

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal procedures.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 01 61 00 – Common product requirements.
- .4 Section 34 43 05 – Common Work results for airfield lighting

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 (latest edition), Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 (latest edition).
 - .3 CAN3-C235 (latest edition), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1 (latest edition), Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122 (latest edition), The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

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

1.4 DESIGN REQUIREMENTS

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

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 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.
 - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .4 Submit one copie of drawings and product data to authority having jurisdiction.
 - .5 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction and inspection authorities for approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

1.8 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.
- .4 For the start-up of each system, inform the Departmental Representative for him to be present and provide training.

1.9 OPERATING INSTRUCTIONS

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

1.10 PROTECTION

- .1 During Work, protect material exposed and under tension to ensure safety of personnel.
- .2 Close and mark pieces under tension with the inscription *Circuit under tension 120V* (or appropriate tension), in both French and English.
- .3 Install temporary doors to close rooms containing power distribution equipment. Keep those doors locked, except when an electrician provides constant direct surveillance.

1.11 EQUIVALENCE

- .1 Contractor shall present his submission with specified material, with no substitution. Contract can be allowed without any equivalence or substitution.
- .2 Equivalences can still be submitted on a separate list to submission, but attached to basic submission. Price to be deducted shall be given back if there is a difference. A single price for different equivalences is not acceptable. If no list is attached to basic submission, Contractor accepts to do the Work, as indicated on plans and specifications.
- .3 Equivalences are only acceptable if these conditions are followed :
 - .1 Proof of equivalence, Contractor shall pay for any charges.
 - .2 Samples are required for tests.
- .4 All proposed equivalence that need a time increase of installation or material or modifies the project in any way, doesn't justify supplementary charges. Price to be deducted or added must include all these changes.
- .5 Departmental Representative can accept or denial one or more equivalences; his decision is final. Price of submission is adjusted in accordance with Departmental Representative's decision.
- .6 When equivalence proofs are not presented, Departmental Representative shall approve conformity of proposed material, Charges will then be paid by Contractor..
- .7 It is understood that equivalence demands are not verified before Contract is given, but Contractor has 30 days after giving of Contract to give proofs of equivalence.
- .8 Contractor shall do, at his charge, every required modification (fastenings, support or other), when done by him or his subcontractor, when he choses a material or equipment other than the ones specified in plans and specifications.
- .9 Departmental Representative can ask Contractor to provide equipment or materials concerned with documents, i.e. technical specifications or laboratory test reports. Principal criterias are : construction, rate, capacity, dimension, fittings, minimal requirements, disponibility of back-up pieces, maintenance problems, shipping delays, existence of ressembling equipment in service for a certain time, ressembling equipment owned by Departmental Representative.

Part 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.2 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.3 WIRING TERMINATIONS

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

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: plastic laminate lamicaid 3 mm melamine, matt white finish face, black core,[lettering accurately aligned and engraved into core.
 - .2 Sizes as follows:

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

- .2 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture. All inscriptions on nameplates will be provided by Departmental Representative.
- .3 Allow for minimum of twenty-five (25) letters per nameplate.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .5 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .6 Terminal cabinets and pull boxes: indicate system and voltage.
- .7 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.

2.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish or according to recommendations.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

2.8 FIRE PROTECTION

- .1 When cables or conduits go through floors or firewall, stuff openings with certified fireproof materials as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.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 CONDUIT AND CABLE INSTALLATION

- .1 Install sleeve everywhere a conduit goes through a floor, a beam, mason wall, dry wall, etc.
- .2 Sleeves in walls, drywalls, and ceilings end at finished surface.

- .3 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule PVC-FT4 pipe, sized for free passage of conduit, and protruding 50 mm.
- .4 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .5 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 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.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.6 FIELD QUALITY CONTROL

- .1 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.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 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 Megger up to 5 000 V circuits, feeders and equipment with a 5000 V instrument.
 - .4 Check resistance to ground before energizing.

- .5 Grounding
- .6 Every other system on plans et specifications.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 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.

3.8 TEMPORARY SERVICES

- .1 All temporary services necessary to achieve Work described on plans and specifications, must be included in payment, even if they are not mentioned or showed in plans and specifications.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common work results for electrical
- .2 Section 26 05 43.01 – Installation of cables in trenches and in ducts.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2, No 3 Test methods for electrical wires and cables.

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Section 26 05 00 – Common work results for electrical.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 or 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE or RWU90 XLPE, Jacketted.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Chemically cross-linked thermosetting polyethylene, type RW90.
 - .2 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride.

- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 NON-METALLIC SHEATHED CABLE

- .1 Non-metallic sheathed copper cable type: XLINK size as indicated, type 5 000V.
- .2 Non-metallic sheathed copper cable type: SOW size as indicated, type 600V.

Part 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 26 05 43.01 - Installation of cables in trenches and in ducts.
- .2 Cable Colour Coding: to Section 26 05 00 Common Work Results for 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 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 43.01 – Installation of cables in trenches and in ducts.
 - .2 In underground ducts in accordance with Section 33 65 76 – Direct buried underground cables ducts.

3.4 INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837 (latest edition), Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)
- .3 CAN/CSA Z32-1999, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – 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, corrugated cardboard, packaging material in appropriate on-site bins for recycling.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as indicated to electrically conductive underground water pipe.
- .2 Rod electrodes: copper clad steel 19 mm dia by 3 m long.
- .3 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated or as needed.
- .4 Insulated grounding conductors: green, type RWU90 in ground or humid places, type RW90 in any other places.
- .5 SDBC balancing conductor.

- .6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors (if applicable).
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
 - .7 Grounding copper rod;
 - .8 Any other required material.

Part 3 EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 MANHOLES

- .1 Install conveniently located grounding stud, electrode, size 6 stranded copper conductor in each manhole.
- .2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-F98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-M1981, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-F04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985, Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984, Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-F05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - 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 Section 01 74 21 – 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 PRODUCTSs

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel, threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No B136.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, steel, liquid-tight flexible metal.
- .5 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTING

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 6 mm Polypropylene.

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 Conduit diameter is indicated on drawings but electrical code takes precedence in all times.
- .2 All conduits shall be parallel or perpendicular to structural axis. Use expansion garnitures for conduits going through control joints of building.
- .3 Install conduits at least 150 mm from any conduit or equipment creating heat. Fill conduits with metal washers during construction.
- .4 Use electrical metallic tubing (EMT) for interior surface tracks and not damageable, inside walls and ceilings in concrete and masonry blocks and for telecom, fire alarm and other systems.
- .5 Use rigid pvc conduit underground and for primary and secondary transformer.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Minimum conduit size for lighting and power circuits: 19 mm.
- .8 Install rigid metal (EMT) conduit from computer room, telecommunication and phone branch circuit panel to outlet boxes located in sub floor.
- .9 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19 mm diameter.

- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Run 4 - 25 mm spare conduits up to ceiling space from each flush panel.
 - .1 Terminate these conduits in junction boxes 152 mm x 152 mm x 102 mm in ceiling space or in case of an exposed concrete slab, terminate each conduit in type box.
- .14 Ask a structural engineer when passing of a conduit causes doubt for structural integrity.
- .15 Isolate conduits that go through areas with a temperature difference of 20 °C and install runoff garnitures.
- .16 Length of flexible conduits or cables must be reduced to minimum, meaning 1 m for AC90 flexible cable or conduit.
- .17 The extremity of each conduit must be milled and provided with a protective ring to avoid damaging of conductor.
- .18 Fastening of conduits shall be done with waterproof sleeves and fittings.
- .19 When a conduit goes through a wall, floor or ceiling that is fire resistant, fill the void around the conduit with fireproof materials.
- .20 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .21 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

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

3.4 CONCEALED CONDUITS

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

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 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 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 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 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – 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, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .5 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .6 Do not dispose of preservative treated wood through incineration.
- .7 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.
- .8 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental Representative.
- .9 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 PRODUCTS

2.1 MARKERS

- .1 Markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

Part 3 EXECUTION

3.1 DIRECT BURIAL OF CABLES

- .1 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
- .2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.
 - .1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.
- .4 Underground cable splices not acceptable.
- .5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .6 Cable separation:
 - .1 Maintain 75 mm minimum separation between cables of different circuits.
 - .2 Maintain 300 mm horizontal separation between low and high voltage cables.
 - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
 - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
 - .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
 - .6 Install treated planks on lower cables 0.6 m in each direction at crossings.

3.2 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests.
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
 - .1 Perform a thermographie on each splice.
- .6 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing in accordance with manufacturer's and ICEA recommendations.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION