

1 GENERAL

- .1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1.
- .2 Read this Section in conjunction with all other contract documents.

2 REFERENCES

- .1 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000V.
- .2 CSA-C22.1-15, Canadian Electrical Code, Part 1 (23rd edition), Safety Standard for Electrical Installations.
- .3 CSA Z85-1983, Abbreviations for Electrical Terms.
- .4 EEMAC Y1-2-1979, Standard for Performance Specification for Finishing Systems for Outdoor Electrical Equipment.

3 CARE, OPERATION  
AND STARTUP

- .1 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of all equipment.
- .2 Arrange and pay for services of manufacturer's factory service representative to supervise start-up of installation, check, adjust, balance and calibrate 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 all aspects of its care and operation.

4 VOLTAGE RATINGS

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

5 PERMITS, FEES

- .1 Submit to the Electrical Inspection Department,

AND INSPECTION

Municipal Authority and supply authority the necessary number of drawings and specifications, for examination and approval prior to commencement of Work.

- .2 Provide the Departmental Representative with a copy of the electrical Inspection Department and supply Authority Plans Review Report, immediately upon receipt. No shop drawings will be reviewed prior to receipt of the Plans Review Report from the Contractor.
- .3 Obtain all necessary permits including an Electrical Wiring Permit for electrical work and Communications Cabling Permit for communications cabling work from the authority having jurisdiction, prior to commencement of Work. Provide a copy of each permit to the Departmental Representative upon receipt. Display permits on the Work site.
- .4 Upon specific request, the Departmental Representative will provide, to the Contractor, up to a maximum of three (3) copies of the drawings and specifications required for submittal to the Electrical Inspection Department and Supply Authority. These drawings and specifications will be provided to the Contractor at no cost, unless otherwise specified.
- .5 Arrange for all required inspections to be conducted by the authority having jurisdiction. Provide a copy of all inspection reports to the Departmental Representative immediately upon receipt. Notify the Departmental Representative immediately of changes required by the authority having jurisdiction.
- .6 Furnish Certificates of Acceptance from authorities having jurisdiction upon completion of work. Include a copy in the Operation and Maintenance Manual.
- .7 Pay all associated fees for permits, fees and inspection.

6 MATERIALS AND  
EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the authority having jurisdiction.
- .3 Factory assemble control panels and component assemblies.

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 to EEMAC Y1-1.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

8 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as specified herein.
- .2 Identification:
  - .1 All disconnect switches, transformers, control panels, magnetic starters, TOL's, etc. are to be provided with lamicoïd nameplates as further described herein. Confirm that all plates are affixed true and level, and plumb in all instances.
  - .2 Affix nameplates to all metal surfaces with steel type pop-rivets.
  - .3 Affix nameplates to other types of surfaces with contact type cement.
  - .4 Affix nameplates to building exterior surfaces with nylon inserts and self tapping screws unless specifically indicated otherwise.
  - .5 Apply contact type cement to complete rear side of plate, as opposed to several locations or areas on same.
  - .6 Lamicoïd nameplates installed on distribution panelboards, motor control centres, splitter troughs and transformers to 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.

Sample:

PANEL A - 225 AMPS  
120/208V - 3PH - 4W

FED FROM MAIN SWITCHBOARD 'SB-1'

- .7 Lamicoïd nameplates installed on combination starters, magnetic starters, manual starter and all various systems 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).

EXHAUST FAN NO. 1                      SUPPLY FAN NO. 1  
PANEL A - CCT. NO. 10                  M.C.C. NO. 1  
120V - 1-Phase                          600V - 3-Phase

- .8 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate maximum designated/designed fuse size.
- .9 Install lamicoid nameplates 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.
- .10 Lamicoid nameplates are to be installed adjacent to each overcurrent devices located in switchboards, CDP panels, etc. They need only indicate designated name and/or number of equipment they feed. Unused O.C. devices are to be identified as SPARE(S).
- .11 Lamicoid nameplates installed on main service entrance switches, or main entrance switchboards to indicate the following information on minimum size 150 mm x 50 mm plate complete with two lines of 13 mm high lettering (Size #8 nameplate)

Sample:                                      Sample:  
MAIN BREAKER 400 AMPS                  MAIN SWITCH 400 AMPS  
600/347V, 3PH, 4W                      120/208V, 3PH, 4W

- .12 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 contain overcurrent devices (i.e., circuit breakers and/or fuses), that have been designed for, and incorporate interrupting capacity greater than 10 kA I.C.

Sample:  
Min, interrupting capacity of breakers installed in this panel to be not less than 22 kA I.C.

Sample:  
Min. interrupting capacity of fuses installed in this MCC to be not less than 100 kA I.C.

- .13 Lamicoid 3mm thick plastic engraving sheet, white face, black core, for all electrical systems.
  - .1 1.5mm thick nameplates with top left and right corners to be rounded off.
  - .2 Lettering on lamicoid nameplates shall not start, nor end nearer than 13mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in the following chart:

NAMEPLATE SIZES

Size 1	9mm x	50mm	1 line	5mm high letters
Size 2	13mm x	70mm	1 line	6mm high letters
Size 3	16mm x	75mm	2 lines	5mm high letters
Size 4	19mm x	90mm	1 line	9mm high letters
Size 5	6mm x	90mm	2 lines	13mm high letters
Size 6	25mm x	100mm	1 line	13mm high letters
Size 7	25mm x	100mm	2 lines	6mm high letters
Size 8	50mm x	150mm	2 lines	13mm high letters

- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for average of forty (40) letters per nameplate and label.
- .5 Identification to be English.
- .6 Provide and install lamicoid nameplates on, or adjacent to, all various systems' control panels, equipment racks and/or cabinets complete with information as indicated. Nameplates to reflect individual system's assigned name, and where applicable, indicate both designated panel name and associated branch circuit breaker number(s).
- .7 Control Transformers:
  - .1 Concealed control transformers located within ceiling spaces to have lamicoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, complete with associated branch circuit breaker number(s).
  - .2 Install second plate with identical information on underside of room grid system or access opening frame directly below control transformer, so as to identify its concealed location directly above same.
  - .3 Identify control transformers installed in either control cabinets or on walls adjacent to same, with lamicoid nameplates containing information as previously indicated.
- .8 Junction and pull boxes: indicate system and voltage.
- .9 Co-ordinate names of equipment and systems with other trades to ensure that equipment identification is consistent.
- .10 In addition to required nameplates and colour coding, junction boxes to have the panel and circuit numbers of all wiring contained within listed on the coverplate. List to be neatly written using black indelible marker.
- .11 All electrical junction boxes, pull boxes, and conduit

fittings are to be colour coded as follows:

- .1 Apply colour coding prior to pulling conductors into boxes.
- .2 Where primary colour only is indicated:
  - .1 Colour inside and outside of box.
  - .2 Colour all cover plates.
  - .3 Where primary and secondary colours are indicated:
    - .1 Paint inside and outside of box with the primary colour.
    - .2 Diagonally apply to each half of the cover plate the primary and secondary colours.

9 WIRING IDENTIFICATION

- .1 Identify wiring with self laminating, permanently mechanically imprinted labels on both ends of each conductor and cable utilized. Identify conductors and cables in each junction or pull box through which they pass. Labels to be installed in a "flagged" manner around individual conductors.
- .2 Maintain phase sequence and colour coding throughout.
- .3 All conductors are to have their insulation colors identified as follows:

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

Isolated Ground - Green c/w yellow strip

- .4 Color coded Conductor Insulation as per the following:
  - .1 All sizes of phase conductors up to and including #2AWG.
  - .2 All sizes of neutral, bond and/or ground conductors up to and including #3/0AWG.
  - .3 Approved colored tapes in lieu of insulation coloring may be used to identify conductors that exceed sizes as previously indicated. Labelling is to take place at both ends of all runs at a minimum of 300mm from terminations, in addition to within all boxes between both ends of the run.
- .5 Use colour coded wires in communication cables, matched throughout system.
- .6 Indicate panel and circuit number of all phase conductors e.g.: "Panel "P-1" - CCT.03". Identify all neutral conductors bonding and ground conductors to indicate the phase conductor with which they are

associated.

10 CONDUIT AND  
CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables. Boxes are to be coloured inside and outside where one colour is required. Boxes are to be coloured on inside only where two colours are required. Metal cover plates are to have both colours applied diagonally where two colours are required. Paint entire cover plate where one colour is required.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.
- .3 Colours: 25mm wide prime colour and 19mm wide auxiliary colour.

System	Primary Colour	Secondary Colour
0-50 volts	VIOLET	-
51 volts to 240 volts	YELLOW	-
241-600volts	ORANGE	-
Fire alarm	RED	-
Telephone (Voice only)	BLACK	-
Public Address and Intercom	BLUE	-
Ground or Bond	GREEN	-
Security	BROWN	-
Mech. Controls	RED	WHITE
Cable Television	YELLOW	WHITE
Computer (data only)	BLACK	WHITE
Voice and Data	BLUE	WHITE
CCTV	GREEN	WHITE

- .4 All various system junction and/or pull boxes etc., where located above ceiling grid system to have location identified on underside or room side of t-bar spline, with (19mm) or (6mm on 19mm) self adhering colour coded circular shaped discs, affixed directly to spline in close proximity to where concealed box is located. The same type of discs to be installed on ceiling or wall access cover plates.

6mm discs are all white in colour. 6mm to be affixed to center or middle of of 19mm discs as system colours indicates.

	<u>Outer</u> 19mm Discs	<u>Inner</u> 6mm Discs
Various Systems		

0 to 50 volts	VIOLET	
51 to 240 volts	YELLOW	
241 to 600 volts	ORANGE	
Fire Alarm	RED	
Telephone (voice only)	BLACK	
P.A. and Intercom	BLUE	
Security	BROWN	
Ground or Bond	GREEN	
Cable Television	YELLOW	WHITE
Energy Management	RED	WHITE
Computer (data only)	BLACK	WHITE
Voice and Data	BLUE	WHITE
CCTV	GREEN	WHITE
Other	BROWN	WHITE

- .5 Provide a legend of colour coding, mounted under plexiglass cover. Install in main electrical room.

11 WIRING  
TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors only.
- .2 Label all branch circuit wiring including phase conductors, neutral, ground and/or bonding conductors to be done on both ends of all circuit wires plus in any junction and pull boxes located between ends. Use write-on self laminating labels. Wrap around conductor in a "U" fashion.

12 MANUFACTURERS  
AND CSA LABELS

- .1 Visible and legible after equipment is installed.

13 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department and Departmental Representative.
- .2 Porcelain enamel decal signs, minimum size 170mm x 250mm.

14 SINGLE LINE  
ELECTRICAL  
DIAGRAMS

- .1 Provide single line electrical diagrams under plexiglass as follows:
- .1 Electrical distribution system: locate in main electrical room and local electrical room.
- .2 Include a legend of colour coding for the various systems identified in item 10-conduit and cable identification.
- .2 Drawings: Full drawing size from most recent drawing set, in main electrical room and 610mm x 610mm (minimum) size drawing in the penthouse.

15 LOCATION OF  
EQUIPMENT

- .1 Do not install outlets back-to-back in wall. Allow minimum 150mm horizontal clearance between boxes. Do not install boxes back to back in the same stud space wherever possible.
- .2 Change location of equipment at no extra cost or credit, providing distance does not exceed 3m, and information is given before installation.
- .3 Locate light switches on latch side of doors unless otherwise indicated. Locate disconnect devices in mechanical and elevator machine rooms on latch side of the door.

16 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or otherwise indicated.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Mounting heights for devices to conform with NBC and NS Building Code regulations for Barrier Free design.
- .4 Install electrical equipment at following heights unless otherwise indicated.
  - .1 Local switches: 1200mm
  - .2 Wall receptacles:
    - .1 General: 460mm
    - .2 Above top of continuous baseboard heater: 200mm, minimum 460mm AFF.
    - .3 Above top of counters or counter backsplash: 150mm
    - .4 In mechanical rooms: 1200mm
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Wall mounted telephone, data and CATV outlets:
    - .1 General: 460mm
    - .2 Above top of continuous baseboard heater: 200mm, minimum 460mm AFF.
    - .3 Above top of counters or counter backsplash: 150mm
    - .4 In mechanical rooms: 1200mm
  - .5 Fire alarm stations: 1200mm
  - .6 Fire alarm signals: 2300mm
  - .7 Security keypads: 1200mm
  - .8 Pin/Prox readers: 1200mm
  - .9 Wall mounted motion sensors: 150mm below finished ceiling.

17 LOAD BALANCE

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

18 CONDUIT AND  
CABLE INSTALLATION

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

19 FIRESTOPPING

- .1 Provide firestopping and smoke sealing of all cable, cabletrough or conduit penetrations through fire resistant separations as specified.

20 FIELD QUALITY  
CONTROL

- .1 Conduct and pay for following tests:
  - .1 Distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: fire alarm system and lighting control system.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to

each system has been installed to manufacturer's instructions.

- .3 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of Departmental Representative.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit typed test results for Departmental Representative's review and inclusion in the Operation and Maintenance Manual.

21 COORDINATION  
OF PROTECTIVE  
DEVICES

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

## PART 1 - GENERAL

- 1.1 REFERENCES
- .1 CSA C22.2 No. 65-2013, Wire Connectors, Tri-National Standard, with UL 486A-486B and NMX-J-543-ANCE-03.

## PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required. Provide for all panels including main switch board and main transformer.
  - .2 Fixture type splicing connectors: with current carrying parts of copper and copper alloy sized to fit copper conductors #10 AWG or less.
  - .3 Clamps or connectors for armoured cable, liquid tight flexible metal conduit.

## PART 3 - EXECUTION

- 3.1 MATERIALS
- .1 Make connections and terminations electrically and mechanically secure. Sizes of connectors to be as per manufacturer's recommendations for various sizes and combinations of wire sizes.
  - .2 Make joints required in branch wiring #10 and smaller utilizing "twist-on" type connectors as manufactured by "Ideal" (colour coded wirenut) of "Marrettes" #31, #33 or #35, or approved equivalents.
  - .3 Make joints for all other wiring utilizing "Thomas & Betts" colour keyed compression type connectors #5400 series c/w TBM series compression tools. A first layer of compound type tape to be followed by an additional layer of "Scotch" #33 vinyl tape. Approved alternative for wire connections up to, and including #6 may be colour coded wing-nut as manufactured by "Ideal".
  - .4 Marrette type connectors to be plier tightened.



## PART 1 - GENERAL

- 1.1 REFERENCES
- .1 CSA C22.2 No. 0.3-2009, Test Methods for Electrical Wires and Cables.
  - .2 CSA C22.1-2015, Canadian Electrical Code (CEC).
- 1.2 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
- 1.3 OPERATION AND MAINTENANCE DATA
- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.4 RELATED WORK
- .1 Electrical General Requirements: Section 26 05 00.

## PART 2 - PRODUCTS

- 2.1 BUILDING WIRES
- .1 Conductors: to be soft drawn stranded copper (of 98% conductivity). Minimum size: #12 AWG.
  - .2 Copper conductors sized as indicated or as required by C.E.C., with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90-XLPE.
  - .3 Copper conductors sized as indicated or as required by C.E.C., with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RWU90-XLPE.
- 2.2 TECK 90 CABLE
- .1 Conductors:
    - .1 Grounding conductors: stranded copper.
    - .2 Circuit conductors: stranded copper, size as indicated.

- .2 Insulation:
  - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V.
- .3 Inner jacket: polyvinyl chloride material.
- .4 Armour: interlocking aluminum.
- .5 Overall covering: polyvinyl chloride (PVC), heat, flame and moisture resistant material.
- .6 Connectors:
  - .1 Non-hazardous areas: Thomas & Betts Star Teck aluminum connectors or Crouse-Hinds or Appleton approved equivalent, complete with aluminum locknut.
- .7 Multi-conductor TECK cable ampacity is to be de-rated in accordance with the Canadian Electrical Code (based on number of conductors in cable assembly, ambient temperature, etc.).

### 2.3 ARMOURED CABLES

- .1 Conductors: 600 V insulated (RW90 XLPE), copper (of 98% conductivity), size as indicated, minimum #12 AWG.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: designed for cable.

### 2.4 CONTROL CABLES

- .1 Type LVT: two (2) soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
- .2 Control circuit wiring 50V and less: CAT 6 (colour to suit system, see Section 26 05 00). FT6 rated when run in free-air.

## PART 3 - EXECUTION

### 3.1 VOLTAGE DROP

- .1 Unless cable or wire sizes are indicated or noted on the electrical drawings, all 15A, 120VAC branch circuits size based on the following table. Length

includes vertical drop. De-rated multi-conductor TECK cable sizes, if larger, will supersede the following table.

0-20m	#12 AWG
21-35m	#10 AWG
36-55m	#8 AWG
56-90m	#6 AWG
91-140m	#4 AWG
141-180m	#3 AWG
181-215m	#2 AWG

3.2 INSTALLATION  
OF BUILDING WIRES

.1 Install wiring as follows:  
.1 In conduit systems in accordance with Section 26 05 34.

.2 The feeder neutral for all branch circuit panels which feed computerized equipment shall be rated to 200% of phase conductors.

3.3 INSTALLATION OF  
TECK 90 CABLE  
- 1000V

- .1 Install cables where indicated on drawings and herein. All mounting hardware will be galvanized steel.
- .2 Group cables wherever possible on hanging assemblies.
- .3 Cables to be supported independently of supports used for equipment of other trades; do not support from, or secure cables to any mechanical piping.
- .4 Install cables in neat and professional manner, so as to conserve headroom.
- .5 Cables shall enter all wall mounted equipment from the top.
- .6 Do not locate cables less than 300mm parallel to steam or hot water lines with minimum 100mm at crossovers.

3.4 INSTALLATION OF  
ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .3 Install AC-90 cable as per the following guidelines:  
.1 Do not use AC90 for panel feeders or branch circuit wiring that originates in the Level 300 MCTS Operations Room UPS and Emergency Power panels.

- .2 USE AC90 for branch circuit wiring in dry locations except otherwise indicated.
- .3 The grouping together of AC-90 cables to form a bundle for securing purposes is acceptable providing the following procedures are adhered to:
  - .1 In addition to securing type AC-90 cables at 1.5m intervals to structure, multiple or bundled groups of armoured cables must be tye-wrapped together at mid-point between each structure support, or every 760mm and secured to structure at 1.5m intervals, and also secured together (between each structure point) at 1.5m intervals.
  - .2 Limit grouping of AC-90 cables to a maximum of eight (8) current carrying conductors, including associated oversized neutral conductors where phase sharing occurs.
- .4 The following samples incorporate uses of both, common and dedicated (separate) branch circuit neutral conductors:
  - .1 Maximum of two (2) runs of #12/4 conductor cables, including common (oversized) branch circuit neutral in each.
  - .2 Maximum of two (2) 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 (4) 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 Originate AC-90 fixture feeds from the sides of outlet boxes and not from the box cover. Where three (3) and/or four (4) fixture drops extend from any one outlet box, the box must not be sized smaller than 119mm<sup>2</sup> square.
- .7 A 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 only) and its respective light fixture.
  - .1 Fixture drops are not to exceed 4.5m in total length unless specifically indicated otherwise.
  - .2 There will be not more than four (4) drops permitted to be fed from any one box regardless of its size. Secure AC-90 cables used for fixture drops within 300mm of the junction box. Each light fixture is to be complete with its own separate fixture drop originating from a junction box located within same ceiling of room as fixture. An exception will be recessed down

lights which may be wired from one fixture to another if they have integral junction boxes and the luminaire access opening is 150mm or greater in diameter.

.3 Wire light fixtures with a separate whip emanating from an overhead junction box within a T-bar ceiling space.

.4 #12 AWG type AC-90 armoured cables may be used where total fixture drop loads do not exceed the following:

.1 Maximum of 5000 watts @ 347 volts using #12 AWG drop.

.2 Maximum of 1800 watts @ 120 volts using #12 AWG drop.

.8 Provide separate pig-tail type leads in each light fixture junction/outlet box for final connections to fixture drops. Connect pig-tail leads to light fixture line and associated neutral conductors.

.9 Install in accordance with Installation of Cables: General.

3.5 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield where required.
- .3 Install insulated bonding conductor (minimum #12AWG Stranded Copper, green RW90 insulation) in conduit for control systems less than 50V.

3.6 INSTALLATION OF CABLES: GENERAL

- .1 Cables to be supported independently of supports used for equipment of other trades; do not support from or secure cables to ductwork, piping and ceiling hanger wires.
- .2 Do not lay cables on top of suspended ceiling grids and tiles.
- .3 Install cables in a neat and professional manner, so as to conserve headroom. Inspection will be by the Departmental Representative. Correct any unacceptable Work at no cost to the Departmental Representative.
- .4 Install cables parallel and perpendicular to building lines.
- .5 Secure cables to underside of metal decking wherever practicable.
- .6 Exposed wiring at panels to be neatly marshalled from

panel to finished ceiling space using suitably sized (minimum 450mm wide) ladder type cable tray.

- .7 Ty-rap branch circuit phase conductors and neutral (where applicable) at the closest point of entry within all panelboards, pull boxes, junction boxes, MCC's and switchboards.
- .8 Stranded conductors are to be twisted together at each termination.
- .9 Do not notch or cut structural members of wood frame construction to accommodate wiring installation.
- .10 Provide mechanical protection as required to protect wiring from damage from mechanical fasteners (nails, screws etc).
- .11 Drill individual holes for wiring and cables penetrating wood frame floor joists. Locate holes in centre third of joist depth. Space holes a minimum of 25 mm and not less than one diameter apart.
- .12 Obtain permission of Departmental Representative
- .13 Obtain permission of Departmental Representative prior to drilling where more than 4 holes must be clustered or adjacent to structural connections.

PART 1 - GENERAL  
Not Applicable

PART 2 - PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 40mm x 40mm, 2.7mm thick galvanized steel, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.
- .2 Standard rolled structural steel shapes, plates and pre-fabricated components to form a complete assembly.

2.2 CABLE TIES

- .1 The use of cable ties for supporting purposes is not permitted. Cable ties can only be used to hold various system cables "in place".
- .2 Nylon flame retardent, low smoke cable tie. Size as required.
- .3 Nylon flame retardant, low smoke cable tie mounting bracket. Mechanical fastening type only; adhesive mounts not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Do not support equipment from T-bar ceiling support. Provide independent supports as necessary.
- .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 within a maximum of 1m of each outlet box, junction box, pull box, cabinet or conduit fittings with spacing between supports as per CEC to building construction, conduit type and support system using straps.
  - .1 One-hole straps to secure surface conduits and cables smaller than 41mm.
  - .2 Two-hole straps for conduits and cables 41mm and larger.
  - .3 Conduit straps to be zinc plated steel.
- .7 Suspended support systems for conduits:
  - .1 Support individual conduit runs with minimum 12mm dia. continuously threaded rods and spring clips.
  - .2 Support two (2) or more conduits on u-shaped support channels supported by minimum 12mm dia. threaded rod hangers (trapeze style) where direct fastening to building construction is impractical.
  - .3 Continuously threaded rods to be zinc plated steel.
  - .4 Space channels in accordance with the CEC for the smallest conduit installed (maximum 1.5m spacing).
  - .5 Install washer and nut on both upper and underside of channel.
- .8 For surface mounting of two or more conduits, use channels spaced at 1.5m (center-to-center) spacing (maximum).
- .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 Confirm adequate support for raceways and cables, drop vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or cable ties to support or secure raceways or cables.
- .12 Do not use non-electrical equipment supports or equipment installed for other trades for conduit or cable support.
- .13 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Fasten individual and multiple runs of armoured cables to structure and in bundles using cable ties as permitted in 26 05 21 - Wire and Cables 0-1000 Volts.
- .15 Various suspended types of junction, pull and/or outlet

boxes as well as conduits, are to be supported with minimum size 9 mm threaded rod, nuts and flat washers. Secure threaded rods to boxes with one flat washer and nut installed on both sides of box.

- .1 One (1) rod required for all type boxes sized 150mm x 150mm and smaller (22,500mm<sup>2</sup> and smaller).
  - .2 Two (2) rods required for boxes sized 22,500mm<sup>2</sup> and larger, up to and including those sized 300mm x 300mm (90,000mm<sup>2</sup>).
  - .3 Minimum of four (4) rods required for all boxes sized larger than 90,000mm<sup>2</sup>
  - .4 All excess rod is to be cut-off within 13mm of channel bottom.
- .16 In addition to C.E.C. minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300mm from mid point of all 90° bends.
  - .17 Maximum spacings between conduit support channels shall be as dictated by smallest size conduit(s) being supported and/or secured to same.
  - .18 Touch up all field cut galvanized steel supports with galvanizing paint.

PART 1 - GENERAL

1.1 SHOP DRAWINGS  
AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.1 SPLITTERS

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

2.2 JUNCTION AND  
PULL BOXES

- .1 Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface or flush mounting as indicated.
- .2 Type D: welded steel construction with screw-on flat covers for surface mounting. Size cover a minimum of 25mm larger than the actual box dimensions. Surface or flush mounting as indicated.
- .3 Junction and pull boxes larger than 125mm x 125mm shall be Type "E", complete with continuously hinged door. Junction and pull boxes 125mm x 125mm and smaller shall be complete with screw cover.
- .4 Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .5 Single gang sectional type devices boxes being used in steel stud walls for the installation of both metallic and non-metallic type cables, shall not be sized smaller than 250cm<sup>2</sup>, complete with wrap around type bracket.
- .6 Two or more flush installed sectional boxes ganged together, or boxes sized 100mm<sup>2</sup> and larger (intended for devices) are to have an additional support bracket installed on opposite side of box not presently secured

to metal stud.

### 2.3 CABINETS

- .1 Type E: sheet steel, hinged screw-to-lock, door and return flange overlapping sides, handle, and catch, for surface mounting.

### 2.4 EXTERIOR CABINETS

- .1 NEMA 4X, hinged screw-to-lock door for surface mounting.

## PART 3 - EXECUTION

### 3.1 SPLITTER INSTALLATION

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

### 3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2m above finished floor.
- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.
- .4 Where located above accessible ceiling systems, locate enclosures within 760mm of ceiling.
- .5 Suspend enclosures on 9mm plated steel threaded rod or rods secured to enclosure with one flat washer and one nut on both sides of box. Refer to Section 26 05 29 for number of threaded rods.
- .6 Junction or outlet boxes feeding a maximum of two fixture drops shall not be sized smaller than 100mm square.
- .7 Concealed boxes located in the ceiling spaces above suspended type ceilings are not to be installed greater than 762mm above the finished ceiling elevation.
- .8 Junction boxes larger than 150mm x 150mm used in branch

circuit wiring are to be complete with bonding terminal stripes.

.9 Bond all metallic pull boxes with bonding conductor.

### 3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

PART 1 - GENERAL

1.1 REFERENCES .1 CSA C22.1-2015 , Canadian Electrical Code, Part 1.

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 100mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76mm x 50mm x 38mm or as indicated. 100mm square outlet boxes when more than one conduit enters one side with extension and tile rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 100mm x 54mm x 47mm.

.3 100mm square or octagonal outlet boxes for lighting fixture outlets.

.4 100mm square outlet boxes with extension and tile rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES .1 Electro-galvanized sheet steel concrete type boxes for

flush mount in concrete with matching extension and plaster rings as required.

- 2.5 FLOOR BOXES
- .1 PVC type Thomas & Betts 640P series double gang. Accessories to be provided include brass activation kit for carpet floor and brass flip-up cover plate and all fittings to make a complete installation.
- 2.6 CONDUIT BOXES
- .1 Cast FS or FD ferrous alloy boxes with factory-threaded hubs and mounting feet for all surface wiring of switches, receptacle, thermostats and similar devices mounted.
- 2.7 FITTINGS-  
GENERAL
- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Install flush mounted boxes in all finished areas unless otherwise indicated.
- .6 Install surface mounted boxes in service rooms and above ceilings unless otherwise indicated.

- .7 Install flush mounted boxes in outside of exterior walls unless otherwise indicated.
- .8 Install type FS or FD boxes for all outlets (regardless of system type involved) to be surfaced mounted.
- .9 Install concealed boxes in accessible locations.
- .10 Flush installed 100mm or 120mm square box being used as a pull box or junction box to have installed a single or double gange tile ring and blank cover installed on the box.
- .11 Do not use sectional type boxes with rigid galvanized steel conduit, rigid PVC conduit or EMT.
- .12 Boxes to be connected to AC-90 cables are to be specifically made for only AC-90 cables.
- .13 In metal drywall partitions, install a short piece of metal stud (same width as wall) on non-supported side of box and secure to box.

PART 1 - GENERAL

1.1 LOCATION OF  
CONDUIT

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

1.2 REFERENCES

- .1 CSA C22.2 No. 45.1-07, Electrical Rigid Metal Conduit - Steel (Tri-National Standard, with UL 6 and NMJ-J-534-ANCE-2007).
- .2 CSA C22.2 No. 56-2004(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .3 CSA C22.2 No. 83-1985(R2008), Electrical Metal Tubing.
- .4 CSA C22.2 No. 211.2-2006(R2011), Rigid PVC (Unplasticized) Conduit.

1.3 TRADE SIZE

- .1 The following are Metric trade sizes and Imperial trade size equivalent based on CEC Metric Units.

<u>Metric (mm)</u>	<u>Imperial (inch)</u>
12	3/8
16	1/2
21	3/4
27	1
35	1-1/4
41	1-1/2
53	2
63	2-1/2
78	3
91	3-1/2
103	4
129	5
155	6

1.4 RELATED WORK

- .1 Section 26 05 29: Fastenings and Supports.

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1.
- .2 Electrical metallic tubing (EMT) with steel set screw couplings: to CSA C22.2 No. 83.
- .3 Rigid pvc conduit, fittings; couplings and connectors: to CSA C22.2 No. 211.2.
- .4 Flexible aluminum conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.

2.2 CONDUIT  
FASTENINGS

- .1 One hole straps to secure surface conduits smaller than 41mm. Two hole straps for conduits 41mm and larger. Straps to be zinc plated (galvanized) steel.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two (2) or more conduits at 1.5m oc.
- .4 12mm dia threaded rods to support suspended channels.

2.3 CONDUIT  
FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Conduit fittings (LB, LL and LR) are to be used for 90° bends. "Ells" or corner pulling "Elbows" are prohibited.
- .3 Connectors, fittings and couplings for EMT: use steel set-screw type.
- .4 Rain-tight or waterproof type connectors shall be used on all vertical conduit runs to connecting equipment in areas with sprinkler heads.
- .5 Screw on plastic or metal (malleable) type bushings for conduit ends.

2.4 EXPANSION  
FITTINGS FOR RIGID  
CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200mm linear expansion.

- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 21mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## 2.5 FISH CORD

- .1 Polypropylene: minimum 3mm diameter.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Install as high as possible to underside of structure.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas (excluding tenant spaces).
- .3 Use electrical metallic tubing (EMT) in dry areas and where not subjected to damage. Do not use EMT in cast concrete.
- .4 Use EMT for branch circuit wiring from the MCTS Operations Room UPS and Emergency power panels on Level 300.
- .5 Use rigid hot dipped galvanized steel threaded conduit outdoors, in wet/damp areas (water entry and pilot plant rooms) and where subjected to damage.
- .6 Use rigid PVC conduit underground and below concrete floor slabs: minimum size 27mm dia.
- .7 Use liquid tight flexible metal conduit for connection to motors and other vibrating and/or mechanical equipment including but not limited to the following: dry type transformers, valves, motorized dampers, unit heaters, chillers, HVAC equipment, sprinkler system controls, etc.
- .8 Minimum conduit size for lighting, power and control circuits: 21mm.
- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 21mm dia.

- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.
- .15 Install insulated copper bonding conductor in all conduit runs. Minimum size: #14 AWG or Table 16 of C.E.C. which ever is larger.
- .16 Non-connected PVC or steel raceways protruding up through open bottoms of free-standing equipment require PVC bell ends and steel type "ground bushings" installed on ends of respective types of conduits.
- .17 Install bushings in all EMT and rigid galvanized steel conduits sized 35mm and larger before pulling in conductors.
- .18 Raintight EMT connectors and couplings are to be used on the vertical portion of conduit runs where terminating into tops of electrical equipment in areas with sprinkler heads and in wet areas.
- .19 Rigid PVC conduit shall be FT4 rated.
- .20 Install a conduit drop to each flush installed device box in all walls. For cables to be run in free air (telecommunications, etc), stub the conduit out of the wall into the accessible ceiling space of the room containing the flush installed device box.
- .21 For EMT wall stubs, install steel EMT connectors complete with plastic or grounding type bushings screwed on same. CSA approved EMT plastic end cap bushings may also be used.
- .22 All conduit wall stubs and associated boxes are to be adequately bonded to ground per CEC requirements.
- .23 Do not install conduits in concrete floor slabs. Install conduits below concrete floor slabs.

3.2 SURFACE  
CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5m clearance.

- .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 76mm parallel to steam or hot water lines with minimum of 25mm at crossovers.

### 3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Conduits to be installed above the bottom of the concrete ceiling drop panel.

### 3.4 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.
- .3 Where RPVC conduits emerge above floors, provide mechanical protection as required but not less than to a minimum of 150 mm above the slab.
- .4 Below slab conduits shall be installed in trenches not less than 300mm from underside of concrete floor slab to bottom of trench. Provide minimum 50mm of freshwater sand all around conduits.

PART 1 - GENERAL

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Include:
  - .1 Dimensions.
  - .2 Enclosure type.
  - .3 Rating.
  - .4 Accessories.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for disconnect switches for incorporation into manual specified in Section 01 78 00.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Heavy duty, fusible and non-fusible, horsepower rated disconnect switch in CSA Enclosure type as indicated (minimum CSA type 1 with driphood) electrical ratings as indicated.
- .2 Provision for padlocking in both the 'on' and 'off' switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .5 Quick-make, quick-break action.
- .6 ON-OFF switch position indication on switch enclosure cover.
- .7 Auxiliary contact
- .8 Viewing window to view open/close status of disconnect switch blades.

- 2.2 EQUIPMENT IDENTIFICATION
- .1 Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements.
  - .2 Indicate name of load controlled voltage panel designation and circuit numbers on size 4 nameplate.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install disconnect switches complete with fuses where required.