



**Electrical
Specification**
FOR

**CEDARBROOK LODGE PROPOSED MODIFICATIONS
5TH AND 6TH FLOOR**

Unity Health Toronto
Cedarbrook Lodge Retirement Residence
520 Markham Road
Scarborough, ON
M1H 3A1

Issued for Tender & Building Permit Application
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HHA #2250731

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00 00 01

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ELECTRICAL GENERAL REQUIREMENTS

26 01 01

1 REQUIREMENTS

1.1 General Contract Documents

- .1 Comply with General Conditions of Contract, Supplementary Conditions and Division 01 - General Requirements.

1.2 Work Included

- .1 Work to be done under this section to include furnishing of labour, materials, equipment and services required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

1.3 Document organization

- .1 Applicable Divisions for Electrical Work:
 - .1 Division 26 - Electrical
 - .2 Division 27 - Communications
 - .3 Division 28 - Electronic Safety and Security
- .2 For clarity, any reference in the Contract Documents to Division 26 includes Division 27 and 28.
- .3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.
- .4 Contractor is responsible for completion of the Work whether or not portions are sublet.

1.4 Division 26, as it applies to Division 27 and 28

- .1 Division 26 contains common work requirements that are applicable to the Work of Divisions 27 and 28 and apply as if written in full within Divisions 27 and 28.

1.5 Definitions

- .1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in these Specifications, mean that the material or item referred to is "indicated", "shown", "listed" or "noted" on the Drawings or in the Specifications.
- .2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in these Specifications, mean that the material or item referred to, is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by" the Consultant.
- .3 Instructions using any form of the word "provide", requires the Contractor to furnish labour, materials and services as necessary to supply and install the referenced item.
- .4 The term "building code" means the current edition of the "Ontario Building Code".

- .5 The terms “electrical code” and “electrical safety code” mean the current edition of the “Ontario Electrical Safety Code”.
- .6 The terms “electrical authority” and “electrical safety authority” mean the “Electrical Safety Authority, ESA” The term “AHJ” means the “Authority Having Jurisdiction” and can include the local building inspector, the local fire department and the electrical safety inspector or their agents.

1.6 Language

- .1 Specifications are written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where the list follows a semi-colon (;) punctuation is for clarity, where the list follows a colon (:) punctuation is to be read as short-hand form of verb “to be” or “to have” as context requires.
- .2 It is not intended to debate with the Contractor reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

1.7 Examination

- .1 Examine any existing buildings and services, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the Work.
- .2 Examine work of other Divisions before commencing the Work, and report any defect or interference.
- .3 No allowance will be made for any expense incurred through failure to make these examinations of the site and documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.

1.8 Design Services

- .1 Provide design services for elements of the Work where specified. Instruments of this service to be sealed by a professional engineer licensed in the applicable jurisdiction.

1.9 Standard of Material and Equipment

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Material and Equipment.
- .2 Materials and equipment:
 - .1 new and of uniform pattern throughout the Work,
 - .2 of Canadian manufacture where obtainable,
 - .3 labelled or listed by Code and/or Inspection Authorities, CSA certified and CMB listed; where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority,
 - .4 standard products of approved manufacture,
 - .5 in compliance with Standards and Regulations with respect to;
 - (a) chemical and physical properties of materials,
 - (b) design,
 - (c) performance characteristics, and
 - (d) methods of construction and installation,

- .6 identical units of equipment to be of same manufacture,
- .7 within any unit of equipment, identical component parts to be of same manufacture, but various component parts comprising the unit need not be from one manufacturer.
- .3 Materials and equipment are described to establish standards of construction and workmanship.
 - .1 Where manufacturers or manufacturers' products are identified in lists with phrase "Standard of Acceptance", these are manufacturers and/or products which meet standards with regard to performance, quality of material and workmanship.
 - .2 Manufacturers and/or products used are to be chosen from these lists.
- .4 Include items of material and equipment not specifically noted on Drawings or mentioned in Specifications but which are required to make a complete and operating system.
- .5 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Sections, before such items are purchased.
- .6 Provide equipment marked for use with 75°C wiring or with a higher temperature rating. If equipment is not marked with a temperature rating or if the only rating available is less than 75°C, increase the associated conductor sizes accordingly, to the satisfaction of the consultant.
- .7 Factory fabricate control panels and component assemblies.
- .8 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.
- .9 Materials and equipment not satisfying these selection criteria will be condemned.
 - .1 Remove condemned materials from job site and provide properly selected and approved materials.

1.10 Substitutions

- .1 The use of a substitute article or material which the manufacturer represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions;
 - .1 a substitution will not be considered for reasons of meeting the construction schedule unless the Contractor can demonstrate to the satisfaction of the Consultant that all reasonable efforts have been made to procure the specified product or material in a timely fashion,
 - .2 the manufacturer to advise the Consultant of the intention to use an alternative article or material before doing so,
 - .3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer, the manufacturer to supply all information necessary, as required by the Consultant, at no additional costs to the contract,
 - .4 the Consultant to be the sole judge as to the quality and suitability of alternative materials and the Consultant's decision to be final,
 - .5 where use of an alternative material involves redesign or changes to other parts of the Work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,
 - .6 no test or action relating to the approval of substitute materials to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed, such request to be made in ample time

to permit appropriate review without delaying the Work, taking into consideration that such a substitution request may be rejected requiring that the product or material as originally specified be provided,

- .7 whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,
- .8 the costs of testing required to prove equality of the material proposed to be borne by the manufacturer.

2 SUBMITTALS

2.1 Shop Drawings and Product Data

- .1 Submit shop drawings, manufacturers and product data and samples in accordance with Division 01 requirements;
 - .1 Submit for each item of equipment.
 - .2 Submit shop drawings in the same unit of measure as used on the drawings. Both metric and imperial measures may be included.
 - .3 Submit shop drawings by email to: shopdrawings@hhangus.com
- .2 Include an H.H. Angus shop drawing cover sheet form prepared for this project, for each shop drawing (sample included at the end of this section), or, include the same information on the contractors submittal cover sheet:
 - .1 Provide the following information on each submission;
 - (a) Client/Architect name
 - (b) Project Name
 - (c) H.H. Angus project number
 - (d) Date
 - (e) Contractor name
 - (f) Contractor reference No.
 - (g) Manufacturer's name
 - (h) Product type
 - (i) Specification section number
 - (j) Contractor trade: mechanical, electrical, elevators, or general trades
 - (k) If a re-submission, the H.H. Angus reference number from the previous submission.
- .3 Submit shop drawings in PDF format;
 - .1 If submitted in hardcopy format, submit in 11 x 17, black and white originals of graphic quality suitable for photocopying. Allow one additional week for processing of shop drawings submitted in hardcopy format.
- .4 Manufacturers' printed product data sheets for standard items are acceptable in place of shop drawings provided that physical characteristics are identified and are related to specification references.
- .5 Submit manufacturers' data sheets with typed schedules listing manufacturers' and suppliers' name and catalogue model numbers for such items as fire alarm system components, etc.

- .6 For luminaires, submit bound sets of luminaire cut sheets with manufacturers' names and catalogue numbers for all luminaires to be used on the project. Identify and arrange the luminaire cut sheets and catalogue numbers in the same sequence as the Specification Luminaire List.
- .7 Shop drawings and product data to show;
 - .1 CSA or equivalent approval,
 - .2 dimensioned outlines of equipment,
 - .3 dimensioned details showing service connection points.
- .8 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .9 Where applicable, include;
 - .1 wiring, single line and schematic diagrams,
 - .2 diagrams showing interconnection with work of other Sections,
 - .3 equipment elevations,
 - .4 component assemblies,
 - .5 trip settings,
 - .6 description of operation.
- .10 Each shop drawing to be checked and stamped as being correct, by trade purchasing item, before drawing is submitted. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

2.2 Field, Fabrication, or Installation Drawings

- .1 Contractor's field, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal will be returned identifying that the submitted drawings have not been reviewed.
- .2 Maintain a copy on site of such drawings for reference by the Consultant.
- .3 Upon request, provide a copy of such drawings to the Consultant for general information purposes.

3 APPLICABLE CODES AND STANDARDS

- .1 Install electrical systems in accordance with the Electrical Safety Code (ESC).
- .2 Install underground systems in accordance with the latest edition of CSA C22.3 No.7 except where specified otherwise.
- .3 Abbreviations for electrical terms: to the latest edition of CSA Z85.
- .4 Comply with CSA Certification Standards and Ontario Electrical Safety Code Bulletins in force at time of Tender submission.
- .5 Where requirements of this specification exceed those of the above mentioned standards, this specification to govern.

- .6 In the event of a conflict between codes, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring the application of the most demanding requirements.

4 CONFINED SPACES

- .1 Unless otherwise prescribed by the Constructor's/Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces", including but not limited to;
 - .1 horizontal and vertical service spaces, shafts, and tunnels,
 - .2 inside of equipment which permits entry of the head and/or whole body, and
 - .3 ceiling spaces which are identified as containing a hazardous substance.

5 PERMITS, FEES AND INSPECTIONS

- .1 Submit to Electrical Safety Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Consultant will provide drawings and specifications required by Electrical Safety Authority at no cost.
- .4 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.
- .5 Furnish to Consultant, Certificates of Acceptance from Electrical Safety Authority and authorities having jurisdiction, upon completion of the Work.

6 EQUIPMENT

6.1 Manufacturers Nameplates

- .1 Metal nameplate with raised or recessed lettering, mounted on each piece of equipment.
- .2 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating, and approval listings.

6.2 Finishes

- .1 Primary and final painting for Work, other than items specified as factory primed or finished, to be done under Finish Division 9.
- .2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Leave a quart can or a pressurized spray can of paint, as used with switchboards, with Owner for touch-up purposes.
- .5 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

- .6 Store electrical materials and equipment such as switchboards, panels, transformers, bus ducts, fire alarm devices, luminaires, etc., in a dry, clean location and cover with polyethylene plastic to preserve factory finish.
- .7 Protect exposed or free standing equipment with plastic to minimize entry of dust and dirt and marring of finished surfaces during progress of work.
- .8 Schedule luminaires, lamps, diffusers and fire detectors for installation as late as possible during construction in order to minimize accumulation of dust and/or dirt on them. Clean luminaires and diffusers, not acceptable because of dust and dirt, in an approved manner in accordance with the manufacturer's instructions. Wrap surface mounted and suspended luminaires and fire detectors, installed prior to painting or dusty construction being completed in the area, in plastic to prevent dirt or paint from settling on them.
- .9 Wrap bus ducts in heavy gauge plastic to adequately prevent moisture and dirt from entering bus duct. Wrapping to remain until bus ducts are ready to be energized.

6.3 Pre-purchased Equipment, Damage and Ownership

- .1 At time of receipt of pre-purchased or pre-tendered equipment at job site by the installing electrical contractor, the manufacturer/distributor/supplier's technical representative to be present to inspect the equipment prior to unloading and report any damage to the Consultant. The technical representative to also witness the unloading and advise the Contractor on the appropriate method for handling the equipment in order to avoid damage during unloading, moving and setting in place.
- .2 In the event that the equipment or cable is found to be damaged before unloading it is to be returned immediately to the factory for repairs and/or replacement by the manufacturer/supplier.
- .3 In the event of damage occurring at any time during unloading and until the equipment is accepted by the Owner, the Contractor is responsible for repairs and/or replacement to the satisfaction of the Owner.

7 OFFICE, STORAGE & TOOLS

7.1 Office and Storage

- .1 Provide temporary office and lunchroom facilities, workshop, tools and material storage space. Facilities may be site trailers or as otherwise approved by the General Contractor/Construction Manager.
- .2 Assume responsibility for these facilities.
- .3 Provide power, heat, light, telephone and internet services.
- .4 Owner's cafeteria is off limits.

7.2 Appliances and Tools

- .1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, as required to carry out the Work.

8 COORDINATION

8.1 General

- .1 Consultant's drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductbanks, conduits, cabletrays, feeders, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.
- .2 Lay out and coordinate the Work to avoid conflict with work under other Divisions.
- .3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of the Work.
- .4 Where equipment provided under other Divisions connects with material or equipment supplied under this Division, confirm capacity and ratings of equipment being provided.
- .5 Take information involving accurate measurements from dimensioned Architectural Drawings or at the building.
- .6 Install services and equipment which are to be concealed, close to the building structure so that furring is kept to minimum dimensions.
- .7 Location of conduit, bus duct, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.
- .8 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the Work as an operating installation.

8.2 Field, Fabrication, and Installation Drawings

- .1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services and to demonstrate coordination with work of other trades.
 - .1 Drawing scale: minimum 1:50 (1/4"=1'-0")
- .2 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.
- .3 Layout equipment and services to provide access for repair and maintenance.
- .4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;
 - .1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' review."

8.3 Cutting and Remedial Work

- .1 For details of cutting and patching and division of Work refer to Division 1.
- .2 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade, whose work is involved, to do such cutting and patching. Pay for any resulting costs.
- .3 Neatly cut or drill holes required in existing construction to accommodate equipment such as cables, raceways, bus ducts, cabletrays, etc.
- .4 Arrange and pay for cutting and patching as required for the Work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant's approval of location and methods in writing. For weather exposed or moisture resistant elements or sight exposed surfaces, employ the original installer or an expert in finishing of the material, to perform cutting or patching.
- .5 Layout cutting of structural elements, such as floor slabs, walls, columns or beams and obtain approval before starting work. Conduct an electromagnetic scan for reinforcing rods, such as Hilti PS200 Ferrosan, and review with the Structural Engineer.
- .6 Arrange and pay for supplemental x-ray examination to locate concrete reinforcement, conduits and other embedments. Submit x-ray results and obtain approval before starting work.
- .7 Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Repair and reroute any circuits damaged by core drilling.

8.4 Voltage Ratings

- .1 Operating voltages: to latest edition of CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

8.5 Wiring of Mechanical Trades Motors

- .1 To limit responsibility and to specifically define the Work under this Division, use the following procedure with regard to motors provided under Mechanical Division 20.
- .2 The Contractor under Mechanical Division 20 will be responsible for installing equipment which he supplies including motors, starters, disconnect switch, Motor Control Centres, "mechanical" panelboards and miscellaneous controls of the type specified.
- .3 In every instance whether pertaining to Plumbing, Air Conditioning, Refrigeration, Heating or Ventilating equipment, wire to line side of the Motor Control Centre, panelboard, disconnect switch, or starter provided by these trades, in reasonable proximity to equipment being controlled.
- .4 From this point, unless otherwise noted, the cost of electrical material and labour will be borne by the particular trade whose work is involved. That trade will mount starter and wire from it to motor being controlled, together with control wiring, remote switches, and pilot lights.
- .5 Where individual starters and controls are grouped together, the Contractor under Mechanical Division 20 will provide a panel for mounting his equipment. Provide a feeder, main fused disconnect

switch, a splitter of adequate size and capacity, individual fused disconnect switches, and wire to line side of the Division 20 starters.

- .6 In the case of unit heaters, reheat coils, electrical control devices, and cabinet unit heaters, terminate wiring in an outlet immediately adjacent to motor or device being electrically powered. Wiring from this point to starter, thermostat, or other devices will be done under Mechanical Division 20.
- .7 Provide branch circuit wiring and an outlet for each motorized damper or heating control.
- .8 Ascertain exact locations of starters, Motor Control Centres, "mechanical" panelboards and motors, from Mechanical Drawings.

9 PROTECTION OF PERSONNEL, WORK, AND PROPERTY

9.1 Personnel Protection

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.
- .4 Do not leave conduit, wires, cables, tools, equipment or materials in such a way that they constitute a hazard.
- .5 Provide guards around openings in the roof or floor to prevent stock or scrap from dropping down.
- .6 Remove loose equipment and tools from overhead areas before leaving each day.
- .7 Do not leave boards with protruding nails on the floor.
- .8 Cut off bolts at floor level to eliminate a possible tripping hazard.

9.2 Protection During Construction

- .1 Provide protection required to enable existing building and equipment to remain in continuous and normal operation.
- .2 Take the necessary precautions to protect equipment, existing building and service from damage during the Work. Accept responsibility for any damage and make good without cost to the Owner.
- .3 It is of vital importance, during work of this Contract, that all existing surfaces and items are not damaged in any way whatsoever by the work of all trades. Take precautions as necessary to prevent damage to walls, floors, ceilings, windows, doors, door frames, mouldings, finishes, piping, ductwork, light fixtures, etc. Provide protection, hoarding, tarpaulins, dust sleeves etc., as required. Any damage caused because of lack of adequate protection to be made good at no cost to the Owner.
- .4 Take care to eliminate dust in equipment areas.
- .5 Protect switchgear fronts from accidental breaker trips when working around or above them. Provide an extended shield constructed of 12 mm (½") fire retardant plywood a minimum of 450 mm (18") from board front to allow access to board.

9.3 Core Drilling

- .1 Wherever core drilling is required, provide temporary dust proof screens.
- .2 In areas where core drilling through a slab in an operating facility is necessary, the areas to be drilled to be marked out clearly on the underside of slab. Owner's representative to be notified at least 1 week prior to core drilling operation. Provide tarping of equipment supervised by the Owner.
- .3 During core drilling operations, station at least one person directly below the area of drilling with a large plastic container pressed to underside of slab to capture and hold core and water upon completion of operations.
- .4 A wet/dry commercial quality vacuum to be used continuously at location of drilling operation to remove all excess water from the area.

9.4 Temporary Dust Proof Screens

- .1 Provide temporary dust proof screens where required to separate work areas from completed areas and/or existing areas, to prevent dust from settling on the Owner's plant and equipment.
- .2 Dust proof material to be neoprene coated nylon tarpaulin or other types of fabric as approved by the Consultant.
- .3 Provide temporary framing as required.
- .4 Extend dust proof screens from floor to underside of floor or roof above. Lap sections of screen sheets 150 mm (6") minimum and tape joints.
- .5 Secure screen sheets at top, bottom and ends and tape perimeter.
- .6 Co-operate with Owner in the erection of temporary dust proof screens.
- .7 Remove screens when and as directed by Consultant.

9.5 Protection of Floors During Equipment Installation

- .1 Provide protection of floor finishes during installation or removal of equipment, and at any other time when moving or installing heavy equipment.
- .2 Install 19mm (¾") plywood over 6 mil plastic over finished floor areas when moving heavy equipment that could damage floor finish.
- .3 Repaint or re-tile any floors or walls damaged or scratched during construction.

9.6 Housekeeping

- .1 Maintain a high level of cleanliness.
- .2 Remove scrap and refuse from the work area daily.
- .3 Whenever possible, clean up immediately following completion of work.
- .4 Deposit oily and waste solvent rags in approved containers to minimize the fire hazard.

- .5 Sweep and damp mop daily.

10 WORK IN EXISTING BUILDING

10.1 General

- .1 During the tender period, perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of the as built conditions to determine the scope of renovation and demolition work required prior to submitting a tender.
- .2 The Work includes changes to the existing building and changes at junction of old and new construction. Route cabling, ducts, conduits and other services to avoid interference with existing installation.
- .3 Core drilling to be done off hours at a time convenient to the Owner.
- .4 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services as necessary to accommodate the Work.
- .5 Maintain or relocate existing services which pass through the area of renovation or demolition, but which feed items located outside of these areas. Rewire devices to the original circuits.
- .6 Remove existing lighting fixtures, wiring, devices and equipment to suit new construction. Cut back and cap conduits and electrical outlets not being used, so that finished work presents a neat and clean appearance. Disconnect at point of electrical supply, remove obsolete wiring and conduits, and make existing systems safe. Blank off openings in panels or boxes created by the removal of cables, conduits, wireways or ducts.
- .7 Where an existing ceiling is to be removed and reinstalled or replaced under another trades scope of work, and the existing electrical items such as luminaires, fire detectors, speakers, exit signs, emergency lighting heads etc., are to be reused, provide the following regarding the electrical items:
 - .1 remove,
 - .2 store in a secure, clean, dry location,
 - .3 install in the new ceiling, extend wiring and raceways as necessary,
 - .4 provide new items to match existing where existing items have been lost or damaged,
 - .5 make connections,
 - .6 clean,
 - .7 relamp luminaires,
 - .8 test,
 - .9 verify fire alarm devices,
 - .10 replace defective items with new, then retest/reverify,
 - .11 submit test and verification reports.
- .8 Unless noted otherwise removed materials and equipment become the property of the Contractor and are to be taken from the site and disposed of appropriately.
- .9 Review removed luminaires and equipment with the Owner's representative, and if the Owner instructs they wish to keep any items, move them to a designated location on the site. Luminaires and

- equipment that the Owner does not want become the property of the Contractor and are to be taken from the site and disposed of appropriately.
- .10 For devices, fixtures and equipment to be relocated, provide junctions boxes, outlet boxes, wiring, plates, supports, etc., as necessary.
 - .11 Revise panelboard directories accordingly if affected by the Work.
 - .12 Clean and relamp relocated luminaires and replace any faulty ballasts.
 - .13 On completion of relocations, confirm that relocated devices and luminaires are in proper working order.
 - .14 Co-ordinate work affecting fire alarm system, fire safety, or protection systems with the Owner, Consultant, fire alarm system manufacturer and authorities having jurisdiction prior to commencing work. Retain the original fire alarm system manufacturer to verify relocated fire alarm devices, modified equipment and revised wiring. Provide temporary fire protection and/or a fire watch in all areas affected by the demolition and as required by authorities having jurisdiction.
 - .15 Where the Owner wishes to take over renovated areas ahead of the project completion date and these areas are intended to be fed from the distribution systems in the new building, make temporary connections to the existing services in these areas. Reconnect to permanent services at a later date, when the new distribution systems are available.

10.2 Continuity of Services

- .1 Keep existing buildings in operation with minimum length of shutdown periods.
- .2 Make connections to existing systems at approved times.
- .3 Obtain written approval, recording times when connections can be made.
- .4 Repair any damage caused to existing systems when making connections.
- .5 Provide premium time labour to tie-in feeders or wiring at night or on weekends.
- .6 Provide temporary feeders and connections as required to maintain systems in operation where shutdown periods will exceed the allowable time frame determined by the Owner.
- .7 Arrange the Work so that physical access to the existing buildings is not unduly interrupted.

11 MOVING AND SETTING IN PLACE OWNER'S EQUIPMENT

11.1 S.B.O. (Supplied by Owner)

- .1 Items marked SBO on drawings will be;
 - .1 purchased by Owner,
 - .2 received, checked, stored, unpacked, uncrated, assembled and located by the Contractor under Division 1
- .2 Connect electrical services to this equipment.

11.2 R.R. (Remove and Reinstall Existing) or otherwise so identified

- .1 Except as indicated below, items so marked on drawings will be moved from their present location and reinstalled by the Contractor under Division 1. Disconnect and reconnect electrical services to accommodate the relocation of this equipment.
- .2 Disconnect, remove, store as necessary, move into place, reinstall, clean and reconnect electrical items so marked, such as;
 - .1 luminaires,
 - .2 fire detectors,
 - .3 speakers,
 - .4 switches,
 - .5 receptacles,
 - .6 disconnects,
 - .7 splitters,
 - .8 panelboards,
 - .9 switchgear,
 - .10 transformers,
 - .11 etc.

12 FINAL CLEANING

12.1 General

- .1 Do final cleaning in accordance with Division 01 specifications.
- .2 Perform final cleaning after construction activities that create dust, have been completed.
- .3 Clean electrical equipment and devices installed as part of this project.
- .4 Clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt, including the top surface, whether exposed or in the ceiling space.
- .5 Clean switch, receptacle, and communications outlets, coverplates, and exposed surfaces.
- .6 Clean and vacuum any smoke detectors exposed to construction dust, do not use compressed air.
- .7 Electrical rooms and electrical or communication closets:
 - .1 Thoroughly vacuum and clean interiors and buswork of switchboards, panels, cabinets and other electrical equipment of construction debris and dust prior to energization using a HEPA vacuum cleaner. Final clean using clean lint free cloths with a cleaning liquid as recommended by the manufacturer for the purpose.
 - .2 HEPA vacuum the top of switchboards, panels, cabinets, bus ducts, cable trays and conduits, and mechanical duct work in the room, followed by a thorough HEPA vacuuming of the floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.

- .3 Thoroughly re-clean as necessary prior to final turn over.
- .4 Do not lay permanent switchboard matting in electrical rooms until rooms are thoroughly re-cleaned, and floors wet mopped and dried, immediately prior to final turn over.

13 RECORD DRAWINGS

- .1 Provide record drawings in accordance with Section 01 78 39 and as specified herein.
- .2 A set of design drawings in AutoCad 2013 on CD or DVD ROM will be provided by the Consultant. Make sets of white prints for each phase of the Work, and as the Work progresses and changes occur, mark white prints in coloured inks to show revisions. Dimension locations of ductbanks, conduits, maintenance holes, buried cables and similar buried items. Within the building, provide dimensions with respect to building column centres. Outside the building provide dimensions to the building foundation or to the centerline of paved roadways or provide GPS co-ordinates. Mark level with respect to an elevation which will be provided.
- .3 Survey information from excavation and backfill of site services to be kept on site after approval and to be similarly transferred to white prints.
- .4 Retain these drawings and make available to Consultant for periodic review.
- .5 At 50%, 75% and 90% of project completion, scan marked-up drawings to Adobe .pdf format and submit a copy to the Consultant, or to the project document portal if one is in use.

13.2 As-Built Drawings

- .1 Prior to testing, balancing and adjusting, transfer site record drawing information to AutoCad 2013 (CAD) files, to record final as-built condition. Obtain a current set of CAD files from the Consultant.
 - .1 Follow the Consultants AutoCad Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.
 - .2 The Consultant's CAD files might not reflect all or any construction changes.
- .2 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. "Bubble" these revisions, and place these annotations on a separate and easily identified drawing layer.
- .3 Show on electrical as-built drawings final locations of conduit, outlets, panels, branch wiring, system wiring, pull boxes, bus ducts, and equipment.
- .4 Show on site services as-built drawings survey information provided by the Ontario Land Surveyor (OLS) monitoring the services installation.
- .5 Identify each drawing in lower right hand corner in letters at least 12 mm (½") high as follows "AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include signature and stamp of OLS attached to note.
- .6 Submit one (1) set of white prints of the draft as-built CAD files for the Consultant's review.
- .7 Once "AS BUILT DRAWINGS" white prints are reviewed, transfer Consultant's comments to the CAD files. Return AutoCad drawings modified to "As Built" condition to Consultants on CD or DVD ROM.

- .8 Submit three (3) sets of white prints and three (3) copies of CAD files with Operating and Maintenance Manuals.

14 OPERATING AND MAINTENANCE INSTRUCTIONS

14.1 Operating and Maintenance Data

- .1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers.
 - .1 Organize material in volumes generally grouped by Division Section;
 - (a) Site services,
 - (b) Power,
 - (c) Lighting,
 - (d) Low Voltage Systems,
 - (e) Fire Alarm and Security.
 - .2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear;
 - (a) Project Name,
 - (b) Project Number,
 - (c) Date,
 - (d) Trade Section, and
 - (e) List of Contents.
 - .3 Provide three hard-copies to Owner.
- .2 In addition, provide Adobe PDF files for each document, produced from original direct-to-digital file creations.
 - .1 Organize documents into separate PDF files for each Division Section identified above, and apply Adobe Bookmarks to create Table of Contents.
- .3 Include in operations and maintenance data;
 - .1 details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, 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 and performance curves,
 - .4 names and addresses of local suppliers for items included in maintenance manuals,
 - .5 reviewed shop drawings,
 - .6 operating characteristics of the equipment supplied such as calibration curves and coordination data to allow proper co-ordination with Owner's equipment,
 - .7 description of operation of the controls and protective devices used,
 - .8 maintenance and adjustment procedures,
 - .9 lifting and jacking instructions,
 - .10 fault locating guide,
 - .11 spare parts list and an itemized price list,
 - .12 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.

- .4 Approval procedure;
 - .1 submit one set of first draft of Operating and Maintenance Manuals for approval,
 - .2 make corrections and resubmit as directed,
 - .3 review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation,
 - .4 hand-over an additional two copies of Operating and Maintenance Manuals to Owner's operating staff and obtain written confirmation of delivery.

14.2 Operating and Maintenance Instructions

- .1 Provide instructions to Owner's operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections. Include classroom instruction and hands-on instruction, delivered by competent instructors.
- .2 Develop the proposed training plan, submit an outline of the training program for review and adjustment by the Owner. Obtain approval from the Owner before commencing training.
- .3 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each item of equipment, utilizing the services of the manufacturers' representative as required.
- .4 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Repeat each training session approximately one week after the original session.
- .5 Organize each pair of training sessions as follows:
 - .1 Power Distribution - Normal Power- Division 26
 - .2 Power Distribution - Emergency Power- Division 26
 - .3 Power Distribution - UPS Power- Division 26
 - .4 Power Distribution – Other Systems- Division 26
 - .5 Communications – Division 27
 - .6 Electronic Safety and Security – Fire Alarm – Division 28
 - .7 Electronic Safety and Security – Security – Division 28
- .6 Complete the training as close to Substantial Performance as possible, so that the operations staff are prepared to operate the systems after Substantial Performance is certified.
- .7 Keep a record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.
- .8 For each training session, include the following topics;
 - .1 general purpose of the system (design intent),
 - .2 use of O & M manuals,
 - .3 review of single line drawings and control schematics,
 - .4 start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming, troubleshooting and alarms,
 - .5 interaction with other systems,

- .6 adjustments and optimizing methods for energy conservation,
 - .7 maintenance requirements,
 - .8 special maintenance and replacement sources,
 - .9 health and safety issues,
 - .10 occupancy interaction issues, and
 - .11 system response to different operating conditions.
- .9 Develop and provide training material, including printed documents and electronic presentation aids (e.g. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and electronic format, in accordance with article on Operating and Maintenance Manuals.
- .10 Sessions may be videotaped by the Owner as an aid to ongoing training of Owner's staff.

15 CARE, OPERATION AND START-UP

- .1 Arrange and pay for services of manufacturer's factory service technicians to supervise start-up of installation, check, adjust, balance and calibrate components.
- .2 Provide these services for such periods, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with every aspect of the operation, care and maintenance thereof.
- .3 Arrange and pay for services of applicable manufacturer's factory service engineer or certified independent testing organization to supervise initial start-up of specialized portions of installation and to check, adjust, balance and calibrate components including related wiring and controls. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of the installation in complete working order. Provide a certificate indicating that the equipment is free and clear of deficiencies.

16 TESTING

- .1 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 control,
 - .4 motors, heaters and associated control equipment including sequenced operation of systems where applicable,
 - .5 systems: fire alarm system, communications,
 - .6 additional testing as specified in other Sections.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing;
 - .1 megger circuits, feeders and equipment up to 350 V with a 500 V instrument,
 - .2 megger 350-600 V circuits, feeders and equipment with a 1000 V instrument,
 - .3 check resistance to ground before energizing.

- .4 Carry out tests in presence of Consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for Consultant's review. Test electrical equipment to standards and function of specifications, applicable codes and standards in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

17 LOAD BALANCE

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

18 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as per equipment manufacturers' recommendations for each piece of equipment.

19 COMMISSIONING

- .1 Participate in commissioning of equipment and systems in accordance with Section 26 08 15.
- .2 Equipment supplied on this project will be subject to detailed factory inspection and on-site testing and commissioning prior to being placed in service. The electrical contractor, their major system and equipment suppliers, and the Independent Testing Agent (ITA) will be required to participate in special commissioning meetings to review progress and status of the commissioning program.
- .3 Include in Bid amount for licensed electricians to participate in the commissioning program, to undertake temporary power connections, operation of equipment, opening and closing of panel boards and switchboards, testing of power and control wiring, and assisting the ITA and the equipment suppliers' field personnel in the startup and testing of the equipment.
- .4 The contractor and equipment suppliers to include in the Bid amount the costs to accommodate and undertake factory and site testing.

20 TEMPORARY AND TRIAL USAGE

20.1 General

- .1 Temporary and trial usage by Owner of any electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance, is not to be construed as evidence of acceptance by the Consultant.

- .2 Owner to have the privilege of such temporary and trial usage, as soon as the Contractor claims that said work is completed and in accordance with specifications, for such reasonable length of time as is deemed to be sufficient for making a complete and thorough test of same.
- .3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

21 PRICING OF CHANGE NOTICES

- .1 The value of a proposed change in the work shall be determined in one or more of the following methods;
 - .1 by time and material,
 - .2 by unit prices set out in the Contract or subsequently agreed upon,
 - .3 by labour and material costs submitted in a detailed quotation.
- .2 In the case of changes in the Work to be paid for under the time and material or the unit price methods, the form of presentation of costs and methods of measurement shall be agreed to by the Consultant and Contractor before proceeding with the change. Keep accurate records, as agreed upon, of quantities or costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices where applicable.
- .3 In the case of changes in the Work to be paid for under the time and material or the labour and material method, the material costs are to be less trade discounts. Provide a 20% discount from list price for items included in the Allpriser catalogue or Electrical Price Guide.
- .4 The detailed quotation referenced under the labour and material method is to include a summary of charges made up of three components: labour charges, material costs and fees.
 - .1 Labour Charges
 - (a) The labour hour estimates are to be based on the current NECA Columns 1 and 2 as applicable to the portion of the Work as agreed to by the Consultant manual of labour units.
 - (b) Labour costs are to include burden on wages such as taxes, worker compensation charges, CPP, EI, project insurance, safety meetings, estimating, as-built drawings, supervision, small tools, site facilities, labour warranty and clean up.
 - (c) The all inclusive hourly labour rate applicable for quotations submitted for changes to the work is 1.34 times the TOTAL PACKAGE RATE of the current Collective Agreement. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 1.6 times the TOTAL PACKAGE RATE for electricians, plumbers or pipe fitters.
 - (d) The all inclusive hourly labour rate indicated above is to include:
 - Collective Agreement relevant to the place of work (vacation pay, RRSP, Health & Welfare, RST of Health & Welfare, Pension, Union admin fund, ECA fund (or others), Secretariat.
 - Legislation as relevant to the place of work (Emp. Health Tax, E.I., CPP, WSIB, taxes)
 - Project insurance, safety meetings, estimating, lay outs, site facilities, warranties, storage,
 - clean up, office supervision and miscellaneous charges.
 - (e) Foreman Electrician, General Foreman, Superintendent rates shall be as for the calculated Journeyman rate above plus 10.6% of the TOTAL PACKAGE RATE. A maximum of 10% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the Foreman rate.

- (f) A maximum combined amount of 3% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the General Foreman/Superintendent rate.
- (g) No other overhead supervision hours will be permitted.

.2 Material Charges

- (a) Material costs are to be less trade discounts. Provide a 20% discount for items included in the Allpricer catalogue or Electrical Price Guide.

22 CONSULTANT REVIEWS

22.1 General

- .1 Consultant's attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and the local authority having jurisdiction.

22.2 Site Reviews

- .1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances before the work is completed, deficiencies may be recorded where the item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Do not use any such reported items, or lack thereof, as part of the project quality assurance program nor as a change to the scope of work nor as acceptance of the quality of the work.
- .2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless indicated otherwise.

22.3 Milestone Reviews

- .1 Specific milestone reviews may be conducted at key stages by the Consultant, including;
 - .1 before backfilling of buried services,
 - .2 before closing of shafts,
 - .3 before closing of walls,
 - .4 before closing of ceilings,
 - .5 equipment demonstration,
 - .6 Substantial Performance deficiency review,
 - .7 Total Performance deficiency review.
- .2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements into the construction schedule.
- .3 Prior to Work being concealed, notify the Consultant in writing seven (7) calendar days in advance of the planned concealment to arrange a site review, where required by the Consultant. Correct noted deficiencies before concealing the Work. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

22.4 Final Review

- .1 At project completion submit written request for final review of mechanical and electrical systems.

- .1 Refer to section 26 08 19 Project Close-Out.
- .2 Include with the request a written certification that;
 - .1 deficiencies noted during job inspections have been completed,
 - .2 systems have been balanced and tested and are ready for operation,
 - .3 completed maintenance and operating data have been submitted and approved,
 - .4 tags are in place and equipment identification is completed,
 - .5 cleaning is finished in every respect,
 - .6 electrical panels, switchboards, cabinets, and equipment surfaces have been touched up with matching paint, or re-finished as required,
 - .7 spare parts and replacement parts specified have been provided and receipt acknowledged,
 - .8 As-built and Record drawings are completed and approved,
 - .9 Owner's operating personnel have been instructed in the operation and maintenance of systems,
 - .10 fire alarm verification is 100% completed and Verification Certificate has been submitted and accepted.

23 CORRECTION AFTER COMPLETION

23.1 General

- .1 At completion, submit written guarantee, undertaking to remedy defects in work for a period of one year from date of substantial completion. This guarantee is not to supplant other guarantees of longer period called for on certain equipment or materials.
- .2 Guarantee to encompass replacement of defective workmanship, parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.
- .3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by Owner, before completion of whole work.

24 ATTACHEMENTS

24.1 Shop Drawing Submittal Form

- .1 Attached sample of shop drawings submittal form.



H.H. Angus & Associates Limited Consulting Engineers

SHOP DRAWING COVER SHEET

1127 Leslie Street Toronto Ontario M3C 2J6 Canada

T: (1) 416 443 8200 F: (1) 416 443 8290

***Include this cover page with each shop drawing submission.
Submissions without this form will be returned without review.***

Client/Architect: **ABC Architects Ltd**
Project Name: **University Healthcare Wing**
HHA Project No: **2081001**

Contractor to complete the following for each submission.

Date: _____

Contractor Reference No: _____

Manufacturer Name: _____

Product Type: _____

Specification Section No: _____

Contractor Trade:

☐ Mechanical ☐ Electrical ☐ Elevators ☐ General Trades

If this is a resubmission, check here: ☐

Previous submission reference no.: _____
(HHA reference No. only)

HHA distribution - for internal use only:	
Mechanical review:	John Smith
Electrical review:	Joan Smith
Elevators review:	

END OF SECTION

QUALIFICATIONS AND AUTHORITIES - ONTARIO

26 01 02

1 GENERAL

1.1 Scope

- .1 This specification section:
 - .1 describes the qualification requirements for tradesmen in the province of Ontario;
 - .2 defines the applicable authorities having jurisdiction related to construction in Ontario; and
 - .3 describes the responsibilities of the contractor and/or Owner for registration and inspection of systems and application for construction or installation permits.

1.2 Definitions

- .1 **ESA:** Electrical Safety Authority

2 QUALIFICATIONS

2.1 Trades Qualification and Apprenticeship

- .1 Tradesmen to hold a certificate of competency for the following applicable trades:
 - .1 Electrician, R.R.O. 1990, Reg. 1051

3 AUTHOURITIES

3.1 Authorities having Jurisdiction

- .1 When referenced in specification sections in Division 26 to 28, the authority-having-jurisdiction ("AHJ") over regulated portions of the work are identified in the following table.

Work Element	Authority	AHJ Abbreviation
Electrical	ESA	ESA

4 PERMITS, REGISTRATION AND INSPECTION

4.1 Building Code Permits

- .1 Application for Building Permit has been made by the Owner. Submit and pay for separate plumbing and HVAC permits and arrange and coordinate for municipal inspections required under the Ontario Building Code]

4.2 Other Work Permits, Registration and Inspection

- .1 Arrange, provide documentation, and pay for permits, registration, and inspection of the following work elements:
 - .1 Electrical work performed, and
 - .2 Where described elsewhere in Division 26 to 28.
- .2 Arrange, provide documentation, and pay for variance approvals and field inspections where specified elsewhere in Division 26 to 28.

END OF SECTION

ELECTRICAL BASIC MATERIALS AND METHODS

26 05 01

1 GENERAL

1.1 Scope

- .1 Articles that are of a general nature, apply to each Section of Divisions 26, 27 and 28.

1.2 Work Included

- .1 Work to be done under this section to include furnishing of labour, materials, equipment and services required for installation, testing and putting into proper operation complete electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

2 ACCESS DOORS

2.1 Construction:

- .1 Access doors, unless shown or specified otherwise:
 - .1 constructed from galvanized steel sheet,
 - .2 flush mounted,
 - .3 concealed hinges,
 - .4 180° opening door,
 - .5 round safety corners,
 - .6 anchor straps,
 - .7 plaster lock,
 - .8 screwdriver operated latches,
 - .9 without visible screws,
 - .10 finished prime coat only.
- .2 Door metal thickness as follows:
 - .1 up to and including 400 mm x 400 mm (16" x 16"): 1.6 mm (16 gauge)
 - .2 height or width larger than 400 mm (16"): 2 mm (14 gauge)
- .3 Constructed of stainless steel with dish type door design to receive a tile or marble insert for areas finished with tile or marble surfaces.
- .4 Constructed of stainless steel with neoprene gasketed door where used in damp and high humidity areas.
- .5 Dish type door design to receive a tile insert where acoustic tile is applied to plaster or gypsum board ceilings.
- .6 Fire rated where installed in fire rated walls or ceilings. Fire rating to match the rating of the wall or ceiling.
- .7 With keyed cylinder locks, keyed alike, for areas subject to security risks, EG;

- .1 public corridors,
 - .2 psychiatric patient areas,
 - .3 public washrooms,
 - .4 etc.
- .8 Inside clear dimensions:
- .1 approximately 400 mm x 400 mm (16" x 16") for hand access,
 - .2 at least 600 mm x 600 mm (24" x 24") where personnel are to enter through doors,
 - .3 larger where indicated or required.
- .9 Submit access door shop drawings for approval as soon as possible after award of contract, showing size, type and exact location of access doors.

Standard of Acceptance

- Acudor
- Nystrom
- Williams Brothers – GP

2.2 Installation

- .1 Provide access doors for locations where equipment requiring access, maintenance or adjustment is "built-in".
- .2 Submit a list of proposed access door locations and obtain approval before commencing installation.
- .3 Access doors to be installed under the Division in whose work they occur. Arrange for and pay cost of access doors and their installation.
- .4 Access doors are not required in removable acoustic panel type ceilings.
- .5 Size and locate access doors in applied tile, or in glazed or unglazed structural tile to suit tile patterns. Refer to Architectural Room Finish Schedule and details on Architectural drawings in this regard.

2.3 FIRE STOPPING

2.4 General

- .1 Maintain the integrity of floor and wall fire separations around electrical raceways, cables, bus ducts and boxes passing through rated floors or walls.

2.5 Materials

- .1 Materials to form a ULC or cUL listed firestop system to CAN/ULC-S115 "Standard Method of Fire Tests of Firestop Systems".
- .2 Firestop system rating: minimum 2 hrs., higher where indicated.
- .3 Submit shop drawings consisting of product technical data and ULC or cUL listing.

Standard of Acceptance

- Hilti Firestop Systems
- 3M

- A/D Fire Protection System Inc.
 - Eastern Wire + Conduit
- .4 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

2.6 Installation:

- .1 Submit a complete fire stopping and smoke seal schedule to the Consultant for review. Include details, cut sheets, system description and location for each proposed fire stopping and smoke sealing application.
- .2 Install firestopping in accordance with the manufacturer's recommendations and in accordance with the ULC or cUL listing.
- .3 Firestopping to be installed only by personnel trained by the manufacturer on the installation of such systems.
- .4 Firestop system manufacturer's training and inspection services:
 - .1 Provide the services of the firestop system manufacturer to provide training to trades performing the fire stopping. Create and maintain a log of those personnel who obtain training.
 - .2 Provide the services of the firestop system manufacturer to inspect the installation of the firestopping while in progress and a final inspection at completion of work. Provide a manufacturer's inspection report to the Owner and Engineer.
- .5 Seal space between penetrating service and sleeve or opening in fire rated floors and walls with a fire stopping and smoke sealing system.
- .6 At time of application of materials, surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint, loose concrete or masonry and foreign materials.
- .7 Wiring may penetrate a fire rated assembly provided it is enclosed in non-combustible conduit, and the passage of the conduit in turn is suitably sealed to the assembly with fire stop material.
- .8 Where wiring with a combustible covering and not enclosed in non-combustible conduit penetrates a fire resistance rated assembly, group the wiring into separate fire sealed penetrations to ensure the overall diameter of the combined wire(s) in each penetration does not exceed 25 mm.
- .9 Arrange single conductor metal sheathed cables to individually penetrate the fire rated assembly and be individually fire stopped.
- .10 Where wiring is installed in cable trays and penetrates a fire rated assembly;
 - .1 terminate and independently support the cable tray on each side of the fire rated assembly, and
 - .2 provide sufficient working room to properly install and inspect the fire stopping materials and penetration.
- .11 Smoke seal and fire stop electrical boxes that penetrate a fire rated wall using fire rated putty pads, install putty pads on the outside of boxes.
- .12 Co-ordinate installation of cast-in-place fire stopping devices with the Division responsible for the placement of concrete.

3 SPRINKLER PROTECTION

3.1 Materials

- .1 Surface panelboards, switchboards and other electrical equipment in sprinklered areas to be fitted with watertight hubs with insulated throat, for each conduit entrance.

Standard of Acceptance

- Thomas & Betts Ltd. - Series 401
- Efcor of Canada Ltd. - Series 40-50B

- .2 Provide equipment in sprinklered areas, with hoods or shields and gasketed doors for protection against entry of sprinkler discharge, and to comply with the requirements of the electrical code, alternatively, and where indicated, provide indoor weatherproof equipment.
- .3 Ventilation openings to be overhanging drip proof type.
- .4 Indoor weatherproof equipment, where noted in the specifications and/or drawings to have CSA type 3R enclosures in accordance with the requirements of CSA Standard C22.2 No. 94.

4 PENETRATIONS OF BELOW GRADE WALLS AND SLABS ON GRADE

4.1 Materials

- .1 Expanding cement water stop material.
- .2 Submit manufacturer's literature.

Standard of Acceptance

- WATERSTOP-RX or acceptable equivalent

4.2 Installation

- .1 Fit each cable, conduit and duct passing through floor slab in contact with ground or walls below grade, with a water stop.
- .2 Submit schedule showing location, service.
- .3 Install water stop in accordance with the manufacturer's instructions.
- .4 Encircle each cable, conduit and duct and the perimeter of the wall opening with the water stop material.
- .5 Fill the wall openings around the cables, conduits or ducts with hydraulic cement injected for the full width of the wall.
- .6 Seal the exterior of the wall around the cables, conduits or ducts with a waterproof coating. Waterproof coating to be compatible with any existing waterproofing.

4.3 Pressurized Spaces

- .1 For all areas which are considered negatively or positively pressured, contractor shall seal all openings and crevices around all electrical devices and fixtures and all openings created as a result of electrical installation in order to maintain required room pressurization. Coordinate with Div. 01.

5 EQUIPMENT SUPPORTS, AND BASES

5.1 Supports for electrical work

- .1 Equipment supplementary supports to be provided by this Division.
- .2 Concrete housekeeping bases for electrical equipment to be provided by this Division.
- .3 Work to be done by firms specializing in these fields.
- .4 Submit shop drawings for steel and concrete work, prepared by licensed Professional Engineers.

5.2 Supplementary supports and support brackets:

- .1 Fabricated from structural grade steel with anchor bolts and fastenings.
- .2 Designed in consultation with building structural consultant to transfer live loads and dead loads to building structural elements.
- .3 Constructed as frames bracketed from walls, and/or supported from building structure above, and/or floor below.

5.3 Concrete bases for housekeeping pads:

- .1 Constructed using plywood form work and 20 Mpa (3000 lb) concrete,
- .2 Dowelled to concrete floor slab with steel rods not less than 13 mm (1/2 in) in diameter.
- .3 Finish to make flat, level, smooth, neat surfaces.
- .4 Chamfer corners 25 mm (1 in).
- .5 Dimensions:
 - .1 75 mm (3 in) larger all around than base of apparatus for non-seismic applications,
 - .2 200 mm (8 in) larger all around than base of apparatus for seismically restrained equipment,
 - .3 Height: 100 mm (4 in)

5.4 Installation - General

- .1 Locate supporting steel to permit service or repair, and to allow clear access to junction boxes and equipment.
- .2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, and vibration mountings.
- .3 Install anchor bolts, and vibration mountings between equipment and housekeeping pad.
- .4 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .5 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .6 Make field connections with bolts to CAN/CSA-S16.1, or weld.

- .7 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 After completion of erection, touch-up field welds, bolts and burnt or scratched surfaces with primer.
- .9 Where gratings or trench covers are cut in field or damaged, touch up with zinc rich paint.

6 GENERAL WIRING REQUIREMENTS

6.1 Wiring Terminations

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.
- .2 Manufacturers' and CSA labels to be visible and legible after equipment is installed.

6.2 Location of Outlets

- .1 Locate outlets in accordance with Division 01 - General Requirements.
- .2 Do not install outlets back-to-back in wall.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'), and information is given before installation.
- .4 Provide in contract five (5) spare GFI receptacles that can be swapped out with a standard receptacle at any time through the duration of the project.
- .5 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

6.3 Mounting Heights

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 For Barrier Free areas verify the mounting heights with the authority having jurisdiction prior to rough-in.
- .4 Install electrical equipment at following heights unless indicated otherwise.

Description	Barrier Free
Local switches	1050 mm (41")
Wall receptacles: General	450 mm (18")
Wall receptacles: Hospitals	450 mm (18")
Wall receptacles: above top of continuous baseboard heater	200 mm (8")

Description	Barrier Free
Wall receptacles: above top of counters or counter splash backs	175 mm (7")
Wall receptacles shown above top of counters where there is no counter: height above finished floor	1050 mm (41")
Wall receptacles: In Mechanical rooms	1050 mm (41")
Telephone outlets	450 mm (18")
Outlets for wall mounted telephones	1000 mm (39")
Fire alarm pull stations	1200 mm (47")
Fire alarm bells	2100 mm (83")
Wall mounted speakers	2100 mm (83")
Wall mounted door operator push pads	1000mm (39")
Wall or floor mounted, vertical panel type door operator controls	from ≤200mm to ≥900mm (from ≤7.9" to ≥36")
Television outlets	450 mm (18")
Clocks	2100 mm (83")
Other controls	1050 mm (41")
Panelboards	As required by code or as indicated

6.4 Conduit and Cable Installation

- .1 Install embedded conduit prior to pouring of concrete.
- .2 Arrange for holes through exterior walls and roof to be flashed and made weatherproof under Division 7.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .4 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions and assistance to locate and install inserts.
- .5 Secure inserts firmly to form work before concrete is poured.
- .6 Provide insert drawings as required.

6.5 Plywood Backboards

- .1 Provide plywood backboards in electrical and telecommunications rooms and closets where indicated or specified for mounting of equipment.

- .2 Plywood to be securely attached to the building structure.
- .3 Plywood to be 19mm, void free, good one side, mounted with good side exposed.
- .4 Plywood to be Class A fire retardant, FSC certified and contain no added urea formaldehyde.
Plywood to be treated as follows on all surfaces:
 - .1 initially seal the plywood with one coat of Sherwin Williams part No. B49 W 2 wood primer,
 - .2 follow with one coat of Flame Control 10-10 Intumescent Fire Retardant Paint,
 - .3 finish with one coat of Flame Control 40-40 Fire Resistant Paint.

END OF SECTION

WIRES & CABLES 0-1000 VOLTS
26 05 19

1 GENERAL

1.1 Product Data

- .1 Submit product data in accordance with Section 26 05 01 Electrical General Requirements.

1.2 Conductor sizes

- .1 Conductor sizes are based on connected equipment having a temperature marking of 75°C or higher. Where equipment does not have a temperature marking or it has a marking lower than 75°C, increase the size of the conductors accordingly, to the satisfaction of the consultant.
- .2 For wires in conduit, conductor sizes are based on not more than 3 current carrying conductors in a conduit. Where more than 3 current carrying conductors are installed in a conduit increase the conductor size accordingly, to the satisfaction of the consultant.
- .3 Do not reduce conductor sizes, conductors may have been oversized due to voltage drop constraints.

2 PRODUCTS

2.1 Building Wires

- .1 Conductors: copper conductors: size as indicated
- .2 Minimum wire size: No. 12 AWG.
- .3 Stranded conductors for 10 AWG and larger.
- .4 Insulation:
 - .1 chemically cross-linked thermosetting polyethylene material,
 - .2 RW90 or RWU90 to CSA C22.2 No. 38,
 - .3 1000V and 600V ratings.
- .5 Conductors to be colour coded. Conductors to have colour impregnated into insulation at time of manufacture. Phase conductors No. 8 AWG and larger, with black insulation, may be colour coded with adhesive colour coding tape.

Standard of Acceptance

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

2.2 Armoured Cables

- .1 Type: AC90, 600V 90C to CSA C22.2 No 51, FT4 rated.

- .2 Conductors: copper, minimum size #12 with bare copper #12 bonding wire.
- .3 Insulation: RW90 XLPE.
- .4 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

2.3 Armoured Cables with Insulated Bonding Conductor

- .1 Type: AC90 ISO-BX, 600V 90C to CSA C22.2 No 51, FT4 rated.
- .2 Conductors: copper, minimum size #12, with green insulated #12 copper bonding wire.
- .3 Insulation: RW90 XLPE.
- .4 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

2.4 Aluminum Sheathed Cables

- .1 Type: RA90, 600V to CSA C22.2 No 123.
- .2 Conductors: insulated copper quantity and size as indicated.
- .3 Insulation: RW90 XLPE.
- .4 Sheath: corrugated aluminum.
- .5 Jacket: FT-4 rating with rating permanently identified on jacket.
- .6 Connectors:
 - .1 [watertight],
 - .2 non-magnetic for single conductor cables.

2.5 Armoured Cables ACWU

- .1 Type: ACWU90, 600V to CSA C22.2 No 51.
- .2 Conductors: insulated copper quantity and size as indicated.
- .3 Insulation: RW90 XLPE.
- .4 Armour: interlocking aluminum.
- .5 Bonding conductor:
 - .1 bare in multiconductor cables,
 - .2 bare concentric in single conductor cables,
 - .3 copper or same material as phase conductors.
- .6 Jacket: FT-4 rating with rating permanently identified on jacket.
- .7 Connectors:
 - .1 Watertight.

- .2 Non-magnetic for single conductor cables.

2.6 Armoured Cables Teck

- .1 Type: TECK90, 600V to CSA C22.2 No 131.
- .2 Conductors: insulated [copper][copper for sizes up to #1 AWG, aluminum for sizes #1/0 and larger], quantity and size as indicated.
- .3 Insulation: RW90 XLPE.
- .4 Inner jacket; FT-4 rated PVC.
- .5 Armour: interlocking steel for multiconductor cable, interlocking aluminum for single conductor cables.
- .6 Bonding conductor:
 - .1 bare in multiconductor cables,
 - .2 bare concentric in single conductor cables,
 - .3 same material as phase conductors.
- .7 Outer jacket: FT-4 rating with rating permanently identified on jacket.
- .8 Connectors:
 - .1 Watertight,
 - .2 Equal to T&B Star Teck type,
 - .3 Non-magnetic connectors for single conductor cables.

Standard of Acceptance (armoured, aluminium sheathed and TECK cables)

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Northern Cables Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

2.7 Mineral Insulated Cable

- .1 Type: MI, 600V to CSA C22.2 No 124.
- .2 Conductors: solid annealed copper, quantity and size as indicated.
- .3 Insulation: compacted magnesium oxide.
- .4 Sheath: seamless annealed copper.
- .5 Terminations: as supplied by the cable manufacturer.
- .6 Cables to be shipped with ends sealed.

Standard of Acceptance

- Pentair/Pyrotenax System 500

2.8 Fire Rated Mineral Insulated Cable

- .1 Type: MI, 600V to CSA C22.2 No 124.
- .2 Conductors: solid annealed copper, quantity and size as indicated.
- .3 Insulation: compacted magnesium oxide.
- .4 Sheath: seamless annealed copper.
- .5 Terminations: as supplied by the cable manufacturer.
- .6 Fire rating: listed 2 hour rating to ULC S139-12, cables labelled accordingly.
- .7 Cables to be shipped with ends sealed.

Standard of Acceptance

- ° Pentair/Pyrotenax System 1850

2.9 Instrumentation and Control Cabling

- .1 Control cables to CSA Standard CAN3-C2.1-M86 Control Cables - 600 Volts.
- .2 Control cables as follows:

Conductors	Quantity, arrangement and gauge shown on drawings or specified elsewhere.
Identification	Colour coded or numbered.
Insulation	XLPE
Armour	Steel (No armour required if installed in conduit or approved wireway).
Jacket	FT4 Flame Retardant, FT6 when installed in open style cable trays in ceiling spaces that are used as return air plenums.

- .3 Shielded cables to provide 100% shield coverage complete with drain wire.
- .4 Multipair twisted shielded cables to have individually shielded pairs, overall shield, drain wires and overall rated jacket.

Standard of Acceptance

- ° General Cable (Carol)
- ° Belden
- ° Nexans Canada Inc.

3 EXECUTION

3.1 General

- .1 Conductor colour coding to be as follows:
 - Phase A - Red
 - Phase B - Black
 - Phase C - Blue
 - Neutral - White
 - Ground - Green
 - Control - Orange
- .2 Where colour coding tape is utilized, apply at least 50 mm (2") at terminations, junction boxes and pull boxes. Do not paint conductors.
- .3 Use:
 - .1 1000 V insulation for 600 Volt systems,
 - .2 600 V insulation for 347/600 V and 120/208 V systems.
- .4 Wiring installed underground: RWU90.
- .5 Wiring in channel back of luminaires:
 - .1 600 volt type GTF or TEW,
 - .2 temperature rating as required by CSA and/or manufacturer requirements.
- .6 Store wire and cable in a clean, dry, well ventilated area.
- .7 Protect white insulated wire from exposure to NOx gas (eg: exhaust from propane fuelled equipment) by wrapping with shrink wrap, by locating away from sources of NOx and by maintaining adequate ventilation to minimize NOx levels.
- .8 Where white insulated wire has discoloured:
 - .1 do not install,
 - .2 dispose of the wire,
 - .3 remove and replace wire that has been installed.
- .9 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.
- .10 Splice wires:
 - .1 Up to and including No. 6 AWG: with nylon insulated expandable spring type connectors with moulded thermoplastic body and expandable square edge design spring.
 - .2 Larger than #6 AWG: with compression sleeve connectors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.
 - .3 Aluminum Conductors: with long barrel compression sleeve connectors approved for use with aluminum conductors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.
- .11 Do not splice conductors used in parallel runs.

- .12 Where the Consultant agrees that splicing of conductors in a parallel run is unavoidable, connect the paralleled runs of the feeder together in a junction box at the splice location, using:
 - .1 Copper bus bars of quantity and size to match the circuit,
 - .2 A two hole long barrel compression lug on each cable,
 - .3 Two nuts and bolts on each lug,
 - .4 Two oversized flat washers and a spring lock washer, or two Belleville washers, on each bolt,
 - .5 An oversized CSA Type 3R enclosure to house the above.

3.2 Installation of Building Wires

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 33.
 - .2 In wireways and auxiliary gutters in accordance with Section 26 05 37.
- .2 Home runs, of 15 and 20 Ampere circuits to lighting and receptacle panels, which exceed:
 - .1 25 m (75') in length: No. 10 AWG or larger,
 - .2 40 m (120') in length: No. 8 AWG or larger,
 - .3 60 m (180') in length: No. 6 AWG or larger.
- .3 Increase the size of branch circuit conductors and home runs as required so that the total voltage drop, from panelboards to loads, does not exceed 3% under load.
- .4 For branch circuit wiring provide a dedicated neutral conductor for each phase conductor. Where the load does not produce harmonic currents a common neutral conductor may be used with two or three phase conductors, subject to prior approval by the Consultant.
- .5 For branch wiring, common neutral conductors may be used in the following applications:
 - .1 lighting circuits, excluding dimming circuits,
 - .2 housekeeping receptacles,
 - .3 specific purpose receptacles for equipment that does not produce harmonic currents, such as resistance heating.
- .6 Where wires are damaged or contaminated during installation, remove and dispose of wires, swab out conduits and pull in new, clean conductors.

3.3 Installation of Armoured Cables AC90(BX)

- .1 May only be used for drops to surface and recessed mounted fluorescent luminaires.
- .2 Do not use in patient care areas.
- .3 Terminate cables in accordance with Section 26 27 28 - Wire and Box Connectors - 0 - 1000 V.

3.4 Installation of Armoured Cables AC90 ISO-BX

- .1 May be used for drops to surface and recessed mounted fluorescent luminaires in patient care areas.

- .2 May be used for wiring to outlets, receptacles and light switches in patient care areas, provided that the wiring is concealed within walls and that horizontal runs within the ceiling space do not exceed 3m.
- .3 Terminate cables in accordance with Section 26 27 28 - Wire and Box Connectors - 0 - 1000 V.

3.5 Installation of Aluminum Sheathed Cables

- .1 Install and terminate cables in accordance with manufacturer's recommendations.
- .2 Use non-magnetic connectors for single conductor cables.
- .3 Do not use aluminium sheathed cables in systems that serve patient care loads.]
- .4 For single conductor cables in free air circuits rated up to and including 400Amperes:
 - .1 Space cables one cable diameter apart throughout the run,
 - .2 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained,
 - .3 Provide a 6mm thick aluminium termination plate at each end of the run,
 - .4 Size the termination plates to overlap the openings by at least 20mm on all sides,
 - .5 Seal the plates to the enclosures with silicone sealant and secure to the enclosures with nuts, bolts and lock washers every 150mm,
 - .6 Terminate all cables of the circuit on the same terminal plate,
 - .7 Bond each aluminium termination plate to its associated enclosure.
- .5 For single conductor cables in free air circuits rated greater than 400Amperes:
 - .1 Space cables one cable diameter apart throughout the run,
 - .2 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained,
 - .3 At the supply end of the run:
 - (a) Provide a 6mm thick aluminium termination plate,
 - (b) Size the termination plate to overlap the opening by at least 20mm on all sides,
 - (c) Seal the plate to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal plate,
 - (e) Bond the aluminium termination plate to the enclosure.
 - .4 At the load end of the run:
 - (a) Provide a 6mm thick non-conductive fire-resistant FRP (Glastic) termination panel,
 - (b) Size the termination panel to overlap the opening by at least 20mm on all sides,
 - (c) Seal the panel to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal panel,
 - (e) Ensure that the cable connectors do not make electrical contact with the enclosure.
 - .5 Install a separate bonding conductor for the circuit:
 - (a) Copper,
 - (b) Sized per the Electrical Safety Code,
 - (c) Run from the bonding lug or bus in the supply end enclosure to the bonding lug or bus in the load end enclosure,

- (d) Separated from the phase cables throughout the run, by a distance of not less than the spacing between the phase cables,
 - (e) Securely fastened throughout the run.
- .6 For single conductor cables in direct buried circuits:
- .1 Space cables apart per Diagram B4-1 of the electrical code,
 - .2 Maintain cable spacing throughout the run,
 - .3 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings of not less than one cable diameter,
 - .4 At the supply end of the run:
 - (a) Provide a 6mm thick aluminium termination plate,
 - (b) Size the termination plate to overlap the opening by at least 20mm on all sides,
 - (c) Seal the plate to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal plate,
 - (e) Bond the aluminium termination plate to the enclosure.
 - .5 At the load end of the run:
 - (a) Provide a 6mm thick non-conductive fire-resistant FRP (Glastic) termination panel,
 - (b) Size the termination panel to overlap the opening by at least 20mm on all sides,
 - (c) Seal the panel to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal panel,
 - (e) Ensure that the cable connectors do not make electrical contact with the enclosure.
 - .6 Install a separate bonding conductor for the circuit:
 - (a) Insulated RWU90 copper,
 - (b) Sized per the Electrical Safety Code,
 - (c) Run from the bonding lug or bus in the supply end enclosure to the bonding lug or bus in the load end enclosure,
 - (d) Separated from the phase cables throughout the run, by a distance of not less than the spacing between the phase cables.

3.6 Installation of Armoured Cables ACWU and TECK

- .1 Install and terminate cables in accordance with manufacturer's recommendations.
- .2 Use non-magnetic connectors for single conductor cables.
- .3 In systems that serve patient care loads, use only cables with copper ground conductors.]
- .4 For single conductor cables in free air circuits rated up to and including 400Amperes:
 - .1 Space cables one cable diameter apart throughout the run,
 - .2 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained,
 - .3 Provide a 6mm thick aluminium termination plate at each end of the run,
 - .4 Size the termination plates to overlap the openings by at least 20mm on all sides,
 - .5 Seal the plates to the enclosures with silicone sealant and secure to the enclosures with nuts, bolts and lock washers every 150mm,

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- .6 Terminate all cables of the circuit on the same terminal plate,
 - .7 Connect the cable bonding conductors to the enclosure bonding lug or bus at each end of the run,
 - .8 Bond each aluminium termination plate to its associated enclosure.
- .5 For single conductor cables in free air circuits rated greater than 400Amperes:
- .1 Space cables one cable diameter apart throughout the run,
 - .2 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained,
 - .3 At the supply end of the run:
 - (a) Provide a 6mm thick aluminium termination plate,
 - (b) Size the termination plate to overlap the opening by at least 20mm on all sides,
 - (c) Seal the plate to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal plate,
 - (e) Connect the cable bonding conductors to the enclosure bonding lug or bus,
 - (f) Bond the aluminium termination plate to the enclosure.
 - .4 At the load end of the run:
 - (a) Provide a 6mm thick non-conductive fire-resistant FRP (Glastic) termination panel,
 - (b) Size the termination panel to overlap the opening by at least 20mm on all sides,
 - (c) Seal the panel to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal panel,
 - (e) Cut off the cable bonding conductors at the connector and cover with insulating tape, ensure that the cable bonding conductors do not make any electrical contact.
 - (f) Ensure that the cable connectors do not make electrical contact with the enclosure.
 - .5 Install a separate bonding conductor for the circuit:
 - (a) Copper,
 - (b) Sized per the Electrical Safety Code,
 - (c) Run from the bonding lug or bus in the supply end enclosure to the bonding lug or bus in the load end enclosure,
 - (d) Separated from the phase cables throughout the run, by a distance of not less than the spacing between the phase cables,
 - (e) Securely fastened throughout the run.
- .6 For single conductor cables in direct buried circuits:
- .1 Space cables apart per Diagram D8 of the electrical code,
 - .2 Maintain cable spacing throughout the run,
 - .3 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings of not less than one cable diameter,
 - .4 At the supply end of the run:
 - (a) Provide a 6mm thick aluminium termination plate,
 - (b) Size the termination plate to overlap the opening by at least 20mm on all sides,
 - (c) Seal the plate to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal plate,
 - (e) Connect the cable bonding conductors to the enclosure bonding lug or bus,
 - (f) Bond the aluminium termination plate to the enclosure.

- .5 At the load end of the run:
 - (a) Provide a 6mm thick non-conductive fire-resistant FRP (Glastic) termination panel,
 - (b) Size the termination panel to overlap the opening by at least 20mm on all sides,
 - (c) Seal the panel to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,
 - (d) Terminate all cables of the circuit on the terminal panel,
 - (e) Cut off the cable bonding conductors at the connector and cover with insulating tape, ensure that the cable bonding conductors do not make any electrical contact,
 - (f) Ensure that the cable connectors do not make electrical contact with the enclosure.
- .6 Install a separate bonding conductor for the circuit:
 - (a) Insulated RWU90 copper,
 - (b) Sized per the Electrical Safety Code,
 - (c) Run from the bonding lug or bus in the supply end enclosure to the bonding lug or bus in the load end enclosure,
 - (d) Separated from the phase cables throughout the run, by a distance of not less than the spacing between the phase cables.

3.7 Installation of Mineral Insulated Cables

- .1 Provide fire rated mineral insulated cables unless non-fire rated cables are indicated.
- .2 Store cables under dry conditions.
- .3 Handle cables with care to avoid cable kinks; it is recommended that cable be uncoiled from supply reel by rolling. Do not install kinked cables.
- .4 Install and terminate cables in accordance with the manufacturer's recommendations.
- .5 Install fire rated cables in accordance with ULC S139-12 and in accordance with the manufacturer's recommendations.
- .6 Install cables in trays, on hangers or on channels secured to walls, beams or floor slabs, using clamps supplied by or recommended by the manufacturer.
- .7 Support cables with clamps, straps, clips of:
 - .1 Copper,
 - .2 Stainless steel,
 - .3 Steel material.
- .8 Secure cables so that they cannot contact any dissimilar metals other than the approved supporting materials.
- .9 In damp or wet areas wrap cables with electrical tape where the cable contacts the supporting materials unless the supporting materials are copper or stainless steel. For non-fire rated cables only, clamps with integral rubber insets may be used in lieu of tape.
- .10 Support fire rated cables:
 - .1 directly from fire rated structure per ULC FHITC.1850 or, where ULC FHITC.1850 cannot be applied, support cables in accordance with written instructions from the Consultant,
 - .2 on centres not exceeding:

- (a) 1219 mm (4') for cables less than or equal to 7.6mm (0.3") in diameter,
 - (b) 1828 mm (6') for cables greater than 7.6mm (0.3") in diameter,
- .3 with stainless steel clamps or straps on cable groups midway between supports, for single conductor cables.
- .11 For non-fire rated cables provide supports on centres not exceeding 2000mm (6.56').
- .12 Bend cables using a suitable hickey with a bending radius of not less than six times the cable diameter.
- .13 Protect embedded cables from punctures and mechanical damage.
- .14 For unjacketed single conductor cables that form a circuit or form one run of a feeder with parallel runs, install the cables with their sheaths in contact with one another throughout their length, excluding 1m at each point of connection to equipment or box.
- .15 For single conductor cables in circuits rated 200 A and higher:
 - .1 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained,
 - .2 Provide a 6mm thick brass termination plate at each end of the run,
 - .3 Size the termination plates to overlap the openings by at least 20mm on all sides,
 - .4 Seal the plates to the enclosures with silicone sealant and secure to the enclosures with nuts, bolts and lock washers every 150mm,
 - .5 Terminate all cables of the circuit on the same termination plate,
 - .6 Provide a copper bonding conductor, sized per Table 16 of the ESC, from each brass termination plate to the equipment ground lug or bus in the associated enclosure,
 - .7 Connect to the termination plate and to the equipment ground lug or bus using Burndy YA compression connectors with 12mm stainless steel bolts and matching hardware.
- .16 For parallel runs, install cable groups at least 2.15 cable diameters apart.
- .17 Terminate cables using glands and seals as supplied by the cable manufacturer. Install gland and seal assemblies using tools specifically designed for the purpose.
- .18 Upon completion of cable terminations and prior to energization, test the insulation resistance of each cable with an insulation tester. Where measured values are not acceptable to the Consultant, rework or replace the cable until satisfactory results are obtained.
- .19 For fire rated cables, provide the services of the cable manufacturer to inspect the cable installation and termination methods and provide a written report documenting that the cables have been installed in accordance with the requirements of the ULC standard and the ULC listing and in accordance with the manufacturer's recommendations. Submit the report to the Consultant.

3.8 Installation of Instrumentation, Communication and Control Cabling

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 33.
 - .2 In wireways and auxiliary gutters in accordance with Section 26 05 37.
 - .3 In open style cable trays in ceiling spaces, use FT4 rated cable where the ceiling space is not used as a return air plenum.

- .2 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.
- .3 Run instrumentation, communication and control cabling point to point and terminate on terminal strips. Do not splice communication or control cabling. Where long runs make a continuous point to point installation impractical, make splices on labelled terminal blocks in an accessible labelled terminal cabinet, installed at 1200 mm (48") above floor, and indicate cabinet location, terminal and wire numbers on the As-built drawings.
- .4 Terminate control cables in equipment with suitable connectors.
- .5 Clearly identify cables at both ends, with permanent PVC wire markers, Weiland type Z or equal, indicating cable number and wire numbers.

END OF SECTION

GROUNDING AND BONDING SECONDARY

26 05 27

1 GENERAL

1.1 General Requirements

- .1 Conform to Sections of Division 1 as applicable.

1.2 Related Sections

- .1 26 01 01, Electrical General Requirements.
- .2 26 05 01, Basic Materials and Methods.
- .3 26 05 53, Identification for Electrical Systems.

1.3 References

- .1 IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.4 Submittals

- .1 Submit shop drawings and product data in accordance with Section 26 01 01 Electrical General Requirements.
- .2 Submit list of nameplates.

1.5 Applicable Codes and Standards

- .1 Latest edition of CSA C22.2 No 41 Grounding and Bonding Equipment.
- .2 Latest edition of CSA-Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.6 Work Included

- .1 Provide labour, materials, and equipment as required for installation, testing and putting into proper operation complete systems as shown, as specified and as otherwise required.

1.7 Operation and Maintenance Data

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 26 01 01 Electrical General Requirements.

2 PRODUCTS

2.1 Clamps:

- .1 conductor to water main clamps suitable for grounding connections,
- .2 type and size as required to make electrically conductive connections to underground water pipe,
- .3 non-corroding copper, bronze and/or stainless steel construction.

2.2 Electrodes

- .1 Rod electrodes:
 - .1 material: steel with a bonded copper cladding not less than 254 μm (10 mils) thick,
 - .2 size: 19 mm dia by 3 m long ($\frac{3}{4}$ " dia by 10' long),
 - .3 CSA labelled to C22.2 No 41.

2.3 Conductors

- .1 Buried grounding conductors:
 - .1 bare, stranded, tinned, soft annealed copper,
 - .2 size #4/0 AWG unless indicated otherwise.
- .2 Insulated grounding and bonding conductors:
 - .1 bare, stranded, soft annealed copper,
 - .2 type RW90 green insulation.

2.4 Accessories

- .1 Accessories including but not limited to:
 - .1 grounding and bonding bushings,
 - .2 protective type clamps,
 - .3 bolted type conductor connectors,
 - .4 exothermic welded type conductor connectors,
 - .5 bonding jumpers, straps,
 - .6 pressure wire connectors,
 - .7 to be of non-corroding copper, bronze and/or stainless steel construction.

2.5 Raised Floor Bonding

- .1 Communication and computer room raised floor ground clamps: Burndy Uniground.

3 EXECUTION

3.1 Installation

- .1 Ground electrical systems in accordance with the Electrical Safety Code and the latest edition of ANSI/IEEE Standard 142.
- .2 Bond electrical equipment in accordance with the Electrical Safety Code and the latest edition of ANSI/IEEE Standard 142.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding and bonding conductors from mechanical injury.

- .5 Make buried connections, and connections to conductive water main and electrodes, using copper welding by exothermic process.
- .6 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Provide a bonding wire for flexible conduit, connected at both ends to bonding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Provide a separate bonding conductor in each conduit:
 - .1 sized as per Table 16A of the ESC,
 - .2 not less than #12 AWG copper,
 - .3 with one bond conductor for every three line conductors.
- .10 Bond building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at a single grounding point. Avoid loop connections.
- .12 Install grounding conductors outside electrical rooms and electrical closets in PVC conduit and conceal where possible. Where PVC conduit is not permitted use EMT and bond the EMT to the conductor at both ends.

3.2 Electrodes

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Provide a 4/0 AWG copper water meter shunt.
- .3 Install rod, electrodes and make grounding connections.
- .4 Bond grounding electrodes together with 4/0 AWG copper conductors.
- .5 For main electrical rooms on grade, provide a rod electrode at each corner of the room and connect to perimeter ground bus.
- .6 For main electrical rooms on a suspended slab, provide:
 - .1 two runs of 4/0 AWG copper conductor,
 - .2 connect runs to opposite corners of the perimeter ground bus,
 - .3 install in PVC conduit,
 - .4 run via separate routes,
 - .5 connect to opposite corners of the building ground grid.

3.3 System Grounding

- .1 Provide system grounding connections to neutral point of secondary systems using not less than #6 copper conductor unless indicated otherwise.

- .2 Install insulated copper grounding conductor for service raceways and service equipment as required by the electric utility company.
- .3 Install grounding conductors in PVC conduit.

3.4 Equipment Bonding

- .1 Install insulated copper bonding connections:
 - .1 sized not less than #12 AWG and not less than indicated in Tables 16A and 16B of the electrical code,
 - .2 to typical equipment including, but not necessarily limited to the following list:
 - (a) service equipment,
 - (b) transformers,
 - (c) switchboards,
 - (d) panelboards,
 - (e) splitters,
 - (f) disconnect switches,
 - (g) junction and outlet boxes,
 - (h) receptacles,
 - (i) luminaires,
 - (j) frames of motors,
 - (k) motor control centres,
 - (l) starters,
 - (m) fire alarm systems,
 - (n) security systems,
 - (o) CCTV systems,
 - (p) audio systems,
 - (q) communications systems,
 - (r) control panels,
 - (s) elevators,
 - (t) other equipment that is supplied with electrical power.
- .2 Where applicable, run bonding conductors as part of the feeder.
- .3 Where bonding conductors are run separately, install in PVC conduit.

3.5 Communications Systems

- .1 Install bonding connections for telephone, sound, fire alarm, intercommunication systems as follows:
 - .1 telephones: make telephone bonding system in accordance with telephone company's requirements,
 - .2 communications system bonding: in accordance with ANSI/EIA/TIA 607, 568A, 569 standards,
 - .3 sound, fire alarm, intercommunication systems: as required by the electrical code except where indicated otherwise.

3.6 Raised Floor Bonding

- .1 Install #2 bare copper bonding conductors in a grid pattern on four foot centres in each direction of the floor grid. Install Burndy Uniground clamp to raised floor pedestals on four foot centres, at each intersection of the bonding grid conductors.

- .2 Bond each item of equipment on the raised floor to the raised floor bonding grid with not less than a #6 tinned copper flat braid extra flexible bonding jumper.
- .3 Extend #1/0 green insulated copper ground conductor in PVC conduit from the bonding grid to the building main grounding system. Terminate using NEMA 2 hole compression connectors.

3.7 Bonding of Other Items

- .1 Install insulated copper bonding connections:
 - .1 sized not less than #6 AWG,
 - .2 run in PVC conduit,
 - .3 to typical items including, but not necessarily limited to following list:
 - (a) metallic water piping systems,
 - (b) metallic waste water piping systems,
 - (c) metallic gas piping systems,
 - (d) metallic vacuum piping systems,
 - (e) metallic compressed air piping systems,
 - (f) building steel work.
- .2 Review the design and installation of each piping system with the system installer and provide bonding jumpers where necessary to ensure that each piping system is electrically continuous.

3.8 Perimeter Ground Bus

- .1 Provide exposed perimeter ground bus in main electrical rooms.
- .2 Wall mount on stand off insulated spacers using zinc plated steel studs, washers, lock washers and nuts.
- .3 Connect exposed metal work in electrical rooms to perimeter ground bus with insulated stranded copper bonding conductors in PVC conduit, sized in accordance with Tables 16A and 16B of the electrical code but not less than 2/0 AWG copper, except where indicated otherwise.
- .4 For switchgear lineups of four sections or more, provide at least two bonding conductors to the perimeter ground bus, one bonding conductor located at each end of the lineup.
- .5 Protect ground bus with one coat of insulating varnish.

3.9 Field Quality Control

- .1 Perform tests in accordance with:
 - .1 Section 26 01 01 - Electrical General Requirements.
 - .2 Section 26 08 05 - System Co-ordination, Verification and Testing.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.
- .3 Perform tests before energizing electrical system.

END OF SECTION

FASTENINGS AND SUPPORTS

26 05 29

1 GENERAL

1.1 Related Work

- .1 Concrete bases and housekeeping pads for electrical equipment shall be arranged and paid for by Division 26, and installed by trade specialists under respective Carpentry, Concrete, and Painting Divisions.

1.2 Shop Drawings

- .1 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.
 - .1 Shop drawing details:
 - (a) construction detail drawings for each loading condition,
 - (b) span deflection calculations,
 - (c) building attachment load calculations and type.
 - .2 Provide services of engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

2 PRODUCTS

2.1 Support Channels

- .1 Hot dipped galvanized steel, U shape, size 41 mm x 41 mm x 2.5 mm (1½" x 1½" x 1/10") thick, surface mounted, suspended or set in poured concrete walls and ceilings.

2.2 Inserts

- .1 Inserts for conduits and raceway hangers, for single, double and multiple runs shall be galvanized.

Standard of Acceptance

- Unistrut Canada
- Burndy (Canada) Ltd. - Flexibar
- Pilgrim Technical Products Ltd. - Tufstrut

2.3 Hangers

- .1 Hangers for electrical conduit shall be hot dipped galvanized after fabrication.

Standard of Acceptance

- Burndy Canada Ltd.
- Canstrut
- Electrovert Ltd.
- E. Myatt & Co. Ltd
- Steel City Electric Ltd.
- Pilgrim Technical Products Ltd.

2.4 Trapeze hangers

- .1 Performance:

- .1 Manufactured:
 - (a) to product load listings.
- .2 Custom fabricated:
 - (a) maximum deflection between supports: 1/250 (0.4%) of span
 - (b) minimum factor of safety : 5 times load to ultimate tensile or compressive strength.
- .2 Construction:
 - .1 Carbon steel shapes, to suit load application:
 - (a) hollow steel section,
 - (b) equal leg EI section, or
 - (c) double C channel "strong-back", with welded clips.
 - .2 Hanger rods:
 - (a) as specified above, and
 - (b) minimum two support rods,
 - (c) rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.
- .3 Finish:
 - .1 hot dipped galvanized finish in mechanical rooms and outdoors.
 - .2 black steel finish in other areas.

Standard of Acceptance

- ° Anvil Fig 45, 46, 50

3 EXECUTION

3.1 Installation

- .1 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions to locate and install inserts.
- .2 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .3 Secure equipment to poured concrete with expandable inserts.
- .4 Secure surface mounted equipment with T-bar support hanger fastened to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

Standard of Acceptance

- ° Caddy model No. 512 c/w BHC clip

- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm (2") and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm (2").
 - .3 Beam clamps to secure conduit to exposed steel work.

- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm (1/4") dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm (1/4") dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels.
- .9 Provide galvanized after fabrication metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Supply and erect special structural work required for the installation of electrical equipment. Provide anchor bolts and fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- .15 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets. Install angle or channel iron supports to bear the equipment where it is shown in or on structural tile walls, or walls that are inadequate to bear the equipment.
- .16 Provide channel iron or other metal supports where necessary to adequately support lighting fixtures. Do not use wood. Lighting fixtures shall be supported totally independent of ceiling and supported from structure above.
- .17 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members required between beams for supporting conduits.
- .18 Do not use explosive drive pins in any section of work without obtaining prior written approval.
- .19 Provide re-enforced concrete pads under switchboards, generators, and all other floor mounted electrical equipment. Pads are to be formed with chamfered edges to prevent chipping. Pads are to be sealed and painted to prevent dust from entering and interfering with electrical equipment.

END OF SECTION

SPLITTERS, JUNCTION AND PULL BOXES, CABINETS

26 05 32

1 GENERAL

1.1 Shop Drawings and Product Data

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01 Electrical General Requirements.

1.2 Reference

- .1 CSA C22.2 No. 76 Splitters.
- .2 CSA C22.2 No. 40 Junction and Pull Boxes.
- .3 Cabinets to Section 26 27 18 Panel Trim.

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 and 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.
- .4 Distribution riser splitters shall be of special construction with hinged access door, copper bus bars predrilled to accept two hole compression connectors for all incoming and outgoing cables.

2.2 Junction and Pull Boxes

- .1 Welded steel hot dipped galvanized 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, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface or flush mounting as indicated.
- .3 Surface mounted cabinets shall be finished in ASA 61 grey.

2.4 Instrumentation and Control Terminal Cabinets

- .1 Surface mounted, gasketed, drip proof and dust tight, JIC enclosure, CEMA type 12 With hinged door, lock, 2 keys, white raised and removable internal mounting panel, diagram pocket, finished with ASA 61 grey.

Standard of Acceptance

° Hammond

- .2 Panel wiring to be contained in PVC wiring ducts complete with cover strips, minimum 50 mm x 50 mm (2" x 2"). Wireway fill to be limited to 60%. Where there are a large number of door mounted devices, door wiring harnesses shall also be contained in wiring ducts at rear door. All door wiring devices to emanate from the control panel terminal strips. Wiring to panel face mounted devices to be bundled neatly on hinge side of panel, enclosed in flexible spiral wrap, and installed such that wiring will not be damaged when opening and closing door. Ground panel door to panel with a flexible copper bonding strap. Label all wiring with permanent PVC sleeve type markers.
- .3 Phoenix contact terminal blocks with mounting rails, end covers, terminal markers, partition plates and accessories: UK 2.5 termination of wiring 22 to 12 AWG; UK 5 and UK 10 series for current transformers and other leads #10 AWG and #8 AWG; UDK or UK 5 twin for connecting two or more conductors to one terminal block; DIK 1.5 for three wire sensor device wiring; MTKD for thermocouple leads.
- .4 Provide lamacoid nameplates for all panel mounted control and indicating devices, and all internal components such as terminal strips, control transformers, control devices, relays, etc. as per 26 05 01.

3 EXECUTION**3.1 Splitter Installation**

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

3.2 Junction, Pull Boxes and Cabinets Installation

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m (6'-6") above finished floor.
- .3 Install terminal block as indicated in Type T cabinets
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m}{100'} of conduit run between pull boxes.

3.3 Identification

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical - General Requirements.
- .2 Install size 2 identification labels indicating system name, voltage, phase and source of power.
- .3 Provide a typed directory in cabinets showing following information: Nature, actual quantities and room number of device or devices connected to each terminal, as well as signal circuit number where applicable.

END OF SECTION

CONDUITS, FASTENINGS AND FITTINGS

26 05 33

1 GENERAL

1.1 General Requirements

- .1 Conform to Sections of Division 1 as applicable.
- .2 Conform to Section 26 05 01, Electrical General Requirements.

1.2 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

1.3 Work Included

- .1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.4 Location of Conduit

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

1.5 References

- .1 CSA C22.2 No. 45 Rigid Metal and Epoxy Coated Conduit
- .2 CSA C22.2 No. 83 Electrical Metallic Tubing
- .3 CSA C22.2 No. 136 Rigid PVC Conduit
- .4 CSA C22.2 No. 56 Flexible Metal and Liquid-Tight Flexible Metal Conduit
- .5 CSA C22.2 No 211.2 Rigid PVC Conduit
- .6 Conduit accessories, conduits and fittings to CSA C22.2 No. 18.

1.6 Wiring Methods

- .1 Install wiring in surface mounted EMT conduit unless otherwise specified. In finished areas, conceal conduit in walls and ceiling spaces.
- .2 In areas designated as Explosion Proof on Drawings, conduit and wiring shall be Class I, Group D, Division I.
- .3 Where shown on drawings, armoured cable shall be Teck 90 type. Jackets of cable shall have FT-4 rating identified. Connectors shall be equal to T&B Star Teck Type
- .4 Rigid PVC conduit with ground wire as per Electrical Safety Code Table 16 shall be used throughout below grade areas and may be used in or under slab on grade areas. It shall not be used in above grade slabs.

- .5 PVC coated rigid galvanized steel conduit shall be used throughout basement; in damp locations including but not limited to intake and exhaust shafts and air handling units; for rigid metallic conduit underground or in floor slabs; for wiring outdoors and in unheated buildings; and where noted on Drawings.
- .6 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass.
- .7 Use EMT conduit for branch circuit and signal wiring in ceilings, furred spaces, and in hollow walls and partitions.
- .8 Use rigid galvanized steel conduit for wiring where conduits are exposed to possible mechanical damage.
- .9 Use epoxy coated rigid galvanized steel conduit for wiring in poured concrete.
- .10 Aluminum conduits shall not be used.
- .11 Flexible conduit and armoured cable will be accepted in parts of existing building, where furred spaces above ceilings are too congested to permit conduit to be installed, but only with Consultant's written permission. Terminate armoured cable, where shown, in accordance with the manufacturer's recommendations.
- .12 Flexible steel conduit with integral insulated green ground wire is permitted for the final connection to luminaires mounted in suspended ceilings from the branch wiring junction box above, with flexible conduit length not to exceed 3 m (10'), and be neatly installed and attached to luminaire support chain
- .13 Conduit shall be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.
- .14 Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.
- .15 Where existing locations of flush mounted electrical devices (switches, receptacles, etc.) correspond to new devices shown, the existing dropdown conduit and outlet box may be re-used. Provide new devices, new coverplates, new home-run conduit and complete new wire.
- .16 Vertical raceways to be provided with insulated cable support bushings or other approved method of supporting the weight of the cable, where vertical runs exceed those of Table 21 of the Electrical Code.

2 PRODUCTS

2.1 Conduits

- .1 Rigid hot dipped galvanized steel threaded conduit
- .2 Epoxy coated rigid galvanized steel conduit: with zinc coating and corrosion resistant epoxy finish inside and outside equal to Columbex Green Guard II
- .3 PVC coated hot dipped galvanized rigid steel conduit: with 40 mil PVC exterior coating, 2 mil urethane interior and thread coating equal to Rob Roy Plastibond RedHot.

- .4 Electrical metallic tubing (EMT), [hot dipped] galvanized: with couplings.
- .5 Rigid PVC conduit.
- .6 Flexible metal conduit and liquid-tight flexible metal conduit.
- .7 Conduit shall be of sufficient size to allow easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

2.2 Conduit Fastenings

- .1 One hole steel straps to secure surface conduits 50 mm (2") and smaller. Two hole steel straps for conduits larger than 50 mm (2").
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Six mm dia threaded rods to support suspended channels.

2.3 Conduit Fittings

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90 degree bends are required for 25 mm (1") and larger conduits
- .3 Insulated throat steel set screw or raintight insulated throat steel compression connectors and couplings for EMT.
- .4 Threaded or compression type raintight/concrete tight insulated throat zinc plated steel connectors and couplings for rigid steel conduit.
- .5 Raintight insulated throat steel connectors at all surface panelboards, switchboards and other electrical equipment in sprinklered areas for all conduit terminations.

2.4 Expansion Fittings

- .1 Electrogalvanized steel with internal grounding for EMT suitable for 100mm linear conduit movement.

Standard of Acceptance

- ° Cooper Crouse Hinds XJG-EMT
- .2 Weatherproof expansion fittings with internal bonding assembly suitable for [100mm (4")] [200 (8")] linear expansion.
- .3 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm (3/4") deflection in all directions.
- .4 Concrete type, water tight, corrosion resistant for conduit installations embedded in concrete
- .5 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 Fish Cord

- .1 Polypropylene

3 EXECUTION

3.1 Installation

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use electrical metallic tubing (EMT) except: in cast concrete, underground or where installed exposed within 2.0m (6'-6") of floor.
- .4 Use rigid galvanized steel conduit where installed surface mounted within 2.0m (6'-6") of floor.
- .5 Use rigid PVC conduit in slab on grade cast concrete and underground. Do not use PVC conduits in slabs above grade. All conduits shall be surface mounted to minimize risks of future damage when core drilling during future renovations. Where localized congestion or circumstances forces the use of conduits in the floor slabs, they shall be epoxy coated rigid galvanized steel.
- .6 Provide PVC conduit with bonding conductor as per Table 16A of Ontario Electrical Safety Code.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment
- .8 Use explosion proof flexible connection for connection to explosion proof motors.
- .9 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .10 Use raintight connectors or hubs for terminating conduits at all surface or floor mounted panelboards, switchboards, and other equipment located in sprinklered areas or where at risk of exposure to dripping liquids.
- .11 Install wiring in conduit unless otherwise specified.
- .12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Mechanically bend steel conduit over 19mm (3/4") dia.
- .14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .15 Install fish cord in empty conduits.
- .16 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .17 Dry conduits out before installing wire.
- .18 Conduit manufacturer's touch up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

- .19 Install junction boxes or cable anchor boxes wherever necessary for proper pulling or anchoring of cables. Install so as to be accessible after building is completed and set to come within finished lines of building.
- .20 Where EMT or rigid PVC is used, run green insulated bonding conductor in conduit, with minimum one bonding conductor per three ungrounded conductors.
- .21 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.
- .22 Where conduits or cables are installed under raised floors and are required to be fastened in place, use two hole inverted "U" straps. No sharp edges or corners will be permitted which may damage PVC jackets or cables.
- .23 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. They shall be installed as close to building structure as possible such that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

3.2 Surface Conduits

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5m (5') clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.

3.3 Concealed Conduit

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings.

3.4 Conduits in Cast-in-place Concrete

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

- .6 Encase conduits completely in concrete with minimum 25 mm (1") concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.5 Conduits in Cast-in-place Slabs on Grade

- .1 Run conduits 25 mm (1") and larger below slab and encased in 75 mm (3") 75 mm concrete envelope. Provide {50 mm (2")} of sand over concrete envelope below floor slab.

3.6 Conduits Underground

- .1 Slope conduits to provide drainage.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

26 05 35

1 GENERAL

1.1 Related Work

- .1 Box connectors to Section 26 27 28.

1.2 References

- .1 CSA C22.2 No. 18.
- .2 CSA C22.1 Canadian Electrical Code, Part 1, Ontario Hydro Electrical Safety Code.

2 PRODUCTS

2.1 Outlet and Conduit Boxes - 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.
- .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 Hot dipped galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 38 mm (3" x 2" x 1½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.
- .3 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 Masonry Boxes

- .1 Hot dipped galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

- .1 Hot dipped galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Floor Boxes

- .1 Concrete tight hot dipped galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass or brushed aluminum faceplate. Device mounting plate to accommodate short or

long ear duplex single or receptacles. Minimum depth: 28 mm (1¼") for receptacles; 73 mm (3") for communication equipment.

- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm (½") and 19 mm (¾") conduit. Minimum size: 73 mm (3") deep.

2.6 Conduit Boxes

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle, outside building and where weatherproof boxes are required.
- .2 Explosion proof boxes in areas indicated on drawings.

2.7 Fittings - General

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm (1½") and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

3 EXECUTION

3.1 Installation

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm (¼") of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.
- .6 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
- .7 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.
- .8 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.
- .9 Where 100 mm (4") square boxes are installed in exposed concrete or cinder block in finished areas, blocks will be cut under masonry division as instructed under this section. Openings shall be cut to

provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

26 05 53

1 GENERAL REQUIREMENTS

1.1 Scope

- .1 Provide identification and warning signs for complete electrical systems as shown, as specified, as intended, and as otherwise required.

1.2 Shop Drawings

- .1 Submit list of nameplates with proposed wording, prior to engraving.
- .2 Submit list of labels with proposed wording, prior to printing.
- .3 Submit representative samples of nameplates, labels and warning signs.

2 PRODUCTS

2.1 Warning Signs

- .1 As required to meet requirements of Electrical Safety Authority.
- .2 Outdoor signs:
 - .1 fibreglass,
 - .2 minimum size 250 mm x 360 mm (10" x 14").
- .3 Indoor signs;
 - .1 aluminum,
 - .2 baked enamel finish,
 - .3 minimum size 180 mm x 250 mm (7" x 10").

Standard of Acceptance

- Brady
- Seton

2.2 Equipment Identification

- .1 Nameplates for panels and equipment:
 - .1 3 mm ($\frac{1}{8}$ ") thick laminated plastic plates,
 - .2 engraved lettering,
 - (a) first line: 11 mm (7/16") high lettering,
 - (b) second line: 7mm (1/4") high lettering,
 - (c) third line: 5mm (3/16") high lettering,
 - .3 black lettering on white background,
 - .4 with bevelled edges,
 - .5 mechanically attached with self-tapping stainless steel screws.

.2 Labels for warnings, instructions etc on panels and equipment:

- .1 printed on white polyester background,
- .2 7 mm (1/4") high letters unless specified otherwise,
- .3 UV resistant inks,
- .4 clear polyester over lamination,
- .5 pressure sensitive adhesive.

Standard of Acceptance

- Brady
- Ideal Industries
- Safety Sign

.3 Do not commence manufacture of nameplates and labels until wording has been reviewed by the Consultant.

2.3 Wiring Identification

.1 Colour coded phasing tapes:

- .1 7 mil poly vinyl chloride,
- .2 pressure sensitive adhesive,
- .3 compatible with wire insulation,
- .4 permanent colour,
- .5 electrically insulating,
- .6 UV and moisture resistant,
- .7 to CSA C22.2 No. 197

Standard of Acceptance

- 3M Scotch 35
- Electro Tape Specialties 103/103C Series

.2 Wire markers:

- .1 heat shrink,
- .2 military grade polyolefin sleeves,
- .3 permanent printed wire identification.

Standard of Acceptance

- Brady
- Panduit

3 EXECUTION

3.1 Equipment Identification

.1 Identify electrical equipment with nameplates, directories and labels.

.2 Nameplates:

- .1 secure to top exterior of equipment except where indicated otherwise,

- .2 switchboards: indicate name, voltage and ampacity,
- .3 rear of switchboard cubicles or cells: indicate name of cell or cubicle,
- .4 panelboards: indicate name, voltage and source of power,
- .5 terminal cabinets: indicate name, system and voltage,
- .6 disconnects, starters and contactors: indicate equipment being controlled and voltage,
- .7 transformers: indicate name, capacity, primary and secondary voltages,
- .8 pull boxes and junction boxes: indicate system, circuit numbers and voltage,
- .9 cabinets for low voltage systems, such as signals and communications: indicate name and system,
- .10 equipment not listed above, such as, instruments, fire alarm, clock and program equipment and control panels: identify in a similar manner showing name and number of the equipment, voltage and load information.
- .11 typical identification standards:
 - (a) Lighting, Receptacle and Power Panels: each identified with an engraved lamicaid nameplate secured to top interior trim as follows:

LP-4NW-1EA	11 mm (7/16") high lettering
120/208 volts	7 mm (1/4") high lettering
Fed from PP-SBSW-EAA	5 mm (3/16") high lettering

.3 Directories:

- .1 Supply each panelboard with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard Name LP-4NW-1EA	
Panel Voltage 120/208 Volts	
Circuit Number	Description
1	Lighting Room #34
2	Receptacles Room #34
3	Ice Machine Room #17

- .2 Cabinets for low voltage systems, such as signals and communications: as for panelboards with a directory showing circuit numbers and room locations plus a blank column for "Remarks".
 - .3 Cover directory list with a 0.8mm (1/32") minimum thick clear plastic sheet to protect it.
 - .4 Label all receptacles with circuit number and source panel information.
- .4 Pull Boxes and Junction Boxes
- .1 Identify feeder pull boxes and junction boxes:
 - (a) lettering stamped on brass or aluminum tags,
 - (b) showing the name of the feeder or system,
 - (c) voltage involved,
 - (d) data for both termination points whether equipment or panel,

- (e) secure tag under box lid screws using steel wire.

3.2 Service Rough-in Identification

- .1 Apply a small dab of paint to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:

Red	Fire Alarm System and Emergency Voice Communication System
Dark Blue	Intercom and Public Address
Dark Green	Telephone and Data Systems
Black	Annunciator and Buzzer System
Grey	Clock System
White	Central Dictation
Orange	Nurse Call
Yellow	Alarm Systems
Pink	Computer Systems
Light Green	TV Systems

- .2 Junction boxes in furred ceilings to have colour identification on both inside and outside.
- .3 As an alternative to applying paint dabs, prepainted conduit/EMT may be used where applicable.
- .4 Colour coding is not required for lighting and power circuits.

3.3 Wiring Identification

- .1 Identify feeders and branch circuit wiring with wire markers;
- .1 at each end of run,
- .2 in each junction box,
- .3 wherever they are introduced into ducts or equipment.
- .2 Identify incoming utility service lines by Red - Phase "A", Black - Phase "B", Blue - Phase "C", with colour coded phasing tape.
- .3 Band buswork in each;
- .1 switchboard,
- .2 unit substation cubicle,
- .3 power panel,
- .4 lighting and receptacle panel,
- with colour coded phasing tape as follows:

Red	Phase A
Black	Phase B
Blue	Phase C
White	Neutral
Green	Ground

- .4 Band feeder and sub-feeder bus and conductors as above.
- .5 Maintain phase sequence and colour coding throughout.
- .6 Connections in equipment to be Phase A, B, C from left to right when viewing from front or accessible direction.
- .7 For control conductors for motors and equipment, schedule and chart marker numbers with corresponding machine numbers and locations and include with Record Drawings and Operation and Maintenance Data.
- .8 Use colour coded wires in communication cables, matched throughout system. Schedule and chart, marker numbers and wire colours with corresponding equipment and include with Record Drawings and Operation and Maintenance Data.

3.4 Conduit and Cable Identification

- .1 Label;
 - .1 incoming service cables,
 - .2 bus ducts,
 - .3 feeder conduits/EMT,
 - .4 feeder cables,
 - .5 communications cables.
- .2 Locate labels as follows;
 - .1 at every end of every conduit, duct or cable run, adjacent to item of equipment serviced,
 - .2 on each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall, partition or floor),
 - .3 at intervals of not more than 15 m (50') along every exposed conduit, EMT, duct or cable run exceeding 23 m (75') in length,
 - .4 at every access point on concealed conduit, EMT, duct or cable runs,
 - .5 visible from 1.5 m (5') above adjacent floor or platform.

3.5 Fire Stopping Identification

- .1 Provide a warning card adjacent to each opening exceeding 25mm (1") in diameter, indicating the following;
 - .1 a warning that the opening is protected by a fire stopping material,
 - .2 the fire stop system used, ULC or cUL,
 - .3 F rating or FT rating,
 - .4 specific fire stop product(s) used,

- .5 name and telephone number of the contact person should any changes to the fire stopping be required.
- .2 Provide warning labels for each fire stopped penetration as follows;
 - .1 permanently attached to walls, floors, underside of slabs, adjacent to the penetration,
 - .2 on each side of the penetration,
 - .3 vinyl panel, white and red background with black lettering,
 - .4 self adhesive with permanent pressure sensitive adhesive,
 - .5 stating:

WARNING
THROUGH PENETRATION FIRESTOP SYSTEM - DO NOT DISTURB
NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE

3.6 Fire Alarm Diagrams

- .1 Provide at the fire alarm control panel and annunciator;
 - .1 a fire alarm riser diagram,
 - .2 plan diagrams showing fire alarm zoning.

END OF SECTION

WIRING DEVICES

26 27 26

1 GENERAL

1.1 Related Sections

- .1 Section 26 05 01 - Electrical Basic Materials & Methods.
- .2 Section 26 05 53 Identification for Electrical Systems.
- .3 Section 26 28 19 - Ground Fault Circuit Interrupters.

1.2 Submittals

- .1 Submit shop drawings for each type and size of device.

1.3 Applicable Codes and Standards

- .1 Latest version of CSA C22.2 No. 111-M1986 Switches.
- .2 Latest version of CSA C22.2 No. 42-M1984 Receptacles.

1.4 Scope

- .1 Provide labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

2 PRODUCTS

2.1 Nameplates

- .1 Wall mounted:
 - .1 engraved laminated plastic to Section 26 05 53 Identification for Electrical Systems,
 - .2 7 mm ($\frac{1}{4}$ ") high letters unless indicated otherwise.
- .2 Receptacle mounted:
 - .1 permanently printed on white polyester background,
 - .2 7 mm ($\frac{1}{4}$ ") high letters unless indicated otherwise,
 - .3 UV resistant inks,
 - .4 clear polyester over lamination,
 - .5 pressure sensitive adhesive.
- .3 Colours:
 - .1 normal power: black lettering on white background,
 - .2 emergency power: red lettering on a white background,
 - .3 "NOT FOR PATIENT CARE": white lettering on green background

2.2 Switches

.1 Features:

- .1 20 A, 120 V, general purpose AC type,
- .2 higher ratings where indicated,
- .3 CSA listed,
- .4 fully rated for tungsten filament and fluorescent lamps, and for inductive loads,
- .5 HP rated where used in motor circuits, with rating not less than the motor HP,
- .6 industrial/specification grade for toggle switches, commercial grade for Decora style switches,
- .7 Decora style in finished areas, toggle handle type in unfinished areas,
- .8 silent operation,
- .9 terminals rated for No. 10 AWG wire,
- .10 suitable for back and side wiring,
- .11 silver alloy contacts,
- .12 single pole, double pole, three-way, four-way switches as indicated.

.2 Toggle colours:

- .1 Normal power: ivory.
- .2 Normal power:
 - (a) ivory in finished areas,
 - (b) brown in unfinished areas.
- .3 Emergency power: clear. Switches on emergency power to have a lighted handle.

.3 Decora rocker colour: ivory

.4 Switches of one manufacturer throughout project, unless accepted otherwise.

Standard of Acceptance

- Pass & Seymour (Legrand)
- Hubbell
- Bryant Electric
- Cooper-Eaton Wiring Devices (Arrow Hart)
- Leviton

.5 Catalogue numbers listed below have been used for convenience only to indicate quality standards:

	Approved Catalogue Numbers	
	Hubbell(120 Volt) (Toggle) / (Decora)	Hubbell(347 Volt) (Toggle)
Single Pole	1221 / DS120	18201
Double Pole	1222 / DS220	-
Three-Way	1223 / DS320	18203
Four-Way	1224 / DS420	18204

- .6 Switches controlling lights on 120 volt emergency power circuits: lighted handle, light to be on when load is off, as follows:

Type	Approved Catalogue Numbers				
	Hubbell	Bryant	P & S	Cooper	Leviton
Single Pole (Toggle) (Decora)	1221-ILC	4901GL	20AC1-SL	AH1221LT	1221-LH
	DS120-IL	9901GL	2625	7631	5631-2
Three-Way (Toggle) (Decora)	1223-IL	4903GL	20AC3-SL	AH1223LT	1223-LH
	DS320-IL	9903GL	2626	7633	5633-2

- .7 Pilot light switches: red pilot light to be on when the load is on, as follows:

Type	Approved Catalogue Numbers				
	Hubbell	Bryant	P & S	Cooper	Leviton
Single Pole (Toggle) (Decora)	1221-PL	4901PLR	20AC1-RPL	AH1221PL	1221-PLR
	DS120-PL	9901PL	2629	7641	5628-2

- .8 Weatherproof switches:
- .1 equal to those above,
 - .2 complete with weatherproof box,
 - .3 with 'While-In-Use' weather protective cover.

Standard of Acceptance

- Pass & Seymour No. WIUC10

2.3 Dimmer Switches

- .1 Dimmers for 0-10V LED drivers and fluorescent ballasts:

Standard of Acceptance

- Lutron Diva DVSTV c/w stainless steel cover plate
- Colour:

- .2 Normal power: ivory
- .3 Emergency power: red.

2.4 Receptacles

- .1 Decora style in finished areas, standard style in unfinished areas.
- .2 Heavy duty industrial/specification grade.
- .3 Patient care areas: hospital grade.
- .4 Mental health areas and areas designed for children: tamper-resistant with tamper proof screws.
- .5 With the following features:

- .1 eight back wired entrances, four side wiring screws,
 - .2 suitable for no. 10 AWG for back and side wiring,
 - .3 break-off links for use as split receptacles,
 - .4 triple wipe contacts,
 - .5 riveted or integral ground contacts.
- .6 Colour coded as follows:
- .1 Normal power: ivory
 - .2 Emergency power: red
- .7 One manufacturer throughout the project.
- Standard of Acceptance*
- Pass & Seymour (Legrand)
 - Hubbell
 - Bryant Electric
 - Cooper-Eaton Wiring Devices (Arrow Hart)
 - Leviton
- .8 The receptacles listed below represent the most common configurations and are not necessarily used on this project. Refer to drawings for types used.
- .1 Duplex receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5262	5262	5262	5262	5262
(Hospital grade)	8200	8200	8200	8200	8200
Decora	26252	2152	9252	5280	6262
(Hospital grade)	26262HG	2172	9200	16262-HG	8262

- .2 Weatherproof:
- (a) 15 ampere, 120 volt as above,
 - (b) complete with weatherproof box,
 - (c) with 'While-In-Use' weather protective cover.

Standard of Acceptance

- Pass & Seymour No. WIUC10D

- .3 Isolated ground duplex receptacle: 15 ampere, 120 volt, CSA Configuration 5-15R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	IG5262	IG5262	5262IG	5262-IG	IG5262
Decora	IG26262	-	-	-	-
(Hospital grade)	IG26262HG	-	9200IG	16262-IG	IG8262

- .4 Transient voltage surge suppressor duplex decora receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Decora	5262-SP	HBL5262-SA	SP52-A	7280	5262-S
(Hospital grade)	8200-SP	HBL8262-SA	SP82-A	8280	8200-S

- .5 Twistlock receptacle: 15 ampere, 120 volt, grounded CSA Configuration L5-15R:

Standard of Acceptance

- Single: Hubbell/P&S/Bryant/Leviton/Cooper 4710
- Duplex: Hubbell/P&S/Bryant/Leviton/Cooper 4700

- .6 Tamper-Resistant duplex safety hospital grade receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	TR62H	8200-SG	8200-TR	8200-SG	TR 8200
Decora	TR26262HG	-	-	16262-SG	-

- .7 Single receptacle: 15 ampere, 208 volt, single phase, 3 wire grounded CSA Configuration 6-15R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5651	5661	5661	5661	5661
Decora	26661	-	-	-	6650

- .8 Duplex receptacle: 15 / 20 ampere, 120 volt, grounded CSA Configuration 5-20R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5362	5362	5352	5362	5362
(Hospital grade)	8300	8300	8300	8300	8300
Decora	26352	2162	9352	-	6362
(Hospital grade)	26362HG	2182	9300	16362-HG	8362

- .9 Twistlock receptacle: 20 ampere, 208 volt, 2 pole, 3 wire grounded CSA Configuration L6-20R:

Standard of Acceptance

- Pass & Seymour L620R
- Hubbell 2320
- Bryant 70620
- Cooper-Eaton CWL620R
- Leviton 2320

- .10 Single receptacle: 20 ampere, 208 volt, single phase, 3 wire grounded CSA Configuration 6-20R:

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5851	5461	5461	5461	5461
Decora	26861	-	-	-	6450

- .11 Single twistlock receptacle: 20 ampere, 208 volt, three phase, 4 wire grounded CSA Configuration L15-20R:

Standard of Acceptance

- Pass & Seymour L1520R
- Hubbell 2420
- Bryant 71520
- Cooper-Eaton CWL1520R
- Leviton 2420

- .12 Single twistlock receptacle: 20 ampere, 120/ 208 volt, three phase, 5 wire grounded CSA Configuration L21-20R:

Standard of Acceptance

- Pass & Seymour L2120R
- Hubbell 2510
- Bryant 72120
- Cooper-Eaton CWL2120R
- Leviton 2510

- .13 Single receptacle: 30 ampere, 120 volt, single phase, 3 wire grounded CSA Configuration 5-30R:

Standard of Acceptance

- Pass & Seymour 3802
- Hubbell 9308
- Bryant 9530-FR
- Cooper-Eaton 5716N
- Leviton 5371

.14 Single twistlock receptacle: 30 ampere, 208 volt, 2 pole, 3 wire grounded CSA Configuration L6-30R:

Standard of Acceptance

- Pass & Seymour L630R
- Hubbell 2620
- Bryant 9630R
- Cooper-Eaton CWL630R
- Leviton 2620

.15 Single twistlock receptacle: 30 ampere, 208 volt, three phase, 4 wire grounded CSA Configuration L15-30R:

Standard of Acceptance

- Pass & Seymour L1530R
- Hubbell 2720
- Bryant 8430FR
- Cooper-Eaton CWL1530R
- Leviton 2720

.16 Single receptacle: 30 ampere, 208 volt, single phase, 3 wire grounded CSA Configuration 6-30R:

Standard of Acceptance

- Pass & Seymour 3801
- Hubbell 9330
- Leviton 5372
- Cooper 5700N
- Bryant 9630FR

.17 Single receptacle: 50 ampere, 208 volt, single phase, 3 wire grounded CSA Configuration 6-50R:

Standard of Acceptance

- Pass & Seymour 3804
- Hubbell 9367
- Bryant 9650FR
- Cooper-Eaton 5709N
- Leviton 5374

.18 Single receptacle: 50 ampere, 208 volt, three phase, 4 wire grounded CSA Configuration 15-50R:

Standard of Acceptance

- Pass & Seymour 5750
- Hubbell 8450A
- Bryant 8450FR
- Cooper-Eaton 8450N
- Leviton 8450

.19 Single receptacle: 60 ampere, 208 volt, three phase, 4 wire grounded CSA Configuration 15-60R:

Standard of Acceptance

- Pass & Seymour 5760

- Hubbell 8460A
- Bryant 8460FR
- Cooper-Eaton 8460N
- Leviton 8460

2.5 Cover Plates

- .1 Compatible with wiring device.
- .2 Stainless steel 18-8 chrome metal alloy, Type 302, vertically brushed, 1 mm (1/32") thick cover plates for wiring devices in flush-mounted outlet boxes.
- .3 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 Engraving, where indicated:
 - .1 6 mm (1/4") high letters filled with red paint,
 - .2 parallel to finished floor level.
- .5 One manufacturer throughout the project.

Standard of Acceptance

- Pass & Seymour #93000 Series
- Harvey Hubbell of Canada Ltd. #93000 Series
- Bryant Electric #S600 Series
- Leviton #84000 Series
- Cooper #93000 Series

2.6 Ground Fault Circuit Interrupters (GFCI's)

- .1 CSA approved Type A.
- .2 Complete with suitable outlet box.
- .3 15A grounded duplex Decora receptacle type 5-15R.
- .4 15A/20A grounded duplex Decora receptacle type 5-20R where indicated.
- .5 Auto-monitoring (self-test), manual test feature and reset switch.
- .6 Units to include current transformer and sensing mechanism.
- .7 GFCI's in patient care areas: hospital grade.
- .8 Unless noted otherwise, unit to trip at 6 mA.
- .9 No power at device face if reversed wired.
- .10 Colour coded as follows:
 - .1 Normal power: ivory
 - .2 Emergency power: red

- .11 Where shown in outdoor locations, units to be enclosed in "While-In-Use" weatherproof surface-mounted enclosures. In other locations units to be furnished with stainless steel cover plate.

Standard of Acceptance

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
15A: Decora (Hospital grade)	1597 1597HG	GFST15 GFR8200HST	GFRST15 GFST82	7599 N7599-H	SGF15 SGFH15
15/20A: Decora (Hospital grade)	2097 2097HG	GFST20 GFR8300HST	GFRST20 GFST83	7899 N7899-H	SGF20 SGFH20

3 EXECUTION

3.1 Identification

- .1 Label receptacles with circuit identification using a lamacoid label with colour coding for normal, emergency and UPS source with label attached to the receptacle.
- .2 Label receptacles in patient care areas in accordance with the latest version of CSA standard Z32:
 - .1 lamacoid label secured to the wall above the receptacle,
 - .2 engraved with the panel name and circuit number from which the receptacle is fed,
 - .3 lettering not less than 6 mm (1/4") high,
 - .4 normal power: black lettering on white lamacoid,
 - .5 emergency power: red lettering on a white lamacoid.
 - .6 Provide an additional lamacoid, of matching colour, for receptacles on dedicated circuits, stating: "Dedicated Circuit".
 - .7 Identify receptacles, located within a patient care area but not intended for patient care use, with a nameplate stating "NOT FOR PATIENT CARE".
- .3 Label pilot light switches:
 - .1 lamacoid label secured to the wall above the switch,
 - .2 engraved with the name of the load controlled,
 - .3 black lettering on white background.

3.2 Installation

- .1 Switches
 - .1 Mount switches vertically so that the switch contacts are closed when the toggle is up or, in the case of Decora switches, when the top part of the rocker is depressed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.

- .3 Provide separate boxes where switches are supplied from different power systems (normal and emergency).
- .4 Mount switches at heights specified in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.
- .5 Verify the door swing and ensure easy access before installing switches.
- .6 Switches installed adjacent to dimmers: provide switches that match appearance of dimmers.
- .7 Pilot light switches: run a neutral conductor to the switch.
- .2 Dimmers
 - .1 Where more than one dimmer is shown in the same location, mount dimmers in individual backboxes.
 - .2 Where remote dimmers are utilized, install associated components in accordance with the manufacturer's recommendations.
- .3 Receptacles
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Provide separate boxes where receptacles are supplied from different power systems (normal and emergency).
 - .3 Mount receptacles at heights specified in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.
 - .4 For each type of receptacle 20 ampere or larger, supply and hand to Owner two heavy duty caps.
 - .5 Connect receptacle grounding terminal to the outlet box with an insulated green bonding conductor.
 - .6 Verify exact position of service fittings to suit furniture layout.
 - .7 Do not mount receptacles directly on a column, unless column has been appropriately furred, to avoid breaking fire barrier.
 - .8 Mental health areas: install using tamper proof screws.
 - .9 Where equipment is located on a rooftop provide receptacle(s) for maintenance purposes:
 - (a) 15/20A weather resistant GFCI receptacle, type 5-20R,
 - (b) weatherproof housing,
 - (c) located within 7.5 m of the equipment,
 - (d) mounted at least 750mm above the finished roof,
 - (e) supplied from a dedicated circuit,
 - (f) provide additional receptacles as required so that a receptacle is located within 7.5 m of each item of equipment.
- .4 Cover Plates
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .5 Install explosion proof wiring and devices in hazardous locations of Class, Division and Group as indicated on Drawings.

- .6 Ground fault circuit interrupters:
 - .1 Mount receptacles at height indicated in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.
 - .2 Do not connect GFCI receptacles to provide protection to downstream receptacles, unless indicated otherwise.
- .7 Outlets in Movable Partitions
 - .1 Co-ordinate installation of outlet boxes and conduits with the particular trade involved.

3.3 Testing

- .1 Verify the operation of illuminated handles in switches.
- .2 Verify the operation of lights on pilot light switches.
- .3 Test each receptacle for correct polarity and ground continuity.
- .4 For receptacles in patient care areas, provide the testing per Section 26 08 13 Testing of Hospital Wiring.
- .5 Test the manual trip and reset functions of each GFCI.

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V

26 27 28

1 GENERAL

1.1 Applicable Codes and Standards

- .1 Latest version of CSA C22.2 No.65 Wire Connectors.
- .2 Latest version of CSA C22.2 No.188 Splicing Wire Connectors.

2 PRODUCTS

2.1 Materials

- .1 Mechanical pressure type wire connectors:
 - .1 for copper conductors: current carrying parts of copper or tin plated aluminum,
 - .2 for aluminum conductors: current carrying parts of aluminum.

Standard of Acceptance

- Burndy
- IlSCO
- Thomas & Betts

- .2 Compression type pressure wire connectors:
 - .1 long barrel
 - .2 tin plated copper for copper conductors
 - .3 aluminum for aluminum conductors

Standard of Acceptance

- Burndy
- IlSCO
- Thomas & Betts

- .3 Twist on wire connectors:
 - .1 for copper wire up to and including #6 AWG,
 - .2 "live" spring construction,
 - .3 corrosion resistant spring,
 - .4 square wire spring construction,
 - .5 polypropylene cap rated for 105°C

Standard of Acceptance

- T&B Murette
- Ideal
- 3M

- .6 For damp, wet, outdoor and submersible locations: filled with silicone gel.
- .4 Fixture type splicing connectors:
 - .1 current carrying parts of copper,

- .2 sized to fit copper conductors 10 AWG or less,
- .3 temperature rating of not less than 105°C

Standard of Acceptance

- Burndy
- Hubbell
- Thomas & Betts

3 EXECUTION

3.1 Installation

- .1 Provide connectors in accordance with the manufacturer's recommendation for the size, quantity and type of wires.
- .2 Install connectors in accordance with the manufacturer's recommendations.
- .3 Remove insulation carefully from ends of conductors:
 - .1 where the conductor is damaged, remove the damaged portion and strip the insulation back further as necessary,
 - .2 where the conductor is too short, replace the conductor.
- .4 For aluminum conductors, clean the conductors and immediately coat with electrical joint compound.
- .5 Tighten screws of mechanical pressure type connectors in accordance with the manufacturer's recommendations. Installation to meet secureness tests in accordance with CSA C22.2 No.65.
- .6 Install compression type connectors using the appropriate compression tool and die as recommended by the manufacturer. Make two crimps on each wire. Installation to meet secureness tests in accordance with CSA C22.2 No.65.
- .7 Remove all traces of electrical joint compound after each connection has been made.
- .8 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

Lighting

LIGHTING
26 51 13

1 GENERAL

1.1 General Requirements

- .1 Conform to the requirements of Section 26 05 01 Electrical General Requirements.

1.2 Work Included

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

1.3 Shop Drawings and Product Data

- .1 Submit shop drawings in accordance with Section 26 05 01 Electrical General Requirements - Shop Drawings and Product Data.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.
- .3 Photometric data to include:
 - .1 Total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures.

1.4 Requirements

- .1 Luminaires shall not be delivered to building or stored therein until dry and protected space is available for proper storage of luminaires.
- .2 Submit samples of luminaires which are not catalogue items for approval. Additional luminaires shall not be manufactured until sample has been approved. Each approved sample shall be retained on job site until final completion of project. Luminaires which do not match quality and workmanship of standard sample will be rejected.
- .3 Finishes of luminaires, as specified in the "Luminaire List" must be maintained. Where the description of the luminaire directs a "colour/ finish to suit Architect" it is to be understood that during construction the final colour/finish will be selected. The Architect must be permitted to make their choice from a standard colour/finish range but the selected colour will apply to all of the particular type of luminaire unless otherwise specified.
- .4 "Allowances" when shown, are in Canadian dollars and cover the cost of the lighting luminaires and lamps. Allowances do not include applicable taxes, delivery to the site, handling, installation, overhead or profit.

Lighting

1.5 Substitutions

- .1 Luminaires included under this Section are specified by approved manufacturer and type. Furnish equipment, as specified, unless substitutions are mutually agreed upon, as follows:
 - .1 During the construction period, no substitutions shall be considered unless compelling reasons are given such as inability to meet delivery schedule. This reason shall not be acceptable if delay is caused by Contractor's failure to order luminaires in accordance with the schedule. In such cases, it is the Contractor's responsibility to provide luminaires as specified without delay to the project and without additional cost to the Owner.
 - .2 Substitutions shall be named, samples, catalogue cuts and complete photometric reports submitted, and cost savings documented. Submit a written request for proposed luminaires to be substituted to Engineer at least two weeks before the end of the bid period. Make the request an alternate, separate proposal, accompanied by complete descriptive and technical data. Indicate addition or deduction from the base bid. Substitutions proposed less than two weeks before the end of the bid period, or not including proper documentation shall not be considered. Engineer shall accept or reject proposed substitutions.
 - .3 Where proposed substitutions alter functional or visual design, or change the space requirements or mounting details indicated here or on the drawings, detail such changes in the proposal and include costs for revised design and construction for trades involved.
 - .4 Reimburse Engineer and his/her consultants for costs of evaluating proposed substitutions, after the bid period, whether or not such substitutions are accepted.

2 PRODUCTS

2.1 General

- .1 Similar luminaires shall be products of same manufacturer.
- .2 Luminaires shall be suitable for individual or continuous mounting.
- .3 Supply recessed luminaires, where installed in plaster or in acoustic ceilings, complete with plaster trim frame or ring and mounting brackets.
- .4 Fluorescent troffers in ceiling shall be equipped with adjustable mounting brackets.
- .5 Luminaires shall be completely assembled in factory and shall be delivered to building in cartons or in palletized form, as directed.

2.2 Ballasts

- .1 Energy Saving "T-8" Electronic Rapid Start Fluorescent Ballasts
 - .1 Certified in an accredited laboratory
 - .2 Rating: 120v, 60 Hz, designed for use with T-8 rapid start lamps.
 - .3 Ballasts case temperature shall not exceed 70°C
 - .4 Ballast factor 0.88 minimum or as specified.
 - .5 Sound rated: A. Frequency >20 kHz
 - .6 Lamp current crest factor (L.C.C.F): 1.7 maximum
 - .7 Capacitor: non PCB

Lighting

- .8 Total harmonic distortion (T.H.D): less than 10%.
- .9 Withstands line transients as defined in ANSI C62.41, Category A.
- .10 Power factor of 90% or above.
- .11 Ballast shall meet requirements of FCC Rules and Regulations, Part 18 and meet the FCC Regulations for Radio Frequency Interference (RFI) or Electro-magnetic Interference (EMI).
- .12 Suitable for 1220mm (4'-0") or 915mm (3'-0") T-8 rapid start lamps.
- .13 Warranty: 5 years

Standard of Acceptance

- Advance - Rapid Start
- Universal - HP Series Rapid Start
- Ultrasave - SR Series/Programmed - Rapid Start/PR Series - Rapid Start
- Osram Sylvania - Rapid Start T-8

- .2 Energy Saving Instant Start T8 Electronic Fluorescent Ballasts (Total watts for two 28 watt T8, 1220mm (4'-0") lamps - 48 watts)
 - .1 Rating: 120v, 60 Hz
 - .2 Ballast factor: 88 minimum
 - .3 Sound ratings: A. Frequency >20 kHz (not including 30 to 40 kHz range) or (>40 kHz range)
 - .4 Lamp current crest factors: 1.7 maximum
 - .5 Capacitor: non PCB
 - .6 Total harmonic distortion: less than 10%
 - .7 Line transients: ANSI C62.41, Category 'A'
 - .8 Power factor: +90%
 - .9 FCC regulations for (RFI) and (EMI): Part 18. Non-consumer.
 - .10 Anti-stirration circuit if required.
 - .11 Warranty: 5 year

Standard of Acceptance

- Advance "Optanium"
- Osram Sylvania "Quicktronic-High Efficiency - QHE
- Universal "Triad Ultim"
- Ultrasave - "UT" Series

- .12 Note: Cannot be dimmed.
- .3 Energy Saving Instant Start T8 Electronic Fluorescent Ballasts 915mm (3'-0") 25 watt lamps)
 - .1 Rating: [120v][347v], 60 Hz
 - .2 Ballast factor: 88 minimum
 - .3 Sound ratings: A. Frequency >20 kHz (not including 30 to 40 kHz range) or (>40 kHz range)
 - .4 Lamp current crest factors: 1.7 maximum
 - .5 Capacitor: non PCB
 - .6 Total harmonic distortion: less than 15%
 - .7 Line transients: ANSI C62.41, Category 'A'

Lighting

- .8 Power factor: +90%
- .9 FCC regulations for (RFI) and (EMI): Part 18. Non-consumer.
- .10 Warranty: 5 year

Standard of Acceptance

- Advance "Centium"
- Osram Sylvania "Quicktronic-Professional Series"
- Ultrasave
- Universal "RH Series"

.4 Energy Saving "T5" Electronic Rapid Start Fluorescent Ballasts:

- .1 Certified in an accredited laboratory
- .2 Rating: 120v, 60 Hz, designed for use with T-5 rapid start lamps.
- .3 Ballasts case temperature shall not exceed 70°C
- .4 Sound rated: A.
- .5 Lamp current crest factor (L.C.C.F.): 1.7 maximum.
- .6 The ballast shall not contain PCB's.
- .7 Total harmonic distortion (T.H.D.): less than 10%.
- .8 Withstands line transients as defined in ANSI C62.41, Category A.
- .9 Power factor of 90% or above.
- .10 Ballast shall meet requirements of FCC Rules and Regulations, Part 18 and meet the FCC Regulations for Radio Frequency Interference (RFI) or Electro-magnetic Interference (EMI).
- .11 Ballast factor 1.0
- .12 Suitable for 610mm (2'-0") T-5 rapid start lamps.
- .13 Must have a circuit for end of lamp life protection.
- .14 Warranty: 5 years.

Standard of Acceptance

- Advance - Rapid Start (Programmed Start)
- Universal - HP Series Rapid Start (Programmed Start)
- Ultrasave - ER Series/SR Series (Programmed Start)
- Osram Sylvania - Rapid Start (Programmed Start)

.5 Energy Saving "T5" HO Electronic Rapid Start Fluorescent Ballasts:

- .1 Certified in an accredited laboratory
- .2 Rating: 120v, 50/60 Hz, designed for use with T-5 HO rapid start lamps.
- .3 The ballast output frequency to the lamps shall be above 40 kHz to minimize interference with infrared control systems and eliminate visible flicker.
- .4 Sound rated: A.
- .5 Lamp current crest factor (L.C.C.F.): 1.7 maximum.
- .6 The ballast shall not contain PCB's.
- .7 Total harmonic distortion (T.H.D.): less than 10% when used with primary lamp.
- .8 Withstands line transients as defined in ANSI C62.41, Location Category A3.

Lighting

- .9 Power factor greater than 98%.
- .10 Ballast shall meet requirements of FCC Rules and Regulations, Title 47 CFR Part 18 and meet the FCC Regulations for Radio Frequency Interference (RFI) or Electro-magnetic Interference (EMI).
- .11 Ballast factor: 1.0 when used with primary lamp.
- .12 Ballast shall withstand a sustained short to ground or open circuit of any output loads.
- .13 Ballast must have an end-of-life lamp shutdown circuit.
- .14 Warranty: 5 years.

Standard of Acceptance

- Advance - Rapid Start (Programmed Start)
- Universal - Rapid Start (Programmed Start)
- Ultrasave - ER Series (Programmed Start)
- Osram Sylvania - Rapid Start (Programmed Start)

.6 Compact Fluorescent Ballasts:

- .1 Power Factor: .95 min.
- .2 Ballast Factor: .95 min.
- .3 Total Harmonic Distortion: less than 10%
- .4 Sound Rating: "A"
- .5 Lamp Flicker: None visible
- .6 Frequency of Operation: greater than 20 KHz/not between 30 to 42 KHz
- .7 Min. Starting Temp.: 10°C
- .8 Note: Must have circuit for end of lamp life protection.

Standard of Acceptance

- Advance
- ESI
- Universal
- Osram/Sylvania
- Ultrasave UR Series and CFL Series

.7 T8 Linear / T5 HO / U-Bent Fluorescent Dimming Ballasts:

- .1 Power Factor: .95 min.
- .2 Ballast Factor: .85 min.
- .3 Total Harmonic Distortion: less than 10%
- .4 Sound Rating: "A"
- .5 Lamp Flicker: None visible
- .6 Frequency of Operation: 25 KHz
- .7 Inrush Current: 10X operating current maximum
- .8 Fusing: Internal
- .9 Min. Starting Temp.: 10°C
- .10 Max. Case Temp.: 75°C

Lighting

- .11 Notes: New fluorescent lamps shall be operated for 100 hours at full output ("seasoned") to accept proper dimming performance and average rated lamp life.

Standard of Acceptance

- Lutron - "Hi-Lume"

.8 Compact Fluorescent Dimming Ballasts:

- .1 Power Factor: .95 min.
- .2 Ballast Factor: .85 min.
- .3 Total Harmonic Distortion: less than 10%
- .4 Sound Rating: "A"
- .5 Lamp Flicker: None visible
- .6 Frequency of Operation: 42 KHz
- .7 Inrush Current: 10X operating current maximum
- .8 Fusing: Internal
- .9 Min. Starting Temp.: 10°C
- .10 Max. Case Temp.: 75°C
- .11 Note: New fluorescent lamps shall be operated for 100 hours at full output ("seasoned") to accept proper dimming performance and average rated lamp life.

Standard of Acceptance

- Lutron - "ECOSYSTEM"

.9 Pulse-Start Metal Halide Ballasts:

- .1 Rating: Rated voltage matching the supply voltage indicated, 60 Hz for use with pulse-start metal halide lamps.
- .2 Minimum Ballast Factor (B.F.): 1.0.
- .3 Power factor: minimum 90%.
- .4 Type: regulated output to appropriate ANSI specification, to maintain correct lamp operation over a voltage input rating of $\pm 10\%$.
- .5 Capacitor: non PCB dry film capacitor for circuitry as per ANSI.
- .6 Minimum starting temperature: -31°F (-35°C) at 90% of line voltage.
- .7 Mounting: integral with luminaire as noted.
- .8 Crest factor: maximum 1.8.
- .9 Lamp and ballast combination must be compatible.**
- .10 Warranty: 2 years.

Standard of Acceptance

- Advance
- Universal
- Osram/Sylvania

2.3 Lamps

- .1 T-8 Fluorescent lamps

Lighting

- .1 Fluorescent lamps shall be rapid start 32 watt 1220mm (4'-0") T-8 Bipin with 3000 initial lumens or 25 watt 915mm (3'-0") T-8 Bipin with 2270 initial lumens, 3500°K with a CRI of 85 or better. Lamps shall be of lengths specified in the luminaire schedule. Verify colour of lamps before ordering.
- .2 Lamp life to be 24,000 + hours (minimum).
- .3 Warranty: 3 years.

Standard of Acceptance

- General Electric "Star Coat SXL Ecolux"
- Osram/Sylvania "Octron XP Ecologic"
- Philips "Alto - Plus"

.2 T-8 Fluorescent lamps (Energy Saving)

- .1 Fluorescent lamps shall be 28 watt 1220mm (4'-0") T-8 Bipin with 2725 initial lumens or 25 watt 915mm (3'-0") T-8 Bipin with 2175 initial lumens, [3000°K][3500EK][4000°K] with a CRI of 85 or better. Lamps shall be of lengths specified in the luminaire schedule.
- .2 Lamp life to be 26,000 + hours average (12 hr start).
- .3 Warranty: 3 years.

Standard of Acceptance

- General Electric "T8 Ultra F28T8 - Ultra Max."/SPX Series" (3'-0")
- Osram/Sylvania "Octron F028XP"/F025XP/EC (3'-0")
- Philips "Alto - Plus"

.3 T-5 Fluorescent lamps

- .1 Fluorescent lamps shall be rapid start 610mm (2'-0") 40 watt twin tube T-5 four pin with 3150 initial lumens, 4100°K with a CRI of 85 or better. Lamps shall be of lengths specified in the luminaire schedule.
- .2 Lamp life to be 20,000 + hours (minimum).
- .3 Warranty: 2 years.

.4 Compact Fluorescent lamps

- .1 Rapid start miniature single ended fluorescent lamp with four pin for electronic ballast.
- .2 The lamp shall have a high colour rendering index of 82+ with a Kelvin temperature of 3500°K. Verify colour of lamps before ordering.
- .3 Lamp life to be 10,000 hours.

.5 Incandescent lamps

- .1 Incandescent lamps shall be inside frosted, 130 volt, 2500 hours extended service type.
- .2 All line voltage Halogen Par lamps shall be diode-free, 130 volt, with a minimum lamp life of 2000 hours.
- .3 All 50 watt low voltage 12 volt MR-16 lamps shall be the "Constant Colour" or "Tru-Aim IR" variety and have a minimum lamp life of **6,000 hours** unless otherwise specified.

.6 HID Lamps

- .1 HID lamps shall be of the wattage rating indicated.
- .2 Unless otherwise indicated H.I.D lamps shall be of the coated type.

Lighting

.3 All Metal Halide lamps shall be of the same manufacturer and the same production batch.

.4 When using pulse start lamps, lamp and ballast combination must meet ANSI specifications.

Standard of Acceptance

- General Electric "Ceramic-CMH"
- Osram/Sylvania "Power Ball"
- Philips Electronics Ltd. "Mastercolour"

.7 Light Emitting Diodes (Accent/Decorative)

.1 40 to 50 lumens per watt (6500°K)

.2 30 to 40 lumens per watt (4100°K)

.3 1.2 or 3 watts per LED

.4 Bin number requirements for colour temperature consistency

.5 Maximum temperature at the base of the "LED cap" mounted to the sub-strate shall be controlled to ensure full lamp life.

.6 Warranty: 5 years

Standard of Acceptance - Driver Acceptance

- Advance
- Lite Tech
- Primo (China)
- VLM (Italy)
- Lumi-Drives (UK)
- Osram

Standard of Acceptance - Lamp Acceptance:

- Cree
- Lumileds
- Nichia
- Osram

.8 Spare Lamps

.1 Provide spare lamps of **EACH** type as follows:

- (a) Incandescent - 15%
- (b) Fluorescent & HID - 5%

2.4 Fluorescent Lens

.1 Fluorescent K12 distribution acrylic lenses. 3.2mm (125") thick, shall have a recessed prismatic pattern of 5mm (3/16") square based female cones running 45 degree to the parallel and perpendicular axis to the panel. Panel shall be made of ultraviolet inhibited injection moulded clear virgin acrylic.

.2 Panels shall be strain-free and uniform in production. There shall be no fade-outs or streaks to detract from job performance.

.3 Lenses shall be low brightness, sparkling crystal panel that provides maximum efficiency and good brightness control in the direct glare zone.

Lighting

Standard of Acceptance

- A.L.P. Lighting and Ceiling Products
- I.C.I. Acrylics Canada Inc.
- Holophane Canada Inc.

3 EXECUTION

3.1 Installation

- .1 Locate and install luminaires as indicated.
- .2 Locate hangers on tile centres or intersections. Mount recessed incandescents, troffers and surface mounted luminaires in or on full tiles.
- .3 Verify quantity of luminaires before placing orders.
- .4 Verify ceiling types with the latest revised Architectural Drawings and order luminaires to suit the correct ceiling.
- .5 Check lighting luminaires and mountings for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Make necessary adjustments to luminaires or hanging arrangement without expense to Owners. Give notification at time of shop drawings and before construction if decision on necessary changes is required.
- .6 Co-operate with other trades to ensure proper installation of lighting luminaires.
- .7 Carefully align luminaires, shown in continuous lines or rows, so that rows appear as straight lines.
- .8 Mount luminaires perfectly level or plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling.
- .9 Take down any improperly installed luminaires and re-install without expense to Owner.
- .10 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.
- .11 Attach boxes or hickies directly to poured concrete with 6mm (1/4") minimum diameter bolts and lead expansion anchors where luminaires are suspended directly from concrete slabs. Use 8mm (5/16") minimum bolts through precast slabs, welded to 100mm x 100mm (4" x 4") minimum, 3.5mm (10 gauge) plate above slabs.
- .12 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan co-operatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown
- .13 All luminaires mounted in or on ceilings shall be supported independently of ceiling by means of chains.
- .14 Provide continuous 12mm x 38mm (1/2" x 1 1/2") channel above the ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6mm (1/4") minimum diameter studs with minimum 1220mm (4'- 0") on centre.

Lighting

- .15 Luminaires installed in or on "T" bar ceilings shall be equipped with safety chains anchored in an approved manner to the floor slab or roof structure above. Fluorescent luminaires shall have two chains, each supporting two corners of the luminaire. Chain shall be #10 Tensile jack chain, installed as noted below.
- .16 Chain shall be No. 10 Tensile jack chain, bright zinc coated, with a strength of 180 kg (400 lbs.) where luminaires are indicated to be chain hung. Attachments shall be made using a No. 10 "S" hook. Caddy fasteners may be used where applicable. "S" hooks must be closed after installation.
- .17 Industrial luminaires where suspended shall be 12mm (½") conduit hangers and ARB ball aligners. Length and location shall clear equipment, ducts and pipes. Metal strut (Flexibar or equal) may be used for mounting of luminaires in mechanical areas and electrical rooms.

3.2 Luminaires

- .1 Provide luminaires exactly as shown and as specified in the following schedule. Luminaires shall be complete with necessary accessories and lamps at time of acceptance.
- .2 All luminaires shall be ULC or CSA certified.
- .3 Each fluorescent luminaire installed on branch circuits with voltage exceeding 150 volts-to-ground shall be provided with a disconnecting means integral to the luminaire that simultaneously opens all circuit conductors between the branch circuit conductors and the supplying ballast(s) and marked in a conspicuous, legible and permanent, manner adjacent to the disconnecting means, identifying the specific purpose in accordance with the Canadian Electrical Code Part 1 Rule 30-308(4).

Lighting

3.3 Luminaire List

.1 Luminaire manufacturers are listed in alphabetical order and not in order of preference.

Title	Description	Lamp Schedule
UV	Wall mounted ultraviolet disinfection unit. Unit is approximately 42.43" length x 13.45" width x 4.57" height. The Unit provides fully automatic fixed UVC Disinfection System utilizes smart sensor technology designed to disinfect patient bathrooms or equipment rooms after every use. Note: this luminaire needs to be assembled on site and requires suitable wall mounting components. The Luminaire is supplied complete with the Luminaire Unit and a removable cover. Contractor shall supply: - Two ultraviolet lamps and shall be installed using cotton gloves when handling the lamps - Two Motion Sensing Detectors which shall be supplied and must be installed as the Luminaire is assembled - Remote Magnetic Contact that needs to be installed on/ at the room door and wired to the control circuit. - Unit shall be fully programmable by the hospital Refer to drawings for wiring details. Unit shall be wet location listed. Voltage: 120 volt Manufacturers: Class 1: ASEPTIX.1X	193 W
LD1	4" round lensed LED down light. Unit is approximately 14.56" length x 14.36" width x 4.97" height. Luminaire housing in durable steel, wet located IP65 rated. Luminaire will have white trim with a acrylic, micro-prism lens. Luminaire to be installed in drywall. Luminaire to be complete with all necessary mounting brackets, corner fittings, etc. for a complete working installation. - Rated life shall be 55,000 hrs - Warranty: 5 Years and meet L70, IES LM-80 and IES LM-79 testing. Voltage: 120 volt <i>Manufacturer:</i> Prescolite Lighting: LTR-4RD-H-SL10L-LTR-4RD-T-SHSL35K9-WTAML Genlyte Cooper Lighting	12W LED 1,000 lumen package 90+ CRI 3500 K

Lighting

Title	Description	Lamp Schedule
LR1	Wall mounted LED vanity luminaire. Nominal dimensions of 2.5" width x 24" length x 2.5" height. Luminaire housing in extruded aluminium and extruded acrylic lenses and aluminum end cap. Damp Location rated. Luminaire to be mounted over vanity mirror. Refer to architectural drawings for mounting height. Luminaire to come complete with all necessary mounting accessories for a complete working installation. LED colour temperature shall be 3500K. Voltage: 120V <i>Manufacturer:</i> Axis Lighting: ED2WD-250DIRECT-90-35-2-AP-120V-1-FL Or Approved equal.	7W per ft LED 250 lumen per ft 90+ CRI 3500 K

END OF SECTION

CLOSEOUT REQUIREMENTS FOR ELECTRICAL WORK 26 77 19.20

1 GENERAL

1.1 Scope

- .1 Provide documentation deliverables at completion of the Work for the following milestone events:
 - .1 Occupancy permit (where applicable) (Form OP1E),
 - .2 Substantial Performance of the Work (Form SP1E),
 - .3 Ready for take-over by Owner (Form RFT1E),
 - .4 Total Performance of the Work (Form TP1E).

1.2 Definitions

- .1 The following definitions apply to this section.
 - .1 **Occupancy permit** – means either: (i) a permit issued by a regulatory authority to allow the Owner to occupy the building subject to the building permit, or (ii) a building permit close-out procedure where documentation must be submitted to the building authority for that purpose.

1.3 General

- .1 The prerequisites and submittal of supporting documentation for the aforementioned milestone events may be combined as a single submission at one point in time for the following combination of events:
 - .1 Occupancy Permit, and Substantial Performance.
- .2 Where a prerequisite is listed in more than one milestone event, it shall be included in the earliest-occurring milestone event unless expressly specified otherwise.

1.4 Occupancy Permit

- .1 Submit the reviewed final record of the Testing of Integrated Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit, where such a report is required.
- .2 Complete the Occupancy Permit Checklist and submit with required documentation to support the Owner's application for occupancy.

1.5 Substantial Performance

- .1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.
- .2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.
- .3 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.6 Ready-for-Takeover by Owner

- .1 The basic prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions and Supplementary General Conditions of the Contract.
- .2 Complete the Ready-for-Takeover Checklist and submit with required documentation when applying for Ready-For Takeover of the Work.

1.7 Total Performance

- .1 Complete the Total Performance Checklist and submit with required documentation when applying for Total Performance of the Work.

Form OP1E: OCCUPANCY PERMIT CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Building department inspection reports.
- ☐ AHJ electrical systems inspection reports.
- ☐ Fire Alarm Installation and Verification certificate to CAN/ULC-S524,
- ☐ Independent testing company, coordination study and testing reports submitted.
- ☐ Integrated Fire Protection and Life Safety test report to ULC-S1001.
- ☐ Equipment start-up reports (Interim).
- ☐ Electrical system testing reports.

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

Form SP1E: SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Occupancy permit has been issued by the AHJ (where applicable).
- ☐ Systems have been started-up, tested, and demonstrated to Owner or Consultant (final)
- ☐ Equipment and wiring identification completed
- ☐ Spare parts and replacement parts turned over to Owner, transmittal attached.

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

Form RFT1E: READY-FOR-TAKEOVER APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Substantial Performance has been certified or verified.
- ☐ Occupancy permit has been issued by the AHJ (where applicable).
- ☐ Final cleaning and waste removal completed.
- ☐ Delivery to Owner of Operating and Maintenance documents for systems being taken-over by Owner.
- ☐ Submit copies of up-to-date as-built drawings.
- ☐ Final start-up, testing and balancing reports completed and submitted to Owner, including any items requiring corrections identified by Consultant.
- ☐ The portions of the building being turned over to the Owner can be secured by Owner.
- ☐ Demonstration and training are completed, or Contractor and Owner has agreed to a schedule to provide such training to be completed within one month after the date of Ready-for-Takeover.
- ☐ All commissioning activities except for those activities that are identified or otherwise agreed by the Owner to be deferred commission activities which may be completed after Ready-for-Takeover of the Work.
- ☐ Integrated systems testing of fire protection and life safety systems.
- ☐ All warranties have been submitted to the Owner.
- ☐ A comprehensive list of items to be completed or corrected is provided to Owner and Consultant and included in the application for Ready-for-Takeover, and includes a schedule of when such work will be completed.

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

Form TP1M: TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ All final Operating and Maintenance documents have been delivered to Owner.
- ☐ All final up-to-date as-built drawings have been delivered to Owner.
- ☐ All demonstration and training are completed.
- ☐ All commissioning activities are completed, including deferred alternate season commissioning activities.
- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ All inspections and tests required to be performed by Contractor or manufacturer's prior to expiry of the warranty period have been completed, and documentation for those inspections and tests are included in this application.

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

End of Section