINGS**

- .1 Provide project record documents as specified in Division 01 as further called for in this Division.

- .2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Departmental Representative on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.
- .3 Prior to or at the time of "substantial performance", obtain a set of CAD files from the Departmental Representative. The Electrical Division shall include all associated costs to obtain and complete the CAD Record Drawings including retaining the services of an approved CAD draftsman to transfer all changes to amend the CAD files in the latest version of AutoCAD. Include all revisions and change orders.
- .4 Submit the "Record Drawing" CAD files and one set of plots to the Departmental Representative prior to Total Performance of the contract.
- .5 Note: The Contractor will be required to sign a standard Stantec / Contractor agreement entitled "Authorization to Use CAD drawing files". The agreement restricts the use of the CAD files to the purpose of "as-built" only and determines the editing procedures.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

#### **3.2 NAMEPLATES AND LABELS**

- .1 Ensure manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

#### **3.3 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"].
- .2 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 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.
- .4 All cables and conduits to be installed concealed in finished areas.

#### **3.4 LOCATION OF OUTLETS**

- .1 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm [16"] horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm [10'- 0"] and information is given before installation.
- .3 Locate light switches on strike side of doors unless otherwise indicated.
- .4 Locate light switches on latch side of doors.
- .5 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

#### **3.5 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 indicated verify before proceeding with installation. Confirm the height of devices in handicapped facilities before installation.
- .3 Refer to detail on drawings.
- .4 In the absence of a drawing detail or drawing note, use the following:

Device	Height	Comment
Local switches	1200 [48"]	
Wall receptacles/data	450 [18"]	General
Wall receptacles/data	200 [8"]	Above top of continuous baseboard heater
Wall receptacles/data	175 [7"]	Above top of counters or counter splash backs – coordinate with Architectural detail
Wall receptacles/data	900 [36"]	In mechanical rooms
Panelboards	2000 [80"]	Panelboards: as required by Code or as indicated.
Wall mtd telephone	1500 [60"]	
Card Readers	1200 [48"]	Confirm before installation
Fire alarm stations	1350 [54"]	ULC S524 requires not less than 1200mm or more than 1400mm.
Fire alarm bells/audio	2200 [88"]	ULC S524 requires not less than 1800mm to centre. In any event not closer than 50mm to the ceiling
Fire alarm visual devices	2000 [80"]	ULC S524 requires not more than 2000mm to centre. In any event not closer than 150mm to the ceiling
End of line resistors	1800 [72"]	
Television outlets		As receptacles – coordinate with equipment location
Wall mounted speakers	2100 [84"]	Coordinate with equipment location
Door bell pushbuttons	1500 [60"]	Coordinate with location
Emergency Lighting (wall mounted)		150mm below ceiling or 4800mm max.

### 3.6 FIELD QUALITY CONTROL

- .1 Load and Balance:
  - .1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase and neutral currents to dry-core transformers and motor control centres, operating under normal load,
  - .3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .2 Conduct and pay for the following tests:
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its controls.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

- .5 Systems: fire alarm system and communications.
- .6 Main ground resistance (at all grounding locations).
- .7 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Check resistance to ground before energizing.
- .3 Provide Departmental Representative with at least one week's notice prior to testing.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
  - .2 Furnish manufacturer's certificate or letter conforming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
  - .3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .4 Schedule site visits to review Work.
- .6 Reports:
  - .1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

### **3.7 CLEANING**

- .1 Do final cleaning in accordance with Division 01.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

### **3.8 WORKMANSHIP**

- .1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

### 3.9 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

### 3.10 PROTECTION OF ELECTRICAL EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".
- .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 CONCEALMENT

- .1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

### 3.12 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.
- .2 The scope includes new services which pass through existing rated separations and also all existing services which pass through a new rated separation or existing separations whose rating has been upgraded.
- .3 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.
- .4 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.
- .5 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number.
- .6 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be repenetrated.
- .7 All penetrations are to be firestopped using UL, ULC or cUL assemblies approved for the application.
- .8 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks.
- .9 Provide split systems where existing cables are involved.

- .10 Provide firestopping approval certificate in including a Building Code / By-Law Schedule B-1, B-2 & C-B signed by a BC registered Professional Consultant. Submit a letter certifying that all work is complete and in accordance with this specification. Electrical Form EF130 in Appendix A should be used for this purpose.

### 3.13 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

### 3.14 CONDUIT SLEEVES

- .1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.
- .2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .3 Conduit sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.
- .4 Conduit sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.
- .5 Conduit sleeves shall extend 25mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.
- .6 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and conduit or wiring.
- .7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .8 Packing of Sleeves:
  - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.
  - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

### 3.15 ACCESSIBILITY AND ACCESS PANELS

- .1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.
- .2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Departmental Representative.
- .3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Acquire approval in writing from the local fire authority if required.
- .4 Access panels shall be painted with a primer coat if applicable and then with a finish coat, colour and type to the Departmental Representative's approval.
- .5 Locate equipment and junction boxes in service areas wherever possible.

### 3.16 EQUIPMENT INSTALLATION

- .1 Provide means of access for servicing equipment.
- .2 CSA identification and equipment labels to be clearly visible after installation.

### 3.17 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .2 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.
- .3 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.
- .4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.
- .5 Openings through structural members of the building shall not be made without the approval of the Structural Consultant.
- .6 Openings in Concrete:
  - .1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.
  - .2 All openings shall be core drilled or diamond saw cut.
  - .3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
  - .4 Refer to structural drawings for locations of steel reinforcing.
  - .5 Be responsible for repairing any damage to steel reinforcing.
- .7 Openings in building surfaces other than concrete:
  - .1 Lay out all openings required.

### 3.18 PAINTING

- .1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.
- .4 Coordinate with Division 09 Interior Painting.

END OF SECTION

## 1 GENERAL

### 1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### 1.2 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Division 01.
- .2 Do verification requirements in accordance with Division 01.

### 1.3 ASBESTOS

- .1 Refer to specification Division 02 Asbestos Abatement for procedures, removal and disposal of asbestos.
- .2 If during renovations / demolition, asbestos is discovered (or material suspected to be asbestos), all work in that area shall immediately cease and the General Contractor advised. The General Contractor shall take appropriate action without delay to verify presence of friable asbestos and be responsible for the removal of all friable asbestos.
- .3 This division will not be entitled to a claim for any delays resulting from the investigation of or removal of asbestos.

### 1.4 PCB (POLYCHLORINATED BIPHENYLS)

- .1 Carefully remove any electrical items containing PCB's (e.g. light fixture ballasts) from equipment or fixtures to be renovated or demolished. Removed items (containing PCB's) to be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

### 1.5 SCOPE

- .1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day. Maintain electrical and communication systems as required to minimize services disruption.
- .2 The Electrical Division to also take note of the dust containment requirements as outlined in the architectural and front end specification.
- .3 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.
- .4 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Consultant who will provide instruction.
- .5 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

### 1.6 SCHEDULING AND PHASING

- .1 Refer to Division 01 Construction Project Schedule – Critical Path Method (CPM).

## 1.7 EXAMINATION

- .1 Refer to Division 01 Examination and Preparation.

## 1.8 PROTECTION

- .1 Refer to Division 01 Temporary Facilities and Enclosures.

## 2 PRODUCTS

### 2.1 STANDARDS

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

## 3 EXECUTION

### 3.1 DEMOLITION

- .1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the Vancouver Building By-Law, current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.
- .3 The following existing electrical components, where indicated on the drawings, are to be disconnected by the Electrical Trade(s), cleaned and suitably packaged where applicable, and turned over to the Departmental Representative at designated location established on site. If the Departmental Representative refuses these items they become property of the Electrical Division and are to be removed from site
  - .1 All fluorescent luminaires complete with lamps and ballasts.
  - .2 Fire alarm components.
  - .3 Security devices.
  - .4 Speakers.
  - .5 Clocks.

### 3.2 DISRUPTION TO OPERATIONS

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before start-up.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

### 3.3 REUSE OF EXISTING COMPONENTS

- .1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location.

### 3.4 DISTRIBUTION OF CIRCUITS

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Consultant. Specific tasks involving the demolition of essential circuits will require that the contractor to obtain permission from the Departmental Representative before proceeding.

### 3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

- .1 All abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.
- .2 Remove all accessible (e.g. surface) wiring and cables back to source.
- .3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.
- .4 All remaining circuits to be rerouted as required and suitably secured to the building structure.
- .5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

### 3.6 EXCAVATION AND CUTTING DAMAGE

- .1 Circuits disrupted by floor cutting or drilling (i.e. buried cables) to be brought to the attention of the consultant. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to Departmental Representative.

### 3.7 FIRE ALARM SYSTEM

- .1 Construction/demolition activities in existing building may require that certain fire alarm devices are protected from construction dust, damage etc. Coordinate with the Departmental Representative as required to protect components of the fire alarm system to prevent nuisance operation and alarms.
- .2 Provide, install and test temporary heat detectors in the area of construction where the construction area is not protected by an active supervised fire protection sprinkler system. The "construction" detectors to be removed and discarded at the end of the project.
- .3 Provide temporary replacement of smoke detectors with heat detectors including interim programming and testing and final re-verification where deemed necessary to minimize false alarms and to ensure other occupants of the building are protected.
- .4 Maintain existing fire alarm system in areas under construction where practical. Relocate, rewire and provide interim connections as required while installing the new system to replace the existing. Provide temporary fire alarm devices and audible signals to suit any temporary exiting provisions.
- .5 Contractor to check in with the Departmental Representative at the start and end of each working day to confirm the fire alarm status in the area of work. Arrange for the related fire alarm zone card or area to be deactivated either to suit the progress of the work and/or where dust will be present on a day to day basis. Bag and protect fire detectors in dusty areas during construction. Remove any bagging at the end of the work day. Any existing detectors subject to construction dust to be immediately vacuumed and marked to be replaced at the end of the project. Any fire alarm devices subject to moisture to be replaced immediately.
- .6 The fire alarm system is to be fully functional in the area of construction when the contractor is neither on site nor after the contractors normal work hours (i.e. overnight, holidays, weekends). Contractor shall provide suitable firewatch system for the duration that the fire alarm system is not fully functional.

END OF SECTION

## 1 GENERAL

### 1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Refer to Division 27 & 28 for particular Communications, Electronic Safety & Security wiring systems and types.

### 1.2 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated.
- .2 Aluminium conductors only permitted where indicated on drawings and then typically only for feeder conductors larger than 3/0 AWG. All conductor sizes indicated on drawings are based on copper conductors unless otherwise noted.
- .3 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-6 flame spread rating.
- .4 Flexible armoured cabling (BX) shall not be used for the general wiring system other than final drops to recessed light fixtures in concealed locations.
- .5 Cabling indicated to be 2-Hour Fire-Rated shall be Mineral Insulated or compliant to CAN/ULC-S139 and CSA 38-95. Cabling shall be low smoke halogen free. Conduit to be sized and installed as per manufacturer's requirements for these specialized cables and assemblies regardless of the size indicated on drawings. Minimum standards of acceptance are Draka Lifeline, Raychem RHW, Shawflex.
- .6 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.
- .7 Refer to Equipment Schedule(s) for detailed responsibilities.

### 1.3 PRODUCT DATA

- .1 Provide product data in accordance with Division 01 Shop Drawings, Product Data and Samples.

## 2 PRODUCTS

### 2.1 WIRING & CABLES – GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.
- .3 Use RWU90XLPE for underground installations.
- .4 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.
- .5 Armoured (BX) cable may only be utilized for recessed tee bar luminaire drops from ceiling mounted outlet boxes. Use anti-short connectors. Cable from luminaire to luminaire is discouraged. Allow nominally 900mm [3'] extra cable looped and supported in the ceiling space to permit fixture relocations of one tile space.

- .6 TBS90 #14 AWG stranded shall be used in all switchgear assemblies. Current transformer secondary wiring shall be #12 AWG stranded. Current transformer leads shall incorporate ring type tongues for termination purposes
- .7 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors not to be painted.

## 2.2 TECK 90 CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors: copper and sized as indicated.
- .3 Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90XLPE,600V
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat galvanized steel.
- .6 Overall covering: PVC jacket with FT-6 flame spread rating. PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .7 Fastenings:
  - .1 One (1) hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two (2) or more cables.
  - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors: Watertight approved for TECK cable

## 2.3 ARMoured CABLE (BX)

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 600 V rated.
- .3 Armour: interlocking type fabricated from galvanized steel.
- .4 Anti-short connectors.

## 2.4 LOW VOLTAGE CONTROL CABLES

- .1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.
- .2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

## 2.5 WIRE & BOX CONNECTORS

- .1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.
- .2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.

- .3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors
- .4 Clamps or connectors for armoured cable, flexible conduit, as required.

### 3 EXECUTION

#### 3.1 INSTALLATION

- .1 Install all cables and wiring.
- .2 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.
- .3 Group Teck, Armoured, MI & Sheathed cables on channels wherever possible.
- .4 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.
- .5 Wiring in walls should typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls should be avoided unless indicated.
- .6 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.
- .7 Colour coding to be strictly in accordance with Section 26 05 00.
- .8 Provide sleeves where cables enter or exit cast concrete or masonry.
- .9 Power wiring up to and including No.6 gauge shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.
- .10 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.
- .11 All branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .12 Provide isolated green grounding conductor to each computer receptacle circuit (i.e. receptacle adjacent to voice/data outlet).
- .13 Install all control cables in conduit.
- .14 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.
- .15 Armoured cable (BX) may be used for wiring drop from ceiling junction box to luminaires only and up to 3000mm maximum.

#### 3.2 VOLTAGE REGULATION

- .1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.
- .2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

### 3.3 WIRE & BOX CONNECTORS

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65
  - .2 Install fixture type connectors and tighten. Replace insulating cap.
  - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .2 All grounding conductors to be stranded soft annealed copper unless otherwise noted.
- .3 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

### **1.3 TESTING REQUIREMENTS**

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions. Measure ground grid resistance.
- .2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Grounding equipment to: CSA C22.2 No.41.

### **2.2 EQUIPMENT**

- .1 Clamps for grounding of conductor, size as required.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified or required to be green.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .4 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:
  - .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.

### **2.3 STANDARDS OF ACCEPTANCE**

- .1 Minimum Standard Acceptable Manufacturers:
  - .1 Burndy Corp.
  - .2 Erico Inc
  - .3 Cadweld.

### 3 EXECUTION

#### 3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Provide ground wire in EMT conduits installed in grade or below slabs.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.
- .8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .9 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .10 Ground secondary service pedestals.
- .11 Provide a bonding conductor appropriately sized within each raceway routed within the building.
- .12 All bonding and grounding connections to be compression type unless noted otherwise.
- .13 Supply and install complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.
- .14 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.
- .15 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.
- .16 All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.
- .17 Bond all low tension equipment with #6 AWG bonding conductor.
- .18 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

#### 3.2 EQUIPMENT GROUNDING OR BONDING

- .1 Install grounding or bonding connections to typical equipment included in, but not necessarily limited to the following list: transformers, frames of motors, starters, UPS, control panels, building steel work, and distribution panel.

- .2 Provide grounding conductor(s) from all major switchgear to solidly ground the secondary system. This includes equipment located in the main electrical room as well as each sub-electrical room. Grounding conductors to be sized to Canadian Electrical Code and switchgear manufacturer's requirements.

### 3.3 MECHANICAL EQUIPMENT GROUNDING

- .1 Provide a #6 ground conductor from the mechanical room ground bus to each VFD
- .2 Ground wires to be installed in all conduits serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

### 3.4 SYSTEMS GROUNDING

- .1 Install home run a #6 AWG insulated bonding conductor in conduit from the main ground bus to the:
  - .1 Communication systems head end.

### 3.5 DATA & VOICE GROUNDING

- .1 Install home run insulated ground conductor in conduit from the building main ground bus as follows:
  - .1 #2 AWG to a ground bus in each telephone backboard in equipment rooms/closets.
- .2 Unless otherwise solidly bonded, bond all data and telephone incoming and outgoing steel conduits with insulated 1#12 AWG from the nearest "Communication" ground bus.

### 3.6 CABLE TRAY BONDING

- .1 Install 1#6 to each new cable tray from nearest ground bus.
- .2 Install 1#6 bare copper ground, unless shown otherwise, for full length of new tray bonded to tray at 15m [50'] intervals and to ground bus at each termination point as specified.

### 3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .3 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Consultant. Include all associated costs.
- .4 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

## 1 GENERAL

### 1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00

## 2 PRODUCTS

### 2.1 SPLITTERS

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

### 2.2 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm [1"] minimum extension all around, for flush-mounted pull and junction boxes.

### 2.3 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle and catch, for surface mountings.
- .2 Type T: sheet steel cabinet, with full length hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood backboard for surface or flush mounting as appropriate.
- .3 Include filtered vents and/or fan-cooling when enclosed equipment is heat producing.

### 2.4 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00.

## 3 EXECUTION

### 3.1 SPLITTER INSTALLATION

- .1 Install splitters as indicated 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 Install pull boxes in inconspicuous but accessible spaces.
- .2 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .3 Provide pull boxes and junction boxes in locations shown on the drawings and as required to suit job conditions.

- .4 Locate pull boxes and junction boxes above removable ceilings, in electrical rooms, utility rooms or storage areas.
- .5 Junction boxes, when used, to be installed in areas that are accessible through luminaire openings, and/or access panels.
- .6 Where pull boxes are flush mounted, provide overlapping covers with flush head cover retaining screws, prime coated and painted to match wall or ceiling finish.
- .7 Where cast corrosion resistant boxes are used, covers to be of matching type and gasketed.
- .8 For special (not 100mm [4"] square or octagonal) pull boxes and/or junction boxes, paint identification for the system and provide lamicoid nametags to box covers with a size 2 nameplate 5mm [0.25"] lettering identifying system.
- .9 Interior of all pull boxes and junction boxes for each system to be spray painted with colour as specified in Section 26 05 00
- .10 All pull boxes, junction boxes and cabinets to be supported directly from building structure using one or a combination of galvanized screws, galvanized bolts, galvanized rods, and approved box clip.
- .11 Support of pull boxes, junction boxes by conduit fittings or wire is not acceptable.

### 3.3 CABINETS INSTALLATION

- .1 Mount cabinets with top not higher than 2 m [6"] above finished floor.
- .2 Cabinets shall be flush mounted in finished areas where depth can be accommodated in the walls. Provide flush trim to suit.
- .3 Provide fit up in Type T cabinets as indicated.

### 3.4 IDENTIFICATION

- .1 Install size 2 identification labels indicating system name, voltage and phase in accordance with Section 26 05 00

END OF SECTION

## 1 GENERAL

### 1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

## 2 PRODUCTS

### 2.1 OUTLET AND CONDUIT BOXES IN GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm [4"] square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

### 2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54mm deep [4"x 2"] outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.
- .2 For larger boxes use GSB solid type as required.
- .3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers.
- .4 Lighting fixture outlets: 102 mm [4"] square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).
- .5 102 mm [4"] square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

### 2.3 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with flanged cover assemblies and faceplate. Device mounting plate to accommodate short or long ear receptacles. Minimum depth: 28 mm [1.1"] for receptacles; 73 mm [2.9"] for communication equipment.
- .2 Cover assemblies to be die-cast aluminum, provide barriers between the power and low voltage sections. A minimum of two (2) gangs for power and two (2) gangs for communications devices.
- .3 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16 mm [0.5"] and 21 mm [0.75"] conduit. Minimum size: 73 mm [2.9"] deep

## 2.4 SURFACE CONDUIT BOXES

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

## 2.5 FITTINGS – GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 35 mm [1.25"] Use pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## 3 EXECUTION

### 3.1 INSTALLATION

- .1 Typical outlet box mounting heights are indicated in Section 26 05 00 or refer to wiring device and communication specification sections and to architectural layouts for particular mounting heights of outlet boxes where indicated.
- .2 Support boxes independently of connecting conduits.
- .3 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.
- .4 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.
- .5 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm [0.25"] of opening.
- .6 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.
- .7 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.
- .8 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.
- .9 No sectional or handy boxes to be installed.
- .10 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.
- .11 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.
- .12 Outlets installed back to back in party stud walls to be off-set by one stud space.
- .13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.
- .14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.

- .15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 REFERENCES**

- .1 All conduits and accessories to be manufactured and certified by the related CSA standards.

### **1.3 SCOPE**

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.
- .3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Departmental Representative where exposed raceway may be substituted.
- .4 Note particular requirements for routing of conduits where detailed.
- .5 Provide polypropylene pull cord in all "empty" conduits.

## **2 PRODUCTS**

### **2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.
- .2 Epoxy coated conduit: to CSA C22.2 No.45 with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.
- .4 Rigid PVC conduit: to CSA C22.2 No.211.2.
- .5 Flexible metal conduit: to CSA C22.2 No.56 liquid-tight flexible metal conduit.

### **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 41mm [1.5"] and smaller. Use two hole steel straps to conduits larger than 41mm [1.5"].
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 10mm [3/8"] threaded rods to support suspended channels.

### **2.3 CONDUIT FITTINGS**

- .1 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .2 Provide factory "ells" where 90 degree bends are required for 27mm [1"] and larger conduits.
- .3 EMT couplings and connectors shall be steel, or Regal die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc) in rooms that are fire sprinkler protected.

## 2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.
- .2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 21mm [3/4"] deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

## 2.5 RIGID P.V.C. CONDUIT

- .1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride.
- .2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.
- .3 Solvent: as recommended by conduit manufacturer.

## 3 EXECUTION

### 3.1 INSTALLATION - GENERAL

- .1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.
- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.
- .3 Where practical conceal conduits.
- .4 Any exposed conduit in finished areas to be free of unnecessary labels and trademarks.
- .5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.
- .6 Ensure grounding continuity in all conduit systems.
- .7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.
- .8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m [5'] above the finished floor.
- .9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.
- .10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.
- .11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.
- .12 All home-run branch circuit conduit and communication/data conduits to be minimum 21 mm [3/4"] diameter unless otherwise indicated.
- .13 Generally, use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: eg where conduits emerge from ground level slab.
- .14 Conduits are not permitted in terrazzo or concrete toppings.
- .15 Cap turned up conduits to prevent the entrance of dirt or moisture during construction.

- .16 Locate conduits more than 75mm [3"] parallel to steam or hot water lines with a minimum of 25mm [1"] at crossovers.
- .17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.
- .18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.
- .20 Damaged conduits to be repaired or replaced.
- .21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .22 Conduits shall not pass through structural members except as indicated.
- .23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.
- .24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.
- .25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.
- .26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.
- .27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.
- .28 Where drawings show conduit designations, these conduits shall be identified at each point of termination. Minimum standard of acceptance: Thomas & Betts "Ty-Rap" No. TY532M labels or equal.
- .29 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.
- .30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.
- .31 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.
- .32 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.
- .33 Use explosion proof flexible connection for connection to explosion proof motors.
- .34 Install conduit-sealing fittings in hazardous areas, isolation rooms and clean rooms. Fill with compound.

### 3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5'] clearance.
- .3 Conduits to be run in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Surface conduits will not be accepted in finished areas unless detailed.

### 3.3 SPARE CONDUITS

- .1 Provide spare conduits as indicated.
- .2 Provide 4x27 mm [1"] spare conduits up to ceiling space and 2x27 mm [1"] spare conduits down to ceiling space below from each flush panel tub. Terminate the conduits in 150x150x100 mm [6"x6"x4"] junction boxes in ceiling spaces or in case of an exposed concrete slab, terminate each conduit in a flush concrete box. Provide cover plates for all junction boxes.

### 3.4 EXPANSION JOINT CONDUIT FITTINGS

- .1 Provide conduit expansion joint fittings at concrete expansion joint.

### 3.5 RIGID P.V.C. CONDUIT

- .1 Use in accordance with the Canadian Electrical Code and Building Codes and as noted below:
- .2 Use as raceways for following applications
  - .1 In poured slab on grade concrete floors and walls and for underground runs exterior to the buildings unless otherwise noted.
  - .2 Wiring installed in areas subject to intermittent or continuous moisture but not surface mounted.
  - .3 Rigid PVC conduit shall not be surface mounted or exposed within buildings.
- .3 Do not use in return air plenums or for exit light circuits and emergency lighting.
- .4 Provide insulated ground wire in all rigid PVC conduits in accordance with the Canadian Electrical Code.
- .5 Where rigid PVC conduit is set in poured concrete, solvent joints must be completed and allowed to set as per manufacturer's instructions before pour.
- .6 Bend rigid conduit in strict accordance with manufacturer's directions. Distorted bends will not be accepted.

END OF SECTION

## 1 GENERAL

### 1.1 RELATED WORK

- .1 This Section of the Specification is to be read, coordinated and implemented in conjunction with all other parts of the Contract Documents.
- .2 Refer to Division 01 General Instructions for additional scope.

### 1.2 REGULATORY REQUIREMENTS

- .1 Restraints shall meet the requirements of the latest adopted editions of the National Building Code and Vancouver Building By-Law (VBBL) and amendments.
- .2 The Seismic Consulting Engineer should be able to provide a proof of professional insurance and the related practice credentials if requested by the Department Representative. The Seismic Consulting Engineer should be familiar with SMACNA, ECABC & NFPA guidelines as well as BCBC requirements.
- .3 The Contractors Seismic Consultant shall submit original signed VBBL "Letters of Assurance" "Schedules B1, B2, and C-B" to the Department Representative.
- .4 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

### 1.3 SCOPE

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01 Shop Drawings, Product Data and Samples.
- .3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Engineer, hereinafter referred to as the "Seismic Consultant". The Seismic Consultant will provide normal engineering functions as they pertain to seismic restraint of electrical installations.
- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.
- .6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.
- .7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.
- .8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.

- .9 Include all costs associated with the Seismic installation and certification.

#### 1.4 SHOP DRAWINGS & SUBMITTALS

- .1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.
- .2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

### 2 PRODUCTS

#### 2.1 SLACK CABLE SYSTEMS

- .1 Slack cable restraints shall be provided on suspended and shelf mounted transformers along with associated equipment and assemblies connected to them at the points of vertical support (4 points). The restraint wires shall be oriented at approximately 90° to each other (in plan), and tied back to the ceiling slab or its structure at approximately 45° to the slab or basic structure. The restraints shall be selected for a 1 g earthquake loading, i.e. each wire shall have a working load capacity equal to the weight of the transformer. The anchors in the structure shall be selected for a load equal to the weight of the transformers at a 45° pull.
- .2 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the Department Representative and inspection authority having jurisdiction.
- .3 Coordinate requirements of slack cables with suppliers prior to installation.

### 3 EXECUTION

#### 3.1 GENERAL

- .1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

#### 3.2 CONDUITS

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:
- .2 Vertical Conduit:
- .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
- .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m [30 ft] on centres (o.c.).
- .3 Riser joints shall be braced or stabilized between floors.
- .3 Horizontal Conduits:
- .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
- .2 EMT tubing - tubing shall be supported at approximately 1.2 m [4 ft] intervals for tubing.

- .4 Provide transverse bracing at 12.2 m [40 ft] o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.
- .5 Provide longitudinal bracing at 24.4 m [80 ft] o.c. maximum unless otherwise noted.
- .6 Do not brace conduit runs against each other. Use separate support and restraint system.
- .7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .10 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to Department Representative for their reference.

### 3.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, e.g. free standing equipment rack, panelboards, control panels, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.
- .2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

### 3.4 LIGHT LUMINAIRES

- .1 Fluorescent luminaires in suspended ceilings shall be hung independently of the ceiling system. Luminaires shall be secured to concrete or structural deck above by at least two taught cables which are connected to the fixture at diagonal points.
- .2 Surface and recessed style luminaires shall be hung independently of the ceiling system. Luminaires shall be secured to concrete or structural deck above by taught cables.
- .3 Luminaires which are hung independently of ceiling systems shall have minimum of one seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.
- .4 Cables shall be corrosion resistant and approved for the application.
- .5 Luminaires which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 26 05 00 Common Work Results
- .3 Section 26 27 26 Wiring Devices
- .4 Section 26 24 16 Panelboards – Breaker Type

### **1.2 SYSTEM DESCRIPTION**

- .1 Lighting control system shall the following components:
  - .1 Relay Panels c/w Controllers and Transformers
  - .2 Relays and Contactors
  - .3 Low Voltage Wall Switches
  - .4 Occupancy Sensors
  - .5 Interfaces with BMCS

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings & product data in accordance with Section 26 05 .00.
- .2 Retain the equipment supplier's representative to assist with the review of the equipment application at the shop drawing stage.
- .3 Provide custom schematic shop drawings of the complete systems and devices specified in this section.

### **1.4 SCOPE**

- .1 Provide a complete lighting control system to interface with the existing building lighting control system as shown on the plans and specified herein.
- .2 Provide all required interfaces, relays and power supplies required between the various system devices including any different control technologies specified and the existing building lighting control system. Refer to drawings for details.
- .3 Any and all modifications to the existing lighting control system shall be updated and reprogrammed into the existing Direct Digital Control (DDC) system of the building. Contractor to allow for all costs relative to this updating and reprogramming which shall be performed by the existing DDC system provider of the building.

## **2 PRODUCTS**

### **2.1 RELAYS (LINE VOLTAGE)**

- .1 Line voltage relays to be rated at a minimum of 20 Amp, 300 volt, with contacts as required and 120 volt coil. Relays to be mounted in separate identified enclosure.

## 2.2 LIGHTING CONTACTORS (LINE VOLTAGE)

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically operated, electrically or mechanically held, multi-pole full voltage type.
- .3 Typically minimum of 4 pole rated at 20A and 600V
- .4 One set of auxiliary N/O and N/O contacts.
- .5 Contactors to have 120V operating coils unless otherwise noted.
- .6 Controlled by remote devices as indicated and rated for type of load controlled.
- .7 Provide Hand-Off-Auto selector switch and Red LED indicating lamp unless otherwise noted.
- .8 Provide CEMA enclosure as required for location unless indicated otherwise.

## 2.3 OCCUPANCY SENSORS WALL SWITCHES (LINE VOLTAGE)

- .1 Line voltage wall switch sensors shall be capable of detecting presence, in the floor area to be controlled, by detecting shifts in infrared energy and/or Doppler shift ultrasonic
- .2 Provide a neutral wire at each switch position using ultrasonic or dual technology.
- .3 Sensors shall be complete with the following:
  - .1 Override push switch.
  - .2 LED detection status indicator.
  - .3 Low profile recessed design to suit "Decorator Plate
  - .4 Dual level lens to enhance detection at desk top level.
  - .5 Ability to maintain luminaires in operation when occupancy is only one person sitting at a desk in accordance with NEMA WD7 guidelines.
  - .6 Temperature and humidity resistance.
  - .7 Time delay range from 30 seconds to 30 minutes.
  - .8 Sensitivity adjustment from 20% to 100%.
  - .9 Compatible with electronic ballasts and CF ballasts.
  - .10 Immunity to RFI and EMI interference.
  - .11 Integrated light level sensor option holds light off when the ambient natural light levels are above the pre-set levels.
  - .12 CSA approved
  - .13 Five-year warranty.
- .4 Minimum Standard of Acceptance:
  - .1 Watt Stopper PW-100 120V PIR  
(UW-100 = Ultrasonic & DW-100 is Dual Technology)
  - .2 Sensor Switch WSX PDT series
  - .3 Douglas Power WOS series

## 2.4 OCCUPANCY SENSORS – CEILING OR WALL MOUNTED (LINE VOLTAGE)

- .1 Sensors shall be capable of detecting presence in the floor area to be controlled by detecting relative shifts in Infrared Energy and/or Doppler shift ultrasonic.
- .2 Provide a bypass switch (or pin) to defeat automatic function that shall be visible from the floor when installed. Function select - on/off switching or off-only switching.
- .3 Load ballast switching capacity: 120V 800W.

- .4 LED detection status indicator.
- .5 Low profile recessed design not protrude more than 25mm [1"] down from the ceiling.
- .6 Ability to maintain luminaires in operation when occupancy is only one person sitting at a desk in accordance with NEMA WD7 guidelines.
- .7 Multi-directional 360° detector with temperature and humidity resistance, Provision for parallel wiring up to five (5) sensors per power pack for large area coverage.
- .8 Time delay range from 30 seconds to 30 minutes.
- .9 Sensitivity adjustment by dip switches – minimum 4 levels.
- .10 Tilt & swivel lens direction adjustment.
- .11 Immunity to RFI and EMI interference.
- .12 CSA approved
- .13 Five-year warranty.
- .14 Minimum Standards of Acceptance:
  - .1 Watt Stopper DT-355 is Dual Technology (UT-355 = Ultrasonic & CI-355 is PIR Technology) or equal.
  - .2 Sensor Switch CMR PDT9 series
  - .3 Douglas Power WOR series

## 2.5 LOW VOLTAGE CONTROL - GENERAL

- .1 Provide low voltage control for lighting and other systems as shown on plans and specified herein which are compatible with the existing low voltage lighting control system.
- .2 Do not connect the secondaries of the control transformers in parallel or connect one side of the secondaries in common. All control transformers to be connected to the same phase.
- .3 Minimum Standards of Acceptance:
  - .1 Douglas Power
  - .2 Watt Stopper
  - .3 General Electric

## 2.6 LOW VOLTAGE RELAYS

- .1 Control relays shall be mechanically latching, firmly mounted in relay panels and be plug-in type. Relays shall include captive screw terminals for both the line voltage and the low voltage wiring connections. Relay load contacts shall be UL/CSA listed for 120, 277 and 347 VAC lighting loads at 20 amperes (HID inductive).
- .2 The relay shall be contained in a moulded case with both low and high voltage terminals. Load contacts shall be able to sustain an inrush current of 2000 amperes. Relays shall be complete with a 5 year manufacturer's limited warranty. The relay shall have a mechanical override and shall continuously display the state of the relay's internal on/off contacts.
- .3 The relays shall have a label indicating the short circuit fault current rating. The relays shall have passed UL 508 short circuit tests at 14,000 amperes.
- .4 It shall be impossible to continuously energize the relay coil by holding the control switch in either the On or Off position. Relays shall be complete with control diodes and internal control circuit eliminator contacts. The eliminator contact shall automatically condition the input control circuit so as to reverse the coil polarity requirement immediately after an "on" or "off" control pulse is received.

- .5 Relays shall be CSA and UL listed.
- .6 Minimum Standards of Acceptance:
  - .1 Douglas Power: WR 6161(single pole) and WR 6162 (double pole)
  - .2 Watt Stopper: HDR series
  - .3 General Electric RR-9P series

## 2.7 LOW VOLTAGE WALL SWITCHES

- .1 Wall switches shall be flush mounted with associated hardware to fit into standard wall boxes. Switches shall be single push operation, with internal solid state circuit that continuously monitors the condition of the associated lighting control load relay and connecting wires. Key operated or secure switches as noted on drawings. Key shall be removable in either the 'enabled' or 'disabled' state.
- .2 Each switch shall be clearly identified with a printed switch label. The label shall indicate the switch function, or area served, as indicated in Lighting Control Schedule. Labels shall be held in place with removable clear plastic cap and shall be field replaceable. Submit label schedule as part of the shop drawing submittal.
- .3 Individual switches shall each contain a green "off" LED and a red "on" LED, thus continuously indicating the status of the associated lighting control load relay.
- .4 Switches shall have color coded captive screw terminals.
- .5 Provide wiring as recommended by the system manufacturer. Typically wiring will be stranded multi-conductor and jacketed.
- .6 Switch plates shall be stainless steel or as otherwise indicated.
- .7 Provide interfaces as required to group relays to common switches.
- .8 Provide master switches in gang arrangements as required.
- .9 Minimum Standards of Acceptance:
  - .1 Douglas Power: WR-86XX series (WRK for key, WNS-23XX for data)
  - .2 Watt Stopper: RS series (HDLS/L1,2,3,4 for data)
  - .3 General Electric

## 2.8 OCCUPANCY SENSORS WALL SWITCHES

- .1 Occupancy sensors shall be capable of detecting presence in the floor area to be controlled using dual technology: passive infrared (PIR) and microphonics. Upon sensing motion using PIR technology, the sensor signals ON, activates the sound detector and starts an internal timer. Timer will be continually reset whenever motion is seen or sound is detected.
- .2 Sensors shall be complete with the following:
  - .1 LED status indicator.
  - .2 Low profile recessed design to suit faceplate.
  - .3 Time delay range from 30 seconds to 20 minutes.
  - .4 Auto On or Manual ON selectability.
  - .5 Manual override capability.

## 2.9 OCCUPANCY SENSORS – CEILING MOUNTED

- .1 Occupancy sensors shall be capable of detecting presence in the floor area to be controlled using dual technology: passive infrared (PIR) and microphonics. Upon sensing motion using PIR technology, the sensor signals ON, activates the sound detector and starts an internal timer. Timer will be continually reset whenever motion is seen or sound is detected.
- .2 Provide a bypass switch (or pin) to defeat automatic function that shall be visible from the floor when installed. Function selection: on/off switching or off-only switching.
- .3 Sensors shall have the ability to directly control up to four low voltage relays directly and have the ability to connect low voltage wall switches in parallel to each relay for occupant override.
- .4 LED status indicator.
- .5 Low profile recessed design not protrude more than 25mm down from the ceiling.
- .6 Multi-directional 360 degree detection.
- .7 Time delay range from 30 seconds to 20 minutes.
- .8 PIR lens capable of being rotated or swivelled.
- .9 Unit assembly shall have one set of normally open and one set of normally closed auxiliary contacts.

## 2.10 POWER PACKS:

- .1 Power Packs shall be self-contained transformer relay module complete with snap-in nipple for installation in a typical electrical box knockout.
- .2 Unit shall have dry contacts capable of switching line voltage (120V) relays controlling up to 20 Amp ballast load or 13 Amp incandescent or 13 Amp fluorescent ballast load.
- .3 Unit shall provide 24 volt DC @ 150 mA output capable for controlling a minimum of three (3) occupancy sensors plus remote slave packs as required.
- .4 Unit shall be capable of parallel wiring without regard to primary AC phasing.
- .5 Unit shall be CSA approved.
- .6 Provide addressable Power Pack as required to suit system.
- .7 Minimum Standards of Acceptance:
  - .1 Watt Stopper B120E-P, addressable type equal to LC 100.
  - .2 Douglas Power PP series
  - .3 Sensor Switch PP20 series

## 2.11 SLAVE PACK:

- .1 Slave pack shall have similar features as the Power Packs but without transformer.
- .2 Minimum Standards of Acceptance:
  - .1 Watt Stopper S120EP
  - .2 Douglas Power PP series
  - .3 Sensor Switch SP20 series

## 2.12 WIRING

- .1 Provide all control wiring as required and recommended by the manufacturer.
- .2 The removal of any addressable device shall have no effect on the communication between other devices and the relay panels in the rest of the lighting control network.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Provide and install all equipment including all components needed to make the system work in the intended manner.
- .2 Confirm control wiring individual conductor sizes with equipment manufacturer prior to installation.
- .3 Retain the equipment supplier's representative to assist with the proper device placement at the rough-in stage.
- .4 Confirm control wiring individual conductor sizes with equipment manufacturer prior to installation.

#### **3.2 INSPECTION**

- .1 Coordinate controls and interfaces with other Divisions.

#### **3.3 COMMISSIONING**

- .1 Check and confirm that all control devices and sensors work in the intended manner.
- .2 Retain the equipment supplier's representative to review the coverage patterns and finally adjust sensor settings after the move in and furniture installation. Provide a supplier's sign-off letter and a schedule indicating the set points of all devices.
- .3 Provide sign-off letter from existing DDC service provider that the lighting control system has been updated and reprogrammed for any modification made to the existing lighting control system.

END OF SECTION

## 1 GENERAL

### 1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### 1.2 SCOPE OF WORK

- .1 In general the HVAC and the Plumbing/Fire Protection motors and drives will be respectively provided under the Mechanical Division and Plumbing/Fire Protection Divisions. Refer to the related division of the specifications and drawings for exact locations and requirements.
- .2 Provide the following components:
  - .1 All disconnect switches required.
  - .2 All starters, contactors, control transformers, except where supplied by the Mechanical or Plumbing/Fire Protection Divisions as noted in the equipment schedule.
- .3 Thermostats, solenoid valves, pressure switches, aquastats, flow switches, timeclocks are generally provided by the Mechanical or Plumbing Divisions except as noted in the equipment schedule(s).
- .4 Refer to equipment schedule(s) for details of motor controls and devices.
- .5 Provide all power wiring from power distribution centre, through starter and control equipment to the motors.
- .6 Conduit, wire and connections for all HVAC low voltage control wiring shall be the responsibility of Mechanical Division unless otherwise specified.
- .7 Provide, connect and verify all Fire Alarm control wiring and devices.

### 1.3 CONTROLS - GENERAL

- .1 Mechanical and Plumbing Divisions differ both in regard to the particulars of drives, motors, etc. specified. The Mechanical Division typically includes a major section on controls whereas the Plumbing Division typically includes more package equipment requiring power service connection only. Because of these variations, the demarcation point between the work of the Electrical Division and the Mechanical and Plumbing Divisions typically differ.
- .2 Generally for drives, equipment, etc. detailed in the Mechanical Division, the work of the Electrical Division finishes with the supply of a standard terminal block array for each starter. All further wiring, relays, timers, etc., together with control consoles, are provided under the Mechanical Division.
- .3 Generally for the package equipment, drives and special controls detailed in the Plumbing Division, the work of the Electrical Division typically includes the provision of all wiring, devices, etc. to complete each system and left ready for commissioning, set up, etc. by the Plumbing Division.

### 1.4 ELECTRICAL DIVISION RESPONSIBILITIES FOR MECHANICAL DIVISIONS

- .1 Provide a ten point terminal block for each starter or contactor.
- .2 Provide interwiring between starters or contacts and terminal blocks. Starter to be entirely factory-wired.
- .3 Terminals to be as follows:
  - .1 120 V line from control transformer.
  - .2 Terminals for remote 3 wire stop/start.
  - .3 HOA or other control.

- .4 120V neutral.
- .5 Normally open dry contact.
- .6 Common.
- .7 Normally closed dry contact.
- .8 Normally open dry contact.
- .9 Common.
- .10 Normally closed dry contact.

- .4 Except where otherwise indicated, the work of the Electrical Division shall not extend beyond the control terminal blocks. The Mechanical Division shall provide all conduit, wire, wiring connections and components such as relays, timers, etc. as required to provide the interlocking functions and controls as outlined in the specifications. If the standard terminals supplied by the Electrical Division require supplementation in any way, e.g. by supplying additional N.O. or N.C. contacts, these facilities are included in the Mechanical Division scope.
- .5 Mechanical Division shall provide the mechanical control consoles complete with pilot controls, indicating lights, etc., as outlined in the specifications.
- .6 When an item provided under the Mechanical Division is factory supplied with a starter or contactor and it is necessary to alter or add to the control wiring in order to achieve the method of operation specified in the Mechanical Division, this work shall be included in Mechanical Division.
- .7 When control items such as thermostats, float controllers, etc., are connected to power wiring in series with the item being powered (e.g. unit heater motor, fractional HP fans, etc.) the supply and installation of the controller devices are included in Mechanical Division. Power wiring to and from the controllers is included in the Electrical Division. Install line voltage thermostats for single phase motors provided by Division 22 and Division 23 where specifically indicated on the drawings and/or Section 26 24 19 of this Specification.
- .8 When the electrical characteristics of a controlled item exceed the capacity of a specified controller, provision of a contactor and the required wiring shall be included in the Mechanical Division.

## **1.5 ELECTRICAL DIVISION RESPONSIBILITIES FOR PLUMBING DIVISIONS**

- .1 When a drive, motor, etc. provided under the Plumbing Divisions is factory supplied with a starter, contactor, alternator, pressure switch, etc., the wiring and installation of these items and controls shall be included in the Electrical Division.
- .2 The ten point terminal blocks similar to those specified under the Mechanical Division controls are not mandatory for the Plumbing Division equipment.
- .3 The Electrical Division shall provide stop/start or HOA controls as specified for each item except where these stations are factory supplied with equipment.
- .4 The Electrical Division shall leave each system fully functional and requiring only minor final adjustments (such as pressure or vacuum settings) by the Plumbing Divisions.

## **2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Refer to appropriate section of the Electrical Division(s).

### **2.2 CONTROL RELAYS**

- .1 Control relays to be rated minimum 10 A, 300V, with contacts as required and 120 V control coil unless otherwise noted. Relays to be typically mounted in CEMA1 enclosures located in control terminal cabinets and/or MCC.

- .2 Provide required fire alarm relays and auxiliary contacts in motor control centres or at the related equipment cabinets to provide activation and deactivation of mechanical fan units as specified in the Mechanical Division.
- .3 Relays for Fire Alarm shutdown system control to be approved for Fire Alarm use and powered from the Fire Alarm panel. Fire Alarm relay enclosures to be finished in red and identified "FIRE ALARM RELAY"
- .4 Time delay relays to incorporate time delay feature to delay either opening or closing as specified. Time period to be adjustable from 0 to 5 minutes unless otherwise specified.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Provide all labour and materials required to complete power wiring for HVAC, Plumbing and Fire Protection equipment as called for in the project specifications and/or shown on the drawings.
- .2 Provide all single and 3 phase motor protection switches, combination starters and disconnects contactors and relays as required for mechanical equipment unless otherwise specifically noted in these specifications or on the drawings.
- .3 Terminate all line voltage wiring to the designated equipment terminals.
- .4 Obtain a full set of HVAC control shop drawings and have a full understanding of the scope before commencing installation and including any fire alarm interface.
- .5 Verify the recommended overcurrent protection and rating of Mechanical and Plumbing and Fire Protection equipment and equipment supplied by the Departmental Representative. Change feeder overcurrent protection as required to comply with equipment recommendations. Notify the Departmental Representative of all revisions.

#### **3.2 FIELD QUALITY CONTROL**

- .1 Cooperate with Departmental Representative and mechanical contractor and check out the operation of all motor controls with all HVAC systems fully operational. Record all electrical loads. Coordinate with equipment supplier to replace any defective or improperly-sized starter overloads, heaters, fuses, circuit breakers or other integral components.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 26 05 00.

## **2 PRODUCTS**

### **1.3 SURFACE RACEWAYS**

- .1 Removable cover finished painted steel surface raceways.
- .2 Internal barriered to provide physical separation between power and communication cabling.
- .3 Colour to be as indicated on the drawings or where not indicated confirm with Departmental Representative before ordering.
- .4 All raceway fittings to be accessories available from the manufacturer.
- .5 Minimum Standards of Acceptance:
  - .1 Wiremold
  - .2 Panduit
- .6 All products to be from the same manufacturer.

### **1.4 INDOOR SERVICE POLES:**

- .1 Indoor service pole assembly are provided by the furniture supplier and are suitable for power/communication requirements.

## **3 EXECUTION**

### **1.5 SURFACE RACEWAYS**

- .1 Where practical provide regularly spaced device outlets and factory pre-cut raceway covers and cover plates. Field install outlets where factory installation is not possible due to delivery issues or irregularly spaced outlet requirement. In this event, covers may be field cut with proprietary factory cover shear equipment with sharp blades.
- .2 Raceways shall be free of burrs inside and out.
- .3 Covers to be matching colour, smooth, free of burrs and parallel with no gaps.
- .4 Preserve and organize the space within the wireway to facilitate multiple wiring runs and future additions. In finished areas and where practical, conduit to feed the surface raceway from a box recessed behind and via grommetted openings to the back of the surface raceway. Maintain pullbox access as required by the Canadian Electrical Code.

### **1.6 INDOOR SERVICE POLES**

- .1 Coordinate final location of the service poles and surface wireways to suit the final furniture or equipment layout.

- .2 Complete power and communication connections.
- .3 Test operation and confirm correct polarity and grounding.
- .4 Coordinate with furniture supplier for re-adjustment of service poles as required after data cables are installed.

END OF SECTION

## 1 GENERAL

### 1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00.

### 1.3 RELATED SECTIONS

- .1 Section 26 09 24 Lighting Controls (Occupancy Sensors, Low Voltage Switching Devices, etc).

### 1.4 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 (Bi-national standard, with UL 514D).
  - .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).

## 2 PRODUCTS

### 2.1 SWITCHES

- .1 Heavy duty specification grade.
- .2 20 A, 120V, single pole, double pole, three-way, four-way switches as indicated.
- .3 Manually-operated general purpose ac switches as indicated and with following features:
  - .1 Terminal holes approved for No.10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine molding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 White toggle (red toggle for emergency power circuits).
- .4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rating capacity of motor loads.
- .5 Switches of one manufacturer throughout project.
- .6 Minimum Standards of Acceptance:
  - .1 Hubbell HBL.1221 20A series
  - .2 Leviton 1221-20A 120V series – 18221 347V
  - .3 Pass & Seymour PS20AC1 120V series – PS37201(3)0 347V

## 2.2 RECEPTACLES – GENERAL

- .1 Heavy duty specification grade.
- .2 Duplex receptacles, CSA type 5-15R, 125V, 15A, U ground, with following features:
  - .1 White nylon molded housing (red for emergency power circuits)
  - .2 Suitable for No.10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and non riveted grounding contacts.
- .3 Use shuttered safety receptacles in Day Care or similar children play areas or as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Minimum Standards of Acceptance:
  - .1 Hubbell 5252 heavy duty, construction series
  - .2 Leviton 5262 series
  - .3 Pass & Seymour 5262 series

## 2.3 RECEPTACLES – PARTICULAR APPLICATION

- .1 Surge Suppression TVSS 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, blue face, parallel blade, U ground, impact resistant nylon face audible and LED alarm. Minimum standards of acceptance:
  - .1 Hubbell 8262SA heavy duty series with LED.
  - .2 Leviton 8280 series
  - .3 Pass & Seymour 8200SP series (Décor)
- .2 Isolated Ground type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, orange face, parallel blade, U ground, impact resistant nylon face. Minimum standards of acceptance:
  - .1 Hubbell IG8262A series
  - .2 Leviton 8200IG series
  - .3 Pass & Seymour IG26262 series (Décor)
- .3 Ground Fault Interrupter type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, white face, parallel blade, U ground, impact resistant nylon face, complete with breaker and reset button. Minimum standards of acceptance:
  - .1 Hubbell GF8200A series
  - .2 Leviton 7599HG series
  - .3 Pass & Seymour HG1595 series (Décor)
- .4 All other single outlet and special purpose receptacles to be similar to the grade and series indicated above. Confirm ampacity, voltage and pin configuration prior to installation.

## 2.4 DIMMERS

- .1 Flush mounted - Specification grade.
- .2 Incandescent application: 600-1500 watts based on connected load plus 25% spare.
- .3 Electronic ballast application: compatible with ballasts specified.
- .4 Radio interference suppression.
- .5 Thin profile: slide to OFF feature.

- .6 Finished in white or as indicated.
- .7 Minimum Standards of Acceptance:
  - .1 Lutron 'NOVA-T' NT series.
  - .2 Leviton 'Illumatech' series.
  - .3 Legrand 'Harmony' series

## 2.5 INTERVAL TIMERS

- .1 Range: 0-30 minutes.
- .2 Spring wound or digital without hold feature.
- .3 Single pole 120 volt, 20 Amp contacts to open at end of timing cycle.
- .4 Flush mounting.
- .5 White finish.
- .6 Minimum Standards of Acceptance:
  - .1 Wattstopper TS series
  - .2 Intermatic FF51-00
  - .3 Leviton 6230M series

## 2.6 COVER PLATES

- .1 Nylon plates: Heavy duty, unbreakable and flush. All nylon plates to match wiring device colour.
- .2 Steel: sheet steel hot dip galvanized with rolled edges for surface mounted utility boxes.
- .3 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.
- .4 All plates to be bevelled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.
- .5 Cast metal: die cast profile, ribbed for strength, flash removed, primed with grey enamel finish and complete with four mounting screws to box for special purpose wiring devices.
- .6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for wiring devices as indicated. Double doors for standard duplex receptacles. Coverplates to fasten to box by four screws.
- .7 Gaskets: resilient rubber or close cell foam urethane.
- .8 Cover plates for all wiring devices to be from one manufacturer throughout project.

## 3 EXECUTION

### 3.1 INSTALLATION - GENERAL

- .1 Mount wiring devices to height specified in Section 26 05 00 or as indicated.
- .2 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.
- .3 All plates to be installed parallel or perpendicular to building lines.

### 3.2 INSTALLATION - PARTICULAR

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .2 Receptacles:
  - .1 Install all receptacles in the vertical plane unless otherwise noted.
  - .2 Generally install the 5-15/20R U ground pin down unless otherwise noted. Neutral up when receptacle in mounted horizontal.
  - .3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.
  - .4 Where split receptacles has one portion switched, mount vertically and switch the upper portion.
  - .5 Surge suppression duplex receptacles to be provided for all communication and computer terminal equipment backboards and cabinets including fire alarm, telephone, public address, door security, nurse call, central dictation, RF television, security television, etc. Provide dedicated neutral conductors for each surge suppression receptacle.
  - .6 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.
- .3 Cover plates:
  - .1 Protect 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.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 00.

## **2 PRODUCTS**

### **2.1 DISCONNECT EQUIPMENT**

- .1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4
- .2 Fuseholder assemblies to CSA C22.2 No.39.
- .3 Fusible and non-fusible disconnect switch in CSA enclosure.
- .4 Provision for padlocking in off switch position.
- .5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Weatherproof as required.

### **2.2 CONTACTOR EQUIPMENT**

- .1 Contactors: to CSA C22.2 No.14.
- .2 Half size contactors not accepted.
- .3 Electrically operated, electrically or mechanically held, multi-pole full voltage type.
- .4 Contactors to have 120V operating (and unlatching) coils unless otherwise noted.
- .5 Controlled by pilot devices as indicated and rated for type of load controlled.
- .6 Breaker or Fused switch combination contactor as indicated.
- .7 Complete with 1 normally open and 1 normally closed auxiliary contacts unless indicated otherwise.
- .8 Provide CEMA enclosure as required for location unless indicated otherwise.

### **2.3 EQUIPMENT IDENTIFICATION**

- .1 Indicate name of load controlled on size 4 name plates to Section 26 05 00.

### **3 EXECUTION**

#### **3.1 DISCONNECT INSTALLATION**

- .1 Install disconnect switches complete with fuses where indicated or required.
- .2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

#### **3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS**

- .1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Departmental Representative has given a special pre-approved circumstance.

#### **3.3 CONTACTOR INSTALLATION**

- .1 Install contactors and connect auxiliary control devices.
- .2 Pilot lights to be illuminated when contactor is closed.
- .3 Control wire to be minimum #14 AWG. Remote control wiring to be 5A fuse protected and the wiring shall be upsized to limit voltage drop to no more than 2%.
- .4 Control circuits shall fail safe leaving the contactor in the open position if the power fails or where automatic reset could be a safety or operational concern. Provide a control circuit seal-in contact for all momentary contact control devices unless otherwise indicated.
- .5 The contactor shall not automatically reset after a power failure unless otherwise indicated or for such items as automatic freeze protection, snow melting, light control etc.
- .6 Electrically held contactors to be located in service rooms where practical.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 REFERENCES**

- .1 CAN/CSA C22.1-09, Canadian Electrical Code, Part I.
- .2 CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.

### **1.3 ADDITION OF ACCEPTABLE MANUFACTURERS**

- .1 Refer to Section 26 05 00 and as noted below.
- .2 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Departmental Representative for consideration not later than five (5) working days prior to closing of tender or of bid depository subtrade tender whichever is earlier.
- .3 Alternate approvals will be given by written addendum only. No other substitution will be permitted after closing of tenders.
- .4 Alternate approvals granted before the closing of tenders will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a tender on the product

### **1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 00.
- .2 Submit complete photometric and heat dissipation data prepared by independent testing laboratory for proposed luminaires.
- .3 Photometric data to include VCP Table and spacing criterion.

### **1.5 SAMPLE LUMINAIRES**

- .1 Submit sample luminaires for review prior to manufacturing when requested by the Departmental Representative.
- .2 Sample luminaires to be operable and complete with lamps, accessories and a plug-in power cord if requested by the Departmental Representative.
- .3 Deliver samples to the Departmental Representative's office or to another location as directed. Collect the sample(s) at the conclusion of the review.

### **1.6 INTENT**

- .1 Provide lighting luminaires and accessories for all outlets as listed in the Fixture Schedule and as shown on drawings.
- .2 Lighting luminaires shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.
- .3 Ground all lighting equipment to grounding system.

- .4 Verify all ceiling types and finishes before ordering luminaires and provide luminaires suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Departmental Representative before ordering luminaires.
- .5 Luminaires of the same or similar type shall be supplied by the same manufacturer.

## 2 PRODUCTS

### 2.1 BALLASTS

- .1 All ballasts shall be supplied with a rated voltage matching the supply voltage indicated on the drawings. Ballast output current and voltage shall match the current and voltage ratings of the lamp or lamps they are designed to operate. All ballasts to be built to CSA Standard C22.2 No.74.
- .2 Ballasts shall comply with FCC and NEMA limits covering EMI and RFI and shall not interfere with operation of other normal electrical equipment.
- .3 Minimum requirements for electronic ballasts:
  - .1 Sound rating of 'A'.
  - .2 High frequency operation (25 KHz or higher).
  - .3 Total harmonic distortion to be less than 10%.
  - .4 Current crest factor to be less than 1.7.
  - .5 Rated lamp life shall be maintained.
  - .6 High power factor of 90% or higher.
  - .7 High efficiency ballasts for linear fluorescent lamps.
  - .8 120 Volt input, or otherwise indicated on the drawings.
  - .9 Ballast to operate no more than two linear fluorescent lamps.
  - .10 Ballasts used in exterior luminaires to have minimum starting temperature of -18°C.
- .4 Minimum requirements for electromagnetic ballasts:
  - .1 Pulse start type for metal halide.
  - .2 Current crest factor to be less than 1.7.
  - .3 Epoxy encased "super quiet" ballast assemblies for all interior luminaires ballast.
  - .4 Ballasts used in exterior luminaires to have minimum starting temperature of -30°C.

### 2.2 LAMPS

- .1 Provide and install lamps in all luminaires in the project as required.
- .2 Install fluorescent lamps with the same watt rating as indicated. Refer to schedule for lamp colour and colour rendering index.
- .3 Compact fluorescent lamps shall be 2700K colour temperature or as indicated.
- .4 Minimum Standards of Acceptance:
  - .1 Philips
  - .2 G.E.
  - .3 Sylvania / Osram

### 2.3 SOCKETS

- .1 Sockets for fluorescent luminaires shall be standard medium bi-pin unless otherwise noted.

### 2.4 LUMINAIRES

- .1 Accessories and components shall comply with relevant CSA Standards.
- .2 Recessed downlighter luminaires shall be of the approved prewired type with junction box forming an integral part of the fixture assembly and so located in relation to the fixture that the junction box is CSA approved for 60 degree C wire. The electrical trade shall supply and install all necessary plaster rings, supports, etc., required for complete and proper installation.
- .3 Except where otherwise noted in the Luminaire Schedule, depth of recessed fluorescent luminaires shall not exceed 150 mm, including mounting yokes, or bridges and the distance from the back face of the diffuser or lens to the centre of the lamp shall be not less than 75 mm. Design of reflector and lamp position shall be to provide high efficiency, even brightness and lack of lamp lines.
- .4 Fluorescent luminaires shall be constructed of not less than code gauge steel. All metal parts shall be thoroughly cleaned and finished in high reflectance baked white enamel over corrosion-resistant primer. Reflecting surfaces and exposed surface shall have not less than two coats of baked white enamel with reflectance of not less than 85%.
- .5 All fixture diffusers, lens panels, lens frames, etc., shall be securely and adequately supported and shall be removable without the use of tools for cleaning.
- .6 Luminaires shall incorporate adequate gasketing, stops and barriers to form light traps and prevent light leaks.
- .7 Luminaires shall be designed for adequate dissipation of ballast and lamp heat to avoid short ballast life, nuisance thermal tripping and decreased lamp output. Heat test reports by independent laboratories shall be provided where required by the Departmental Representative.
- .8 Construction of all luminaires shall be such as to provide a rigid well aligned fixture. Formed or ribbed backplates, end plates, reinforcing channel, heavy gauge sockets, straps, etc., shall be used where required to accomplish this.
- .9 The construction and performance of all fluorescent luminaires shall be subject to the acceptance of the Departmental Representative. Full photometric data from independent testing laboratory shall be provided when requested by the Departmental Representative.

## 3 EXECUTION

### 3.1 INSTALLATION AND SUPPORTS

- .1 Provide complete and proper support for all luminaires, fixture hangers, etc., including headers in ceiling space, where required, for proper support of outlet boxes and fixture hanger assemblies.
- .2 Support luminaires as shown on the drawings, level, plumb and true with the structure and other equipment in a horizontal or vertical position as intended. Wall or side bracket mounted fixture housings shall be rigidly installed and adjusted to give a neat flush fit to the surface on which it is mounted.
- .3 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.

- .4 Self-aligning seismically rated ball joint hangers shall be used for rod suspended luminaires. Ceiling canopies or hood assemblies intended to cover the suspension attachments shall be installed to fit tightly to the ceiling without restricting the alignment of the hanger. Support luminaires by hangers and mounting arrangements which will not cause the fixture frame, housing, sides or lens frame to be distorted; or prevent complete alignment of several luminaires in a row.
- .5 The suspension length of all ceiling mounted suspended types of lighting luminaires as listed in the Fixture Schedule shall be the overall length from the ceiling to the lowest point of the fixture body, reflector or glassware in its hanging position.
- .6 Metal inserts, expansion bolts or toggle bolts in concrete slabs for stems which do not carry wiring must be accurately located in relation to the outlet boxes, to allow perfect alignment and spacing of suspension stems.
- .7 Where luminaires are surface mounted on the underside of an inverted tee bar ceiling, the fixture shall be supported either directly from the building structure by means of rod hangers and inserts or by means of metal angle headers, supported from the tee bar framing structure above the tile. Luminaires shall be supported from the quarter points.
- .8 Wiring from outlet boxes to fluorescent luminaires and wiring through fluorescent fixture channels shall be rated for 90 degrees C.
- .9 All recessed luminaires to be installed so that they are removable from below to gain access to outlet box or prewired fixture box. Connect all recessed luminaires to boxes with flexible conduit and approved fixture wire. Provide approved drywall enclosures in insulated ceilings. Volume of enclosure to comply with the Canadian Electrical Code.
- .10 Install luminaire lenses as late as possible to protect from dirt and dust. Remove and clean or replace lenses to the satisfaction of the Departmental Representative.
- .11 Where ballasts are to be remotely located, they shall be racked together and labelled with size 3 lamicoid. Label shall bear the ballast number which has a corresponding location on an adjacent floor plan reference drawing. Labels and floor plans shall be provided by electrical contractor. Floor plans shall measure 280mm x 430mm [11"x17"] and shall be framed and laminated.

END OF SECTION

## **1 GENERAL**

### **1.1 RELATED WORK**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 REFERENCES**

- .1 Canadian Standards Association:
  - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
  - .2 CSA C860, Performance of Internally-Lighted Exit Signs.
- .2 Vancouver Building By-Law, Part 3, Section 3.4.5

### **1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 00.

## **2 PRODUCTS**

### **2.1 EXIT SIGNS GENERAL**

- .1 Universal mounting.
- .2 Wall, end, or ceiling mounted as shown on drawings.
- .3 Single or double-faced as indicated
- .4 Light Emitting Diode (LED) light source for 120 volt operation.
- .5 Provide 12VDC standby lamps/system and connection points to accommodate standby power from an external 12VDC source.
- .6 Faceplate and housing to have no visible unused knockouts.
- .7 Provide weatherproof exit signs for all exterior installations.
- .8 CSA 860-10 approved.

### **2.2 THIN PROFILE EXTRUDED ALUMINUM EXIT SIGNS**

- .1 Extruded aluminum faceplate, housing and canopy.
- .2 Nominal 25mm [1"] deep (thin profile).
- .3 Brushed finish on faceplate c/w "hidden" universal knock-outs.
- .4 Standard finish or as indicated.
- .5 Rounded corners.

### **2.3 EDGE LIT EXIT SIGNS**

- .1 Extruded aluminum cylindrical housing and canopy.
- .2 White baked powder coat finish or as indicated.
- .3 High clarity solid acrylic faceplate.
- .4 Field removable directional chevron arrows.

- .5 Universal mounting.
- .6 Rounded corners.

## **2.4 SELF POWERED EXIT SIGNS**

- .1 Exit sign unit(s) to be complete with self contained battery system to maintain illumination during a mains power failure.
- .2 Sealed maintenance free batteries.
- .3 Recharge time 24 hours.
- .4 Solid state charger and transfer technology (no relay contacts).
- .5 Status LED to indicate "AC on".
- .6 Push button test switch.
- .7 Operating time for minimum as required by the Vancouver Building By-Law.

## **3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install Exit Signs as indicated.
- .2 Connect Exit Signs to dedicated circuits and breakers as required by the Canadian Electrical Code.
- .3 Provide circuit breaker locks for Exit Sign circuits.
- .4 Power to exit lights to be sourced from emergency power were available.
- .5 All Exit Sign wiring to be installed in separate conduit and boxes.
- .6 All conductors to be minimum #12 AWG with RW90 X-link insulation.
- .7 Provide Exit Sign 12VDC standby lighting and separate connection points where standby emergency lighting battery packs are used for the emergency lighting. For remote connections low voltage cable sizing refer to the battery systems specification section.
- .8 Support Exit Signs from ceiling tile in tee bar installation locations so as to provide a flush/neat installation and minimize tile lift.
- .9 Provide approved support hardware to the tee bar rail assembly to minimize tile stress and provide independent seismic cable(s) restraint from building structure.
- .10 Wall mounted exit lights to be mounted 2290mm [7' 6"] to underside or as detailed.
- .11 Ceiling mounted exit lights in all service spaces to be suspended to 2290mm [7' 6"] to the underside.

### **3.2 FINAL ACCEPTANCE**

- .1 Position exit lights to optimize viewing angles and to avoid line of site obstructions.
- .2 Attend the building occupancy review with the Authority Having Jurisdiction and adjust any locations as required.

END OF SECTION