

PART 1 - GENERAL

1.1 GENERAL

- .1 All conditions included in Section 26 05 01, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000V.
- .2 Nova Scotia Building Code Regulations – Building Code Act – 2010.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .4 National Electrical Manufacturers Association (NEMA).
- .5 These standards together with all Local or Municipal Rules, Regulations, and Ordinances shall be considered as the Latest Approved Editions at the time of Tender Closing. In no instance, shall the standard established by the drawings and specifications, be reduced by any codes.

1.3 PERMITS AND FEES

- .1 The Contractor shall obtain all inspections and permits required by all laws, ordinances, rules, and regulations by public authority having jurisdiction in this district, and shall obtain certificates of such inspections and submit same and shall pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due. In no instance shall the standard established by the drawings and specification be reduced by any codes.

1.4 DEFINITIONS

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

1.5 DESIGN REQUIREMENTS

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

1.6 SUBMITTALS

- .1 Product Data: submit WHMIS MSDS.
- .2 Shop drawings:
 - .1 All shop drawings, other than standard manufacturers' dimensions and data sheets shall bear the stamp of a registered professional Engineer who shall be fully responsible for the Engineering content of such drawings. Where such drawings are prepared in Nova Scotia and/or apply to products to be manufactured in Nova Scotia, the Engineer shall be a member of APENS.
 - .2 Prior to submission, the Contractor shall carefully check all shop drawings to ensure that they comply with the drawings and specifications in both intent and detail. No consideration will be given to shop drawings submitted without this review and review from the Contractor. Refer to Appendix A for information required on Shop Drawing Transmittal form.
 - .3 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .4 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .5 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .6 The Engineer's review of these drawings is general and is not intended to serve as a check and shall not release the Contractor from responsibility for errors or from the necessity of checking the drawings himself, or of furnishing the materials and performing the work as required by the plans and specifications.
- .3 Quality Control:
 - .1 Provide CSA certified equipment and material.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Permits and fees: in accordance with General Conditions of contract. The Contractor shall obtain all inspections and permits required by all laws, ordinances, rules, and regulations by public authority having jurisdiction in this district, and shall obtain certificates of such inspections and submit same and shall pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due. In no instance shall the standard established by the drawings and specification be reduced by any codes, etc.

1.7 QUALITY ASSURANCE

- .1 Quality Assurance:
- .2 Qualifications: Electrical Work to be carried out by qualified, licensed electricians or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

- .3 Health and Safety Requirements: allow construction occupational health and safety outlined in Division 1 specifications.

1.8 DELIVERY, STORAGE AND HANDLING

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

1.9 SYSTEM STARTUP

- .1 At the conclusion of the job, the Contractor shall review and demonstrate to the Owner, all electrical equipment and their respective functions and operation. Such demonstration shall be provided for such reasonable periods of time as the complexity of the job warrants, and as approved by the Engineer. Such review and demonstration shall be made by an authorized representative of the Contractor, who shall be fully knowledgeable of the project, its installation and operation.
- .2 Instruct Engineer and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.10 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include the following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Three bound maintenance and operational manuals shall be reviewed and left with the Owner. These manuals shall be custom written for materials and systems supplied for this project. Generic information may accompany the manuals but must only be supplemental information. These manuals shall include, but not be limited to, approved copies of all shop drawings, guarantees, manufacturers maintenance instructions, diagrams, and parts lists, all packaging and installation instructions, and all operating instructions. Where manufacturers' literature is not available, or appropriate, the Contractor shall provide same in written form. This shall apply particularly to the general light power and control system. Prior to final inspection, submit these manuals to the Departmental Representative for review.

1.11 CONTRACT DRAWINGS

- .1 No omissions in the drawings or specifications are intended and the Contractor shall give due consideration to this matter. Any work or material referred to in the drawings and not in the specifications, or vice versa, shall be furnished and performed as though fully covered in both. This shall apply particularly to the drawings where descriptions are sufficiently detailed so as to require little or no mention in the specifications. Items indicated on floor plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.
- .2 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by the Contractor as the work proceeds, with due regard to the structure and the work of other trades. The Departmental Representative reserves the right to alter locations of conduit and outlets up to 3000 mm without extra cost, provided that the Contractor is advised prior to roughing in. The Contractor shall make any changes dictated by structural requirements, or conflicts with other trades, without charge to the Owner.
- .3 Any error or omission shall be referred to the Engineer whose decision shall be final.
- .4 Building dimensions shall not be scaled from the electrical drawings but shall be obtained from the site. Any discrepancy between the drawings and the building shall be questioned before proceeding with the installation.

1.12 EXAMINATION OF THE SITE

- .1 Prior to Tender, the Contractor shall visit the site and familiarize himself with all matters which may affect his work. No consideration will be given to items arising from the Contractor's failure to do so.

1.13 PROPOSED CHANGES, SUBSTITUTIONS, ETC.

- .1 Wherever it is proposed to make a change or changes in the design arrangement or type of equipment as called for in this specification, and upon written request by the Departmental Representative, the Contractor shall estimate the cost of same and submit in triplicate detailed itemized estimates of the costs of all apparatus, material and labour entering into the change or substitution. Work shall be carried out upon written request by the Departmental Representative.

1.14 UNIFORMITY

- .1 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels and switchgear; all motor control equipment; all fixtures in as much as is possible; etc.).

1.15 OTHER TRADES

- .1 The Contractor shall co-operate and investigate with other trades to make maximum use of the spaces and avoid conflict with pipes, ducts, equipment radiation, etc.. Shop drawings shall be prepared by the Contractor indicating the route of main conduits and ducts which shall be submitted to the Departmental Representative for review.
- .2 The Contractor shall co-operate with other Contractors on the site and carry out the work, in such a way, as not to hinder or hold-up the work of other trades.

- .3 The Contractor shall consult with other Contractors, where their respective installations conflict and shall re-route conduits, ducts, outlets, equipments, etc., as required, subject to the approval of the Departmental Representative.
- .4 The Contractor shall obtain from the mechanical and other trades complete detailed wiring diagrams of equipment requiring connections and shall be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.

1.16 WORK INCLUDED

- .1 The specifications complement the drawings in describing the supply and installation of complete electrical system.

1.17 CUTTING AND PATCHING

- .1 Cutting and patching shall be the responsibility of this Contractor and be performed by a skilled tradespeople.
- .2 Make every effort to minimize cutting and patching by providing dimensions, locations and other data for bases, sleeves, boxes, etc., to be built in as construction proceeds. Set sleeves and mark openings in concrete forms and masonry before placing concrete and masonry.

1.18 MOTOR AND EQUIPMENT CONNECTIONS

- .1 Provide final connections to all motors, equipments, controls, etc. indicated on the drawing. These motors, equipment, controls, etc. shall include those supplied under other sections of this specification, as well as Owner supplied items. Ensure that equipment will operate properly (e.g. proper rotation) and report any instance of defective equipment to the Departmental Representative.

1.19 RENOVATION WORK

- .1 Co-ordinate removal or shutdown of existing services with the Owner or the Owners' representative. Indicate intent to remove, disconnect, or shut down services in writing, and receive an affirmative written reply, prior to the start of such work.
- .2 Remove all equipment and services indicated on the drawings or made redundant by renovation. If doubt exists, with reference to the removal of same items, obtain clarification from the Departmental Representative before proceeding. All equipment removed shall be brought to the attention of the Owner, or his representative, who shall take possession of such items. If the Owner, or his representative, deems such equipment redundant, the Contractor shall remove and dispose of such items at his own cost.
- .3 Maintain services to, and reconnect all equipment and apparatus to remain, should such services be disrupted during the renovation work.
- .4 Where circuitry to an existing panelboard has been changed, revise the existing directory accordingly. In the absence of a directory, provide one and detail the new and/or revised circuitry.

1.20 FIRE PENETRATIONS

- .1 Where conduits and cables pass through fire separations and sound rated separations, including floors, walls, membranes, etc., provide a metallic sleeve, or core drill to (1")(25 mm) radius larger than the conduit or cable passing through the fire separation. Construct a ceramic fibre insulation dam, or dams as required, and fill the penetration with 3M PUTTY 303 or 3M CAULK CP25. A minimum depth of (2")(50 mm) of putty or caulk is required. As an alternate system, pack the space with ceramic fibre insulation to (1")(25 mm) of Electrovert AA-400 FLAMESEAL PUTTY, on each side. Either installation shall be in strict accordance with manufacturers recommendations and to suit UL and/or ULC requirements. All such work shall be performed by personnel familiar and experienced with this type of work.

1.21 RECORD DRAWINGS

- .1 Maintain project "as-built" record drawings and accurately record significant deviations from the Contract documents, caused by site condition or Contract change. Mark changes on white prints in "RED".
- .2 Identify each drawing in the lower right hand corner in letters at least 13 mm high as follows: "AS-BUILT DRAWINGS". (This drawing has been revised to show electrical systems as installed) (Signature of Contractor) (Date).
- .3 Submit to Engineer for approval. Make all corrections as directed.
- .4 Testing, balancing and adjusting to be performed using as-built drawings.

1.22 GUARANTEE

- .1 The Contractor shall guarantee all work, under this Division, free from defects, for a period of one (1) year, after final acceptance of the work. The Contractor shall make good all defects, other than normal wear and tear, during the life of the guarantee. Notwithstanding the above, longer guarantees may be required for specific installations or equipments, as indicated in other sections of the specifications.
- .2 Guarantees shall be submitted in writing, bound, where more than one is required, and submitted to the Engineer for review. Each guarantee shall include:
 - .1 Project name and address.
 - .2 Guarantee time period (commencement date shall be the date as shown on the project final certificate of completion, unless otherwise indicated).
 - .3 Clear and concise definition of what is guaranteed.
 - .4 Signatures of company officers of the Contractor and/or manufacturers, as applicable.

1.23 APPENDIX A

TYPICAL SHOP DRAWING SUBMITTAL INFO

General Contractor:	
Phone Number:	Fax No:
Electrical Contractor:	
Phone Number:	Fax No:
Electrical Contractor Project Representative:	
Phone Number:	Fax No:
Shop Drawing Items:	
Number of Shop Drawing Copies:	
Supplier of Shop Drawings:	
Manufacturer of Shop Drawings:	
Specification Section and Items:	
Drawing Reference:	

<p><i>Specified Options Indicated " Yes " No</i></p> <p><i>Items are in Conformance with Plans and Specifications Confirmed by Contractor.</i></p> <p><i>" Yes " No</i></p> <p><i>(If No, explain):</i></p> <p><i>Contractor's Signature:</i></p> <p><i>Date:</i></p>
--

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Material and equipment to be CSA certified.
- .2 Factory assembled control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and inspection authorities.
- .2 Decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Lamicoid nameplates installed on distribution panelboards, motor control centres, splitter troughs, transformers, etc. shall indicate the following:

- .1 Designated name of equipment.
- .2 Amperage of overcurrent protection device.
- .3 Voltages, number of phases and wires.
- .4 Designation of power source

- .1 Example:

<p style="text-align: center;">PANEL 101 – 150AMPS 120/208V–3PH–4W FED FROM MAIN SWITCHBOARD</p>

- .2 Lamicoid nameplates installed on combination starters, magnetic starters, manual starters, and all various system controls, control panels, disconnect switches, etc. shall contain the following information.

- .1 Designated name of equipment.
- .2 Designated name of power source.
- .3 Branch circuit breaker number(s) where possible.
- .4 Voltage(s).

- .1 Examples:

<p style="text-align: center;">EXHAUST FAN NO. 1 PANEL H – 120V CCT. NO.17</p>

<p style="text-align: center;">SUPPLY FAN NO. 1 M.C.C. NO.1</p>

600V-3PH

- .3 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate maximum designated/designed fuse size.
- .4 Lamicoid nameplates are to be installed on all junction and/or pull boxes sized 6" x 6" and larger indicating name of system, designated panel name and electrical characteristics where applicable.
- .5 Lamicoid nameplates are to be installed on all junction and/or pull boxes sized 150 mm x 150 mm and larger indicating name of system, designated panel name and electrical characteristics where applicable.
- .6 Lamicoid nameplates installed on "main" service entrance switches, or "main" entrance switchboards to indicate the following information on minimum size 6" x 2plate complete with two lines of 1/2" high lettering. (Size #8 nameplate.)
- .1 Example:.

**MAIN BREAKER 1000 AMPS
347/600V-3PH-4W**

- .7 Install an additional "lamicoid" nameplate on all, or any piece of electrical equipment, or apparatus (i.e.: main switchboard, CDP panels, panelboards, motor control centres, etc.) that may contain overcurrent devices, i.e. circuit breakers and/or fuses, that have been designed for, and incorporate interrupting capacity sized "larger" than 10 kaIC.
- .1 Example:.

**Minimum interrupting capacity of
breakers installed in this panel to be not
less than 20 kaIC.**

**Minimum interrupting capacity of fuses
installed in this MCC to be not less than 20
kaIC.**

- .8 Lamicoid nameplates are to be installed above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source complete with associated circuit breaker number(s).
- .5 1/16" thick x 1/2" high complete with 1/4" black letters on white face, directly above all flush receptacles. (Plate to be identical width as finish device plate)
- .1 Example:.

PANEL 101-20

- .9 Allow for an "average" of 40 letters for each lamicoid nameplate.
- .10 Lamicoid 1.6 mm thick plastic engraving sheet, black core, white face.

- .11 1.6 mm thick nameplates above receptacles as previously indicated shall have top left and right corners rounded off. (1.6 mm where not applied to metals)
- .12 Lettering on lamicoid nameplates shall not “start,” nor “end” nearer than 13 mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in following chart:

NAMEPLATE SIZES

Size 1 – 9.5 mm x 50 mm	1 line – 4.8 mm high letters
Size 2 – 13 mm x 75 mm	1 line – 6 mm high letters
Size 3 – 16 mm x 75 mm	2 lines – 4.8 mm high letters
Size 4 – 19 mm x 89 mm	1 line – 9.5 mm high letters
Size 5 – 38 mm x 89 mm	2 lines – 13 mm high letters
Size 6 – 25 mm x 100 mm	1 line – 13 mm high letters
Size 7 – 25 mm x 100 mm	2 lines – 6 mm high letters
Size 8 – 50 mm x 150 mm	2 lines – 13 mm high letter

- .13 Coverplates for junction and/or pull boxes located above or within finish ceilings containing branch circuits, are to have each branch circuit number neatly identified on coverplate. Felt marker-pen may be used for this purpose.
- .14 Examples of “grouped” electrical equipment that could have identical types of removable covers, that will require their Lamicoid nameplates installed on wall(s) adjacent to control, rather than directly to their covers (this is to avoid the possibility of cover mix-up occurring): magnetic starters, magnetic contactors, manual T.O.L. switches, and relays.
- .15 All control transformers installed in either control cabinets or on walls adjacent to same, are to be identified with Lamicoid nameplates containing information as previously indicated.
- .16 All various pieces of mechanical equipment are to be identified with “identical” information as indicated on electrical equipment Lamicoid nameplate feeding aforesaid mechanical equipment. Both “Lamicoid” nameplates are to be supplied and installed by the electrical contractor in the absence of any mechanical trade identification.

2.6 WIRING IDENTIFICATION

- .1 Labelling of all branch circuit phase and neutral conductors is to be done on both ends of all circuit conductors, plus in “all” junction and/or pull boxes located in between. Use write-on, indelible, identifying markings, self laminating labels sized as necessary. To be installed in a “flagged” manner around individual conductor(s). Maintain phase sequence and colour coding throughout.
- .2 Colour coding: to CSA C22.1.
 - .1 Colour coded “conductor insulation” as per the following:
 - .2 All sizes of phase conductors up to and including #2 AWG.
 - .3 All sizes of neutral, bond and/or ground conductors, up to and including #3/0 AWG.
 - .4 Approved coloured tapes in lieu of insulation colouring may be used to identify conductors that exceed sizes as previously indicated. To take place on “both

ends,” of all runs, a minimum of 305 mm from where terminations take place, in addition to within all or any boxes located in-between both ends of runs.

- .3 Bonding conductors require labelling on both ends of runs where they are “dedicated” solely to the designated branch circuit they accompany. Identify with same number(s) as being used to identify accompanying branch circuit phase(s) and neutral conductor(s).

2.7 COLOUR CODING OF ELECTRICAL BOXES

- .1 All various systems junction and/or pull boxes, conduit fittings, etc., complete with their respective coverplates shall be colour coded as per the following. Boxes shall be painted inside and out where one colour is required, with the coverplate painted completely. Boxes shall be painted inside where two colours are required, with the coverplate painted diagonally with both colours.

<u>System</u>	<u>Primary Colour</u>	<u>Secondary Colour</u>
51 volts to 240 volts	Yellow	-
Above 240 volts	Orange	-
Ground or Bond	Green	-
Data	Blue	White

- .2 All various systems junction and/or pull boxes, conduit fittings, etc., where located above suspended ceilings, shall have location identified on the underside or room side of T-bar spline, with 3/4" or 1/4" self-adhering colour coded discs affixed directly to spline in close proximity to where the concealed box is located. The same type of discs shall be installed on ceiling or wall access coverplates.

3/4" discs are to be primary colour.

1/4" discs are to be the secondary colour, affixed to the centre of the 3/4" disc.

- .3 All various systems junction and/or pull boxes, conduit fittings, etc. where not concealed, shall have discs affixed to the outside of the box when architectural painting is complete.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 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.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.5 FIELD QUALITY CONTROL

- .1 Conduct following tests.
 - .1 New circuits originating from branch distribution panels.
 - .2 Motors and associated control equipment including sequenced operation of systems where applicable.
 - .3 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
- .2 Submit test results to Engineer and include in operations manual.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.6 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 All conditions included in Section 26 05 01, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2 No.65, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):
 - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA).

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 1 specification sections.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors as required.
- .2 Twist type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors 8 AWG or less.
- .3 **Water tight connection required for top of in pool light fixture housing. Refer to manufacturer instructions for type of connection.**
- .4 Bushing stud connectors: to NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.

- .4 Bolts for copper conductors.
- .5 Sized for conductors as indicated.
- .5 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.
- .1 Steel connectors are required for all armoured cable unless noted otherwise. Die-cast or malleable type connectors are not permitted.

PART 3 - EXECUTION

1.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .2 Install twist type connectors and tighten. Use pliers or nut driver for final tightening.
 - .3 Install bushing stud connectors in accordance with NEMA.
 - .4 Install water tight connection as required at top of in pool lighting fixture housing.

END OF SECTION

PART 1- GENERAL

1.1 GENERAL

- .1 All conditions included in Section 26 05 01, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 PRODUCT DATA

- .1 Provide product data in accordance with Division 1 specification section..

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return of pallets, crates, paddling and packaging materials in accordance with Division 1 specification sections..

PART 2 - PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 12 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Non Jacketed.
- .3 Conductors pertaining to the wiring of thermostats, motorized valves, damper actuators, and electric pneumatic relays shall be stranded copper conductor of 95% conductivity and of full size and AWG gauge. Insulation shall be thermoplastic "TW" rated 600 volts. Colour code shall be yellow as per DC350 requirements. Minimum size shall be No. 18 AWG.
- .4 Colour coding shall be by insulation colour as follows:
 - .1 Phase conductors on sizes up to and including No. 2 AWG. Neutral, ground and bond conductors on sizes up to and including No. 3/0 AWG. Approved coloured tape, in lieu of coloured insulation, may be used for phase conductors sized No. 1 AWG and larger, neutral, ground and bond conductors sized No. 4/0 AWG and larger.

2.2 CONTROL WIRES

- .1 Conductors: 1Pr, shielded, #22 AWG, installed in conduit. This wiring is for the Scoreboard unit. Terminate at each end in accordance with manufacturer instructions.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.
- .2 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with requirements of specification section. Wire and Box Connectors (0-1000V).
- .2 Cable Colour Coding: to requirements of Common Work Results - Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 The Contractor shall run all circuits so that the voltage drop, in no case exceeds 3% of the line volts. The neutral wire, wherever it is run shall be continuous with no fuses, switches, or breaks of any kind.
- .6 The installation of more than 3 conductors in a run of conduit is permissible provided C.E.C. Section 4-004(1) is adhered to with respect to the derating of the conductors.
- .7 The minimum conductor size for all 15 amp branch circuits is to be #12 AWG. For 15 amp 120 volt branch circuits, the following table shall be followed:

Branch Circuit One-Way Length from Panel to Load (Including Vertical Drops)	Phase Wire Size	Dedicated Neutral Wire Size	Shared Neutral Wire Size	Bond Wire Size
Up to (80'-0")(24.38 m)	#12 AWG	#12 AWG	#10 AWG	#12 AWG
(81'-0" to 125'-0") (24.68 m to 38.1 m)	#10 AWG	#10 AWG	#8 AWG	#10 AWG
(126'-0" to 185'-0") (38.4 m to 56.38 m)	#8 AWG	#8 AWG	#6 AWG	#10 AWG

- .8 All "stranded" conductors are to be "twisted together" prior to any types of terminations taking place, but not necessarily limited to, some of the following areas:
 - .1 Neutral terminal strips.
 - .2 Bonding terminal strips.
 - .3 Circuit breakers.
 - .4 Disconnect switches.
 - .5 Magnetic and manual starters.
 - .6 Magnetic contactors.
 - .7 Relays.
 - .8 Terminating lugs, etc.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 Where pulling wires and cables, the use of an approved lubricant only will be permitted. No wires or cables shall be pulled in conduits until such conduits are free from moisture.
 - .2 All various types of cables are to be installed parallel or perpendicular to building lines and shall be adequately secured to the building structure at not less than 1500 mm intervals or as otherwise indicated, in such a manner as to ensure they are protected from potential types of mechanical damage occurring. Install independent supports for

cabling in ceiling spaces, and do not use those of other trades. Do not secure cables to mechanical systems piping or ducts, suspended ceiling support wires, etc.. The laying of "unsupported" cables of any types whatsoever directly atop ceiling grid system is strictly prohibited.

- .3 Install and secure surface cables directly to underside of metal decking and/or ceiling slab where installed in any concealed ceiling spaces.
- .4 Cables are always to be installed as high as possible to underside of structure.
 - .1 Where metal type Q-Deck is used, all cables are to be installed in upper portions of same (above tops and at right angles to steel joists) and secured directly to sides of metal flutes and/or structure.
 - .2 Where cables are installed in the same direction as steel joists, they are also to be secured as high as possible to underside of metal decking and/or structure.
 - .3 Note that this shall apply to all cables, with the exception of voice and data cabling, which shall run no higher than (30") (762 mm) above the suspended ceiling.
- .5 The grouping together of cables to form a "bundle" for securing purposes, is acceptable provided that the following procedures are adhered to:
 - .1 In addition to securing cables to the structure at 1500 mm intervals, multiple or bundled groups of cables (including low voltage types) shall be ty-rapped together at midpoint between each structure support, or every 750 mm. Secure to structure at 1500 mm intervals, and secure together (between structure supports) at 1500 mm intervals.
- .6 After all wiring devices have been installed, the Contractor shall test all systems to ensure there are no grounds, leaks, or shorts. Such tests shall be performed to the satisfaction of both the inspection authority having jurisdiction and the Engineer.

3.4 INSTALLATION OF ARMOURED CABLES

- .1 **For use in concealed spaces only.** All AC-90 cable shall be run parallel to building lines, secured in accordance with C.E.C. 12-618 and shall be adequately clamped and "ty-rapped" to the building structure in such a manner that they are protected from mechanical damage. This contractor shall install his own supports for cabling in ceiling spaces and he shall not use those of other trades or secure cabling to pipes, ducts, suspended ceiling support wires, etc.. The laying of cables directly atop ceiling grids is strictly prohibited. The incoming (Panel Side) grounding conductor shall be secured to the grounding screw of each outlet box, before connecting to the other grounding conductors. Twist all grounding conductors to the back of the outlet box, such that the grounding conductors obstruct as little room as possible.
- .2 All flexible conduit or AC-90 fixture feeds shall originate from the side of the outlet box and not from the box cover. Where 3 or 4 drops extend from one outlet box, the box shall be a minimum 119 mm square. There shall be no more than 4 drops from any one box. All flex or AC-90 cables used for fixture drops are to be secured within 300 mm of the junction box.
- .3 Grouping of AC-90 cables shall be limited to a maximum of eight current carrying conductors, including associated oversized neutral conductors where phase sharing occurs.
- .4 The following examples incorporate uses of both common and dedicated (separate) branch circuit neutral conductors:
 - .1 Maximum of two runs of #12/4 conductor cables, including common (oversized) branch circuit neutral in each.

- .2 Maximum of two runs of #12/3 conductor cables, including (oversized) branch circuit neutrals (if not 3 phase, 3 wire), plus one run of #12/2 cable.
- .3 Maximum of four runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.
- .5 Where dedicated or separate branch circuit neutral conductors are non phase sharing, they need not be sized larger than phase conductors they accompany unless specifically indicated otherwise.
- .6 Fixture drop is defined as that portion of AC-90 cable or flexible conduit being used to make final connection between “accessible” type junction or outlet box located in ceiling space (above T-bar ceiling) and its respective light fixture.
 - .1 Fixture drops are not to exceed 4500 mm in total length unless noted otherwise.
 - .2 There shall be not more than four drops from any one box regardless of size. All AC-90 cables used for fixture drops are to be secured within 300 mm of the junction box. Each fixture is to be complete with its own separate fixture drop originating from junction box located within same room.
 - .3 Provide 20 amp O.C. protection for “all” lighting branch circuits, unless specifically indicated otherwise.
 - .4 No. 12 AWG and No. 14 AWG Type AC-90 cables may be used where total fixture drop “loads” do not exceed the following:
 - .1 Maximum of 5000 watts at 347 volts using #12 AWG drop.
 - .2 Maximum of 3500 watts at 347 volts using #14 AWG drop.
 - .3 Maximum of 1800 watts at 120 volts using #12 AWG drop.
 - .4 Maximum of 1300 watts at 120 volts using #14 AWG drop.
- .7 Separate pig-tail type leads shall be provided in each light fixture junction/outlet box for “final” connections to fixture drops. These pig-tail leads are to be “only” connected to light fixture “returns” and associated “neutral” conductors.
- .8 AC-90 drops are permitted from a junction box in the ceiling space to light fixtures, receptacles, etc. in the same room only.
- .9 The installation of AC-90 cable branch circuit home runs is not acceptable.

3.5 STRANDED CONDUCTORS

- .1 All stranded conductors prior to terminating under device bolts such as circuit breakers, switches, receptacles, etc., are to be twisted together so as to form a single conductor to ensure a reliable mechanical connection.

3.6 CAPACITIVE LEAKAGE WIRING METHODS

- .1 The following wiring methods detailed below are designed to enhance the ability of the Owner to perform capacitive leakage tests in the future. The capacitive leakage tests are not in contract.
 - .1 All circuit conductors are to be individually ty-wrapped to their corresponding labelled neutral conductor in all panelboards, pull boxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually ty-wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality.

- .2 The ty-wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pull boxes and junction boxes.
- .3 Panelboards are have their respective feeder phase and neutral conductors ty-wrapped together with enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality. This ty-wrapping is to be located such that ease of clamping the ground detector can be accomplished without excessive exposure to live bussing.
- .4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are no ground shorts or grounds.
- .5 All feeders or branch circuits which do not have neutral conductors are to have their respective phase conductors ty-wrapped together in accordance to the methods described previously.

3.7 CONTROL CIRCUIT WIRING – 50 VOLTS OR LESS

- .1 The installation of “surface” wiring on walls or in open (non-enclosed) type ceilings, shall be Type EMT conduit complete with associated steel type connectors and couplings.
- .2 EMT conduit is to be extended to within (24")(600 mm) of “all” various control devices associated with the operation of any given piece of mechanical equipment.
- .3 Unless specifically indicated otherwise, liquid tight, flexible metal type conduit complete with steel type connector and steel locknut may be used for the “final” (24")(600 mm) connection between the end of the EMT conduit and the applicable control device.
- .4 EMT or PVC type conduit “wall stubs” complete with flush installed device box shall be installed in all masonry or concrete partitions where, and as may be required, where plenum rated cabling is used.
- .5 EMT connectors complete with nylon insulated throat or threaded type bushing shall be installed on end of EMT stub above “finish” type ceilings, etc., where plenum rated cabling is used.
- .6 All EMT conduit stubs are to be “bonded” to ground as per CEC.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 All conditions included in Section 26 05 01, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837 Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Grounding equipment shall be to CSA C22.2 No.41.
- .2 Ground conductors to be to ASA-G7.1.
- .3 Insulated ground conductors are to be RW90, green, for sizes up to and including #2. Insulated ground conductors #1 and larger to be TWH, green. All ground conductors to be copper without exception.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.
- .5 All metal parts of equipment installed on pool deck are to have a connection to existing #6 Grounding wire located in crawl space underneath pool deck. Existing grounding system is tied to Main Electrical room ground. All existing grounding leads will be tested and reconnected to grounding grid, install new connection components. Testing results will be submitted to Engineer for review. Relocated equipment will require new grounding connections.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 All equipment and exposed non-current-carrying metal, conduits and parts shall be permanently and effectually grounded to meet minimum requirements of the C.E.C., and as indicated on the drawings and further specified. Standards set either by drawings or specifications which are above those covered by C.E.C. shall not be reduced under any circumstances.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .6 Connect building structural steel and metal siding to ground by welding copper to steel.
- .7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. All metal parts located on deck to include drains, ladders, diving board, diving blocks, skimmers, in pool fixtures, etc.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 All conditions included in Section 26 05 00, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with specification section Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Engineer.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 38 mm x 38 mm, 12 gauge, surface mounted and suspended.
- .2 All strut to be galvanized.
- .3 All threaded hanger rods to be minimum (3/8")(10 mm) diameter, larger if required, made from mild steel.
- .4 Supports for all conduit work shall be one or two hole steel pipe, as detailed in Part 3 Execution; unistrut, or equal, with necessary fittings, or caddy clips, or equal, approved for their respective use.
- .5 All pull and junction boxes and multiple conduits shall be supported by a steel channel support system with all components, hangers, wall supports, cable clamps, etc., specifically manufactured and approved for their application.
- .6 Fastening devices for cabinets, boxes, supports, etc., shall be nut and bolt, expansion shields, wedge anchors, or toggle bolts, size and number to suit the application or as detailed on the drawings. Toggle bolts may not be used in plasterboard construction.
- .7 Fastening devices for outlet boxes shall be nut and bolt, expansion shields, wedge anchors or caddy clips, size and number to suite the application or as detailed on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 EMT shall be securely fastened in place within 1 metre of each outlet box, junction box, pull box, cabinet or conduit fitting, with spacing between supports as per the CEC.

Securing of surface and concealed conduits to the structure for sizes up to and including 1-1/4" diameter may be done utilizing one-hole steel straps. Utilize two-hole steel straps for all sizes 1-1/2" diameter and larger. Grouped or singularly suspended conduits of all sizes shall be supported with minimum size 3/8" threaded rods and concrete shields. Where possible, two or more suspended type conduits shall be secured to a common steel support channel system and are to be suspended utilizing minimum 3/8" threaded rods, washers and nuts. Channel is to be sandwiched between nuts and washers located on both upper and lower portions of channels.

- .2 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .3 Secure equipment to hollow masonry with toggle bolts.
- .4 Do not use toggle bolts in plasterboard construction.
- .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 35 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 35 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems:
 - .1 Support individual cable or conduit runs with 9.5 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 9.5 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Engineer.

- .13 Install fastenings and supports as required for each type of equipment cables and conduits,
and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 All conditions included in Section 26 05 01, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with specification section Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with specification section Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with specification section Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: hinged.
- .4 Boxes 150 mm x 150 mm and larger to have bonding terminal strip.
- .5 Junction boxes used for in-pool light fixtures to contain watertight connections for all knockouts to ensure water does not enter into conduits.

PART 3 - EXECUTION

3.1 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Common Work Results - Electrical.
- .2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 All conditions included in Section 26 05 00, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA C22.2 No. 18-98 Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83, Electrical Metallic Tubing.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with specification section - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with specification section Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with raintight couplings, minimum size 21 mm.
- .2 Flexible metal conduit: to CSA C22.2 No. 56, steel liquid tight flexible metal, minimum size 1 mm.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 35 mm and smaller.

- .1 Two hole steel straps for conduits larger than 35 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods, 9.5 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Set screw couplings and connectors for EMT where run concealed in ceilings and walls or run horizontally. Rain tight compression connectors and couplings for EMT shall be used for vertical conduits which enter into the tops of equipment incorporating drip shields or hoods.

2.4 FISH CORD

- .1 Polypropylene 6 mm.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 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) for all systems.
- .4 Use liquid tight flexible metal conduit for connection to motors or equipment.
- .5 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .6 Mechanically bend steel conduit over 21 mm diameter.
- .7 Install fish cord in empty conduits.
- .8 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .9 Dry conduits out before installing wire.

- .10 In addition to the CEC minimum conduit support spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 12" from the midpoint of all 90 degree bends. Maximum spacing between conduit support channels shall be as dictated by the smallest size conduit(s) being supported and/or secured to same.
- .11 EMT shall be securely fastened in place within 1 metre of each outlet box, junction box, pull box, cabinet or conduit fitting, with spacing between supports as per the CEC. Securing of surface and concealed conduits to the structure for sizes up to and including 1-1/4" diameter may be done utilizing one-hole steel straps. Utilize two-hole steel straps for all sizes 1-1/2" diameter and larger. Grouped or singularly suspended conduits of all sizes shall be supported with minimum size 3/8" threaded rods and concrete shields. Where possible, two or more suspended type conduits shall be secured to a common steel support channel system and are to be suspended utilizing minimum 3/8" threaded rods, washers and nuts. Channel is to be sandwiched between nuts and washers located on both upper and lower portions of channels.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1524 mm clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 All conditions included in Section 26 05 01, Division 1 and General Conditions form part of this specification and the Contractor shall comply with all and each clause included in these Sections.

1.2 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low- Voltage AC Power Circuits.
- .2 Canadian Standards Association (CSA International)
- .3 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with specification section Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Packaging Waste Management: remove for reuse in accordance with specification section Construction/Demolition Waste Management and Disposal.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit complete photometric data prepared by independent testing laboratory for luminaires specified, for review by Consultant. Include disc containing IES formatted photometric data.
- .2 Submit complete information on the lamps and ballasts proposed for this project, including the following:
 - .1 Lamp manufacturer and lamp characteristics.
 - .2 Supply lamp TCLP (Toxicity Characteristic Leaching Procedure) test results from a recognized environmental lab.
 - .3 Documentation supporting the required Lamp and Ballast System Warranty.

PART 2 - PRODUCTS

2.1 LED LUMINAIRES

- .1 LED luminaires shall consist of an assembly that utilizes LED's as the light source. In addition, a complete luminaire shall consist of a housing, LED array, electronic driver (power supply), and optic control system.
- .2 Operating temperature range shall be from -40 C to + 25 C (Celsius degrees).
- .3 Lumen output shall not decrease by more than 20% over a minimum operational life of 60,000 hours.
- .4 Individual LED's shall be connected such that a catastrophic loss or the failure of one LED shall not result in the loss of the entire luminaire.
- .5 LED boards shall be suitable for field maintenance with plug-in connections. Board shall be field upgradable.
- .6 Light colour quality:
 - .1 Correlated Colour Temperature (CCT) as per the Light Fixture Legend for each luminaire.
 - .2 CRI shall be 80 or greater.
 - .3 Colour shift over 6,000 hours shall be <0.007.

2.2 POWER SUPPLIES/DRIVERS

- .1 Drivers shall be UL Listed, CSA Certified, Sound Rated A+. Drivers shall be >80% efficient at full load across all input voltages.
- .2 Drivers shall be suitable for full range dimming without perceivable flicker over a range of 100% down to 5%. Dimmer control shall be 0-10V.
- .3 Lumen efficiency shall be >80lumen/watt.

- .4 Power Factor shall be 90% or greater.
- .5 THD shall be 20% or less.
- .6 Drivers shall be c/w built-in surge protection.
- .7 RF Inference: The luminaire and the on-board circuitry shall meet Class A emission limits as per FCC Title 47.
- .8 Type 4 distribution for pendant mount Type 1 fixture.

2.3 FINISHES

- .1 Type 1 Pendant fixture to be Marine grade die cast aluminum finish:
 - .1 Integral aluminum heat sink with concealed air inlet and convection fins. All power electronics removed from primary thermal path..
- .2 Type 2 In Pool fixture to be stainless steel finish:
 - .1 Housing/Niche to be stainless steel finish, water tight, with pilot screw at 12 o'clock position.
 - .2 Face ring assembly to be stainless steel, uni tension wire clamp assy with gasket.
 - .3 Set screws to be brass.
 - .4 Lens to contain watertight gasket.
 - .5 Fixture to contain internal lighting circuit board and internal fusing and transformer.

2.4 LUMINAIRES

- .1 Refer to light fixture schedule.
- .2 Type 1 fixture to be Kenall HBMO26 series. Alternate manufacturers Eaton and Lithonia provided they can match lighting level characteristics.
- .3 Type 2 in pool fixture to be Pentair Intellibright 5G Pool fixture. Approved alternates Hydrel, Eaton, provided they can match dimensions and lighting characteristics.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.

3.2 WIRING

- .1 Connect luminaries to lighting circuits.
- .2 Install separate #12 RW90 bonding conductor in fixture raceways when fixtures are continuously mounted in rows.

- .3 Provide a separate neutral conductor for all lighting circuits.

3.3 LUMINAIRE SUPPORT

- .1 For fixtures suspended using pendant, supports are to be provided which are independent of any suspended ceiling components. Install to manufactures requirements.
- .2 Luminaires weighing more than 11.4 kg shall be supported independently of the outlet box.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .2 Install in pool fixtures as shown on electrical plans.

3.5 COMMISSIONING

- .1 Carry out the commissioning in conformance with specification section.

END OF SECTION