

1. General

1.1. General

- .1 This section covers items common to all sections of Divisions 02, 26, 27, 28 and 33.
- .2 The specification complements the drawings in describing the supply and installation of new air conditioning units. This system shall include but not necessarily be limited to the following:
 - .1 New wiring and breakers;
 - .2 Fire Alarm System verification;
 - .3 Demolition of existing as noted.

1.2. Related Sections

- .1 Division 0
- .2 Division 1
- .3 Division 23
- .4 Division 25
- .5 26 05 20 Wire and Box Connectors 0-1000V
- .6 26 05 21 Wires and Cables 0-1000V
- .7 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
- .8 26 28 16 Molded Case Circuit Breakers

1.3. Contract Drawings

- .1 The specification together with the drawings are intended to provide a description of a complete electrical system and therefore there shall be no omission of the items necessary or required to make a finished, workmanlike, first class installation, even though each and every item of labour and material may not be mentioned in the specification or shown on the drawings.
- .2 Items indicated on floor plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.
- .3 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by this contract as the work proceeds, with due regard to the structure and the work of other trades. This contract shall make any changes dictated by structural requirements, or conflicts with other trades, without charge.
- .4 Apparent errors or omissions shall be referred to the Departmental Representative whose decision shall be final.
- .5 Building dimensions shall not be scaled from the electrical drawings but shall be obtained from the Departmental Representative and/or structural drawings. Any discrepancy between the drawings and building shall be questioned before proceeding with the installation.

1.4. Codes and Standards

- .1 As a minimum standard perform all work in accordance with the requirements of the Provincial Department of Labour, Canadian Electrical Code C22.1-2018 Part 1, CSA Standards CAN

Z32.4 and CAN Z32.2, National Building Code, and ULC-S524-2018. 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 in these contract documents, be reduced by any codes.

- .2 Abbreviations for electrical terms: to CSA Z85-1983.
- .3 Comply with CSA Certification Standards and Electrical Bulletins in force at the time of tender submission.

1.5. Shop Drawings, Product Data and Samples

- .1 Submit shop drawings, product data and samples in accordance with Division 1. Provide all shop drawings within 30 days after contract has been awarded. Failure to do so will delay progress payments.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .5 Keep one copy of shop drawings and product data on site, available for reference at all times.

1.6. Operation and Maintenance Data

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Division 1.
- .2 Include in the operation and maintenance data:
 - .1 Details of design elements, construction features, component function, and maintenance requirements to permit effective start up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of installation.
 - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical description of items and parts lists. Advertising or sales literature not acceptable.
 - .3 Wiring and schematic diagrams and performance curves.
 - .4 Names and addresses of local suppliers for items included in maintenance manuals.
 - .5 Copy of reviewed shop drawings.
 - .6 Signed receipt for all spare parts.
- .3 Approvals:
 - .1 Submit one draft of Operating and Maintenance Manual to Departmental Representative for approval one month prior to estimated substantial completion date. Submission of individual data will not be accepted unless so directed by Departmental Representative.
 - .2 Make any changes in submission as may be required and re-submit as directed.
 - .3 Failure to do so will result in delay of progress payment.
 - .4 Provide two (2) final bound copies of Operation and Maintenance Manuals to Departmental Representative.

1.7. Project Record Documents

- .1 Provide Project Record Documents in accordance with Division 1.
- .2 Submit record drawings to Departmental Representative showing changes of wire sizes, circuit numbering and location of raceways, fittings, fixtures, panels and equipment, and their sizes, the location of which has changed or deviated during the work.
- .3 Submit sepia or reproducible of record drawings after record drawings have been approved by the Departmental Representative. Originals shall be made available by the Departmental Representative for the making of sepia or reproducible of the contract drawings. All changes reflected on record drawings are to be indicated on these sepia or reproducible.

1.8. Maintenance Material

- .1 Provide maintenance materials in accordance with Division 1.

1.9. Care, Operation and Start Up

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

1.10. Voltage Ratings

- .1 Operating voltages to meet requirements of CAN3-C235.
 - .1 Motors, control and distribution equipment to operate satisfactorily at 60 Hz within normal operating limits established by the above standard. Equipment to operate in extreme operating conditions established in the above standard without damage to the equipment.

1.11. Material and Equipment

- .1 Provide materials and equipment in accordance with Division 1.
- .2 Equipment and materials to be C.S.A. certified, and manufactured to standard quoted.
- .3 Where there is no alternative to supplying equipment, which is not C.S.A. certified, obtain special approval from C.S.A.
- .4 Factory assemble control panels and component assemblies.
- .5 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels; all motor control equipment; all fixtures in as much as is possible, etc.).
- .6 To avoid the possibility of the work being delayed, order all materials as soon as the shop drawings are reviewed, and report at once to the Departmental Representative any delays in the delivery of materials which would hold up the completion of the job.

1.12. Grounding

- .1 All equipment and exposed non-current carrying metal, conduits and parts shall be permanently and effectively *bonded to ground* to meet minimum requirements of the C.E.C. Section 10, 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. Section 10, shall not be reduced under any circumstances.

1.13. Electric Motor, Equipment and Controls

- .1 Provide final connections to all motors, equipment, controls, etc., indicated on the drawings. These motors, equipment, controls, etc., shall include those supplied under other sections of this specification, as well as Departmental Representative supplied items. Ensure that equipment will operate properly (e.g. proper rotation) and report any instance of defective equipment to the Departmental Representative.
- .2 Supplier and installer responsibility is indicated on electrical drawings, and in this specification and related mechanical responsibility is indicated on mechanical drawings, and in the Division 15 specifications.
- .3 All electrical equipment, which is supplied and installed by this Contract or other contracts, that requires wiring at or above 50V, shall be wired by this Contract in accordance with terms and regulations established by this Specification.
- .4 All electrical wiring and connections below 50V related to systems specified under other sections or contracts shall be done by their contractor in accordance with terms and regulations established by this Specification.
- .5 All electrical wiring and connections below 50V related to systems specified by Division 26 shall be done by the Division 26 Contractor.

1.14. Finishes

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment, "Equipment Green" finish to EEMAC Y1-1-1955.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime and paint exposed hangers, racks, and fastenings to prevent rusting.
- .4 Where wire guards are specified in other sections, they are to be constructed of stainless steel. Painted steel is not acceptable.

1.15. Equipment Identification

- .1 All switchboards, motor control centres, starters, disconnect switches, receptacles, voice/data/CATV/multimedia outlets, dry-type transformers, control transformers, pushbuttons, timeclocks, panels, control panels, etc., shall have "Lamacoid" nameplates mounted on or adjacent for identification which shall include the panel designation, voltage, phase, wires overcurrent protection, H.P., KW and amperage as applicable. The nameplates shall be affixed to metal equipment with metal type pop rivets, and to all other equipment with contact type cement applied to the entire nameplate backing. Contact type cement shall be applied (buttered) to complete rear side of plate, as opposed to several points or locations on same.
- .2 Install directories on the back of each door of panel boards, neatly arranged and mounted in frame under transparent cover. Directories shall be typed and shall show system voltage, which outlets are on each circuit and any special information, such as sizes of fuses, etc., necessary for the proper operation and maintenance of the system.
- .3 All sectionalising panels shall have lamacoid plates affixed adjacent to each breaker.

- .4 Size of identification shall be suitable for equipment and importance of information.
- .5 All fused disconnect switches shall have lamacoid plates identifying the equipment they feed and a separate plate indicating maximum fuse size and type.
- .6 Lettering shall be of sufficient size to be readable from normal viewing distance and the information required on the nameplates shall dictate the physical size of plates.
- .7 Nameplates shall have white lettering on black background except for equipment connected to emergency power source, which shall have white lettering on red background.
- .8 All transformers to have lamacoid plates identifying source of primary feeder and secondary equipment which it feeds plus distribution designation lettering and/or numbers.
- .9 All "D" and "E" boxes 200mm x 200mm x 100mm or larger and "C" and "T" cabinets shall have lamacoid plates affixed indicating voltages and/or systems housed within.
- .10 Nameplates:
 - .1 Lamacoid 3mm thick plastic engraving sheet on metal surfaces, 1.5mm where not applied to metals.

NAMEPLATE SIZES

Size 1	10mm x 50mm	1 line	5mm high letters
Size 2	13mm x 75mm	1 line	6mm high letters
Size 3	16mm x 75mm	2 lines	5mm high letters
Size 4	19mm x 91mm	1 line	10mm high letters
Size 5	38mm x 91mm	2 lines	12mm high letters
Size 6	25mm x 100mm	1 line	12mm high letters
Size 7	25mm x 100mm	2 lines	6mm high letters
Size 8	50mm x 150mm	2 lines	12mm high letters

- .11 Labels:
 - .1 Embossed plastic labels with 6.5mm high letters unless specified otherwise.
- .12 Wording on nameplates and labels to be approved by the Departmental Representative prior to manufacture.
- .13 Allow for average of forty (40) letters per nameplate and label.
- .14 Identification to be English.

1.16. Wiring Identification

- .1 Conductor insulation shall be colour coded as follows:

Phase A	-	Red
Phase B	-	Black
Phase C	-	Blue
Neutral	-	White/Grey
Ground /Bond	-	Green
Isolated Ground	-	Green w/Yellow stripe

This shall apply to all phase conductors up to and including #2AWG and all sizes of neutral, bond and ground conductors up to and including #3/0AWG.

- .2 For conductors exceeding sizes as described above, identification of wiring with approved coloured plastic tapes shall be acceptable. Attach to both ends of all conductor runs a minimum of 12" from terminations, and in all junction and/or pull boxes.

- .3 Maintain phase sequence and colour coding throughout.
- .4 Colour code shall be as per Section 26 05 21 2.1.1.
- .5 Use color coded wires in branch circuit wiring, systems wiring and communication cables.

1.17. Conduit, Cable and Junction/Pullbox Identification

- .1 Identify all conduit fittings and junction/pull boxes along with their covers with colours as described below. Boxes shall be coloured both inside and out where one colour is required, and inside only where two are required. Metal coverplates shall be completely painted where one colour is required, and shall have both colours applied diagonally where two colours are required. All junction boxes shall be colour identified prior to installation.
- .2

System	Colour
120/208V Lighting & Power	Yellow
Grounding/bond	Green
Fire Alarm	Red
0 to 50V	Violet
Energy Management	Red/White

1.18. Wiring Termination

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

1.19. Manufacturers' and CSA Labels

- .1 Manufacturers' and CSA labels shall be visible and legible after equipment is installed.

1.20. Warning Signs

- .1 Provide warning signs, as specified and/or to meet the requirements of the Department of Labour Inspection Department.
- .2 Use decal signs, minimum 175mm x 250mm size.

1.21. Mounting Heights

- .1 Mounting heights of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated verify before proceeding with installation.
- .3 Install electrical equipment at the following heights unless indicated otherwise.
- .4 Motor starters, disconnect, etc.: 1500mm

1.22. Protection

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS" or with appropriate voltage in English.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

1.23. Load Balance

- .1 Balance all phase currents of transformers, main switchboard, distribution Panel boards, etc., and where applicable, adjust transformer taps to obtain within 2% of the rated voltage of the load being supplied. Adjust and/or increase conductor size so as to limit voltage drops to 3% and make such adjustments under average load conditions in presence of Departmental Representative.
- .2 Submit to Departmental Representative, at completion of work, a report listing the voltage, phase and neutral currents on the switchboard, Panel boards and dry-type transformers, operating under normal load. On the report, also state hour and date on which each load was measured

1.24. Conduit and Cable Installation

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be constructed of sheet metal, sized for free passage of conduit, and protruding 50mm.
- .2 Install cables, conduits, and fittings to be embedded neatly and close to building structure so furring can be kept to minimum.

1.25. Tests

- .1 Conduct and pay for tests of the following:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Motors and associated control equipment including sequenced operation of systems where applicable.
 - .4 Fire Alarm system.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturers' instructions.
- .3 Carry out tests in presence of Departmental Representative. Notify Departmental Representative seven (7) days in advance of time testing will take place.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 The Departmental Representative reserves the right to use any piece of electrical equipment, device, or material installed under this contract for such reasonable lengths of time and at such times as he/she may require, to make a complete and thorough test of the same, before the final completion and acceptance of the work.
- .6 Such tests shall not be construed as acceptance of any part of the work.
- .7 Submit test results for Departmental Representative's review.

1.26. Insulation Resistance Testing

- .1 Test all wiring, included in the work to ensure that there are no shorts and/or grounds are present on phase conductors for feeders or branch circuits and that insulation values are as required by the Canadian Electrical Code.
- .2 All testing of conductors to be done prior to energization of conductors with 600 volt and 1000-volt meggers as required by the Canadian Electrical Code.

- .3 Capacitive leakage testing of all phases and neutral feeder conductors at various system originating points, are to be recorded for each individual feeder with test results to be submitted to Departmental Representative for approval.
- .4 Systems to be tested for capacitive leakage are as follows: 120/208V/3PH/4W.
- .5 Check resistance to ground before energizing. Ensure resistance to ground is not less than 50 megohms.
- .6 Submit test results for Departmental Representative's review. Test results shall include time of test, feeder tested, and instrument readings.

1.27. Coordination of Protective Devices

- .1 Ensure circuit protective devices such as over-current trips, relays, fuses, are installed to values and settings as indicated.

1.28. Cleaning

- .1 Do final cleaning in accordance with Division 1.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 On completion of work, remove debris resulting from work of this Division and leave the site neat and tidy. Equipment shall be checked for proper fitting and alignment, adjusted, cleaned, repainted where necessary, and left in first class condition.
- .4 This section shall be responsible for the removal of spatters, droppings, soil, labels, and debris from finished surfaces and from surfaces to receive finishes, before the set up. Work and adjacent finished work shall be left in new condition.
- .5 Only cleaning materials which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material shall be used.
- .6 Immediately before and during finishing work shall be made "broom clean". Interior areas shall be "vacuum cleaned" immediately before finish painting commences.
- .7 Material at site cannot be burned or buried except where approved by Departmental Representative and/or Departmental Representative. Removal shall be as often as required to avoid accumulation in order to ensure site is maintained clean.
- .8 Volatile fluid wastes cannot be disposed of in storm or sanitary sewers or in open drain courses.
- .9 Lowering of materials shall be controlled and shall not be dropped or thrown from stories above grade.

1.29. Coordination

- .1 Cooperate to make maximum use of the spaces. Avoid conflicts with pipes, ducts, etc. Prepare shop drawings indicating the route of main conduits and ducts for submission to the Departmental Representative and/or Departmental Representative for approval.
- .2 Cooperate 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 Consult where their respective installations conflict and re-route conduits, ducts, outlets, equipment, etc., as required, subject to the approval of the Departmental Representative and/or Departmental Representative.

- .4 Obtain complete detailed wiring diagrams of equipment requiring connections and be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.

1.30. Supervision

- .1 Provide supervision for work of this Contract to ensure that the work proceeds in proper and efficient manner to its completion. If in the opinion of the Departmental Representative, such personnel are not competent to carry out the work, replace these men immediately upon written request of the Departmental Representative and/or Departmental Representative.

END OF SECTION

1. General

1.1. Reference Standards

- .1 CSA C22.2 No. 18 - Clamps and connectors.
- .2 CSA C22.2 No. 65 Wire Connectors.

1.2. Related Sections

- .1 Division 0
- .2 Division 1
- .3 Division 23
- .4 Division 25
- .5 26 05 00 Common Work Results for Electrical
- .6 26 05 21 Wires and Cables 0-1000V
- .7 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
- .8 26 28 16 Molded Case Circuit Breakers

1.3. Shop Drawings and Product Data

- .1 Not Applicable

1.4. Operation and Maintenance Data

- .1 Not Applicable

2. Products

2.1. Materials

- .1 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each size and combination of wires.
- .2 Joints required in branch wiring #10 AWG and smaller shall be made using fixture twist-on type connectors with current carrying parts made of copper.
 - .1 Standard of Acceptance: Marrette #31, #33 or #35 as required.
- .3 Joints for wiring #8 AWG and larger shall be made using pressure type colour keyed compression connectors with current carrying parts made of copper using compression tools. A first layer of tape shall be compound type followed by a layer of Scotch #3 vinyl type.
 - .1 Standard of Acceptance: 54000 series.
- .4 Bushing stud connectors are not acceptable.
- .5 Clamps or connectors for armoured cable and flexible conduit as required.

3. Execution

3.1. 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 fixture type connectors and tighten with pliers or appropriate tool. Finger-tightening alone is not acceptable. Replace insulating cap.
- .2 All connections shall be made electrically and mechanically secure. Sizes of connectors shall be according to manufacturer's recommendations for each wire size and combination of wires. Twist wires together before installing connectors. All stranded conductors shall be twisted together prior to connection around terminal.

END OF SECTION

1. General

1.1. Reference Standards

- .1 CSA C22.2 No. 38 - Thermoset insulated Wires and Cables.
- .2 CSA C22.2 No. 51 - Armoured cables.
- .3 Wire and cable shall conform to the latest specification of the Canadian Standards Association (CSA), Electrical and Electronic Manufacturers Association of Canada (EEMAC), the Insulated Power Cable Engineers Association (IPCEA), and the American Society of Testing Materials (ASTM).

1.2. Related Sections

- .1 Division 0
- .2 Division 1
- .3 Division 23
- .4 Division 25
- .5 26 05 00 Common Work Results for Electrical
- .6 26 05 20 Wire and Box Connectors 0-1000V
- .7 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
- .8 26 28 16 Molded Case Circuit Breakers

1.3. Shop Drawings and Product Data

- .1 Submit product data in accordance with Division 1.

1.4. Operation and Maintenance Data

- .1 Not Applicable

2. Products

2.1. Building Wires

- .1 Conductors: Copper, soft drawn stranded, at least 98% conductivity for #12 AWG and larger. Insulation shall be chemically cross-linked thermosetting polyethylene rated 600 volts on all RW90 conductors and 1000 volts for RWU-90 for incoming service. Size as indicated on drawings and schedules. Conductor insulation shall be colour coded as follows:

Phase A	-	Red
Phase B	-	Black
Phase C	-	Blue
Neutral	-	White/Grey
Ground/Bond	-	Green
Isolated Ground	-	Green w/Yellow stripe
Isolated Power	-	as indicated hereinafter.

Where extra colours are required for three-way switches, etc., they shall be yellow.

Approved color coded tape is acceptable for color coding phase conductors #1 AWG and larger and for neutral and ground conductors #4/0 and larger.
Neutral conductors for feeders to branch panels feeding computerized equipment shall be sized at 200%.

2.2. Control Cables

- .1 600 V Type: 2 stranded copper conductors, 95% conductivity, full size AWG gauge, sizes as indicated with PVC insulation Type TW with shielding of magnetic tape wire braid over each pair of conductors and overall covering of thermoplastic jacket. Colour code shall be yellow.

2.3. Armoured Cables

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: to manufacturer's recommendations.

2.4. System Wiring

- .1 Wiring for auxiliary systems will be as indicated in specification or on drawings and/or as recommended by Manufacturer of the system.

3. Execution

3.1. Installation of Building Wires

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

3.2. Installation of Control Cables

- .1 Install control cables in EMT conduit complete with all associated steel connectors and couplings where run on surfaces of walls or open ceilings. Conduits shall be extended to within 760mm of all devices associated with the piece of equipment which they control. Final connection shall be made using liquid-tight flexible metal conduit and associated liquid-tight connectors.
- .2 EMT type conduit wall-stub c/w flush installed device box shall be located in all partitions to accommodate wiring between the device and the accessible ceiling space.
- .3 EMT connectors complete with nylon insulated throat or threaded type bushing shall be installed on end of EMT stubs where they protrude through the wall above, and within finished accessible ceilings. CSA approved EMT plastic end cap bushings may also be used.
- .4 All EMT conduit stubs shall be bonded to ground as required by CEC.
- .5 Control cable shields, if applicable, shall be bonded to ground.

3.3. Installation of Armoured Cables

- .1 Group cables wherever possible.
- .2 Flexible type conduit c/w RW90 conductors sized as noted and/or flexible armoured cable AC90 (BX) complete with separate grounding conductor.

- .3 "Fixture drop" is defined as that portion of AC90 cable or flexible conduit being used to make the final connection between the accessible type junction or outlet box located in ceiling space and its respective luminaire.
- .4 Flexible type conduit c/w RW90 conductors sized as noted and/or flexible armoured cable AC90 (BX) complete with separate grounding conductor.
- .5 AC-90 cable or RW90 in flex is to be used for branch circuit wiring drops from ceiling junction boxes to light fixtures, receptacles and other equipment requiring power in the same room only unless otherwise noted on the drawings. AC 90 (BX) cable used for fixture drops with a minimum size of No. 12. Total length of any individual AC-90 cable or flex c/w RW90 not to exceed 4500mm in length unless specifically indicated otherwise. The use of AC90 for home runs or wiring between rooms is not permitted.
- .6 All flex c/w RW90 or AC-90 cables used for fixture drops shall be secured within 300mm of the junction box.
- .7 Where application of AC-90 cables and/or other types of pliable cables are to be used, they shall be installed parallel or perpendicular to the building lines unless otherwise noted.
- .8 Support and securing of type AC-90 cables shall not be derived from either suspended ceiling support wires or directly laying atop of the ceiling grid system.
- .9 All AC-90 feeds shall originate from the sides of outlet boxes and not from the box cover. There shall not be more than 4 drop feeds permitted from any one box regardless of its size. Where 3 or more drop feeds extend from any one box, that box shall be sized no smaller than 119mm square.

3.4. Installation – General

- .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 and in no case shall wires be pulled until approval of the Departmental Representative is obtained.
- .2 All stranded conductors prior to terminating under device bolts such as circuit breakers, light switches, receptacles, etc., to be twisted together to form a single conductor to ensure a reliable mechanical connection.
- .3 All branch circuits are to utilize conduit pathways for home runs to each room or area, including rooms in which the panel is located. Where the branch circuit has multiple splices and/ or drop offs to multiple rooms, the use of AC90 for the drop off is permitted, however, the home run conduit shall be continued until the final room destination splice or drop off is reached.
- .4 "Labelling" of all branch circuit wiring including phase conductors, neutrals, grounding and/or bonding conductors to be done on both ends of all circuit wires plus in any junction and/or pull boxes located in between using "Panduit" write-on, self laminating labels Nos. PDL-1 and PDL-2 as required.
- .5 The following wiring methods are designed to enhance the ability to perform capacitive leakage tests:
 - .1 All circuit conductors are to be individually tie wrapped to their corresponding labelled neutral conductor in all panelboards, pullboxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually tie-wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality.
 - .2 The tie wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pullboxes and junction boxes.

- .3 The main switchboard, CDP's, panelboards, MCC's etc, are to have their respective feeder phase and neutral conductors tie-wrapped together and 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.
- .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 not ground shorts and capacitive leakage in the system.
- .5 All feeders or branch circuits which do not have neutral conductors are to have their respective phase conductors tie-wrapped together in accordance to the methods described previously.
- .6 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.
- .7 For 15 amp, 120 volt circuits the following table shall be used to determine the minimum conductor sizes required to compensate for voltage drop. In no case does this table allow a reduction in conductor size from that shown on the drawings or as specified elsewhere in the specifications.

.1	From	0.3m to 24m	#12 Wire
.2	From	24m to 37m	#10 Wire
.3	From	37m to 55m	#8 Wire
- .8 Find below the branch circuit maximum lengths (120 volt one way length from panelboard to load including vertical drops. Voltage drop shall not exceed 3% in any instance.

.1	From	0.3m to 24m	#12 Wire
.2	From	24m to 37m	#10 Wire
.3	From	37m to 55m	#8 Wire
- .9 Increased wire sizes where required shall not be decreased in size in any portion of length of run between panelboard and the wiring device itself.
- .10 All wiring shall be color coded as per Code requirements and/or as specified herein.

END OF SECTION

1. General

1.1. Reference Standards

- .1 CSA C22.2 No. 18 - Outlet boxes, conduit boxes and fittings.

1.2. Related Sections

- .1 Division 0
- .2 Division 1
- .3 Division 23
- .4 Division 25
- .5 26 05 00 Common Work Results for Electrical
- .6 26 05 20 Wire and Box Connectors 0-1000V
- .7 26 05 21 Wires and Cables 0-1000V
- .8 26 28 16 Molded Case Circuit Breakers

1.3. Shop Drawings and Product Data

- .1 Not Applicable

1.4. Operation and Maintenance Manual

- .1 Not Applicable

2. Products

2.1. Outlet and Conduit Boxes General

- .1 Size boxes in accordance with Canadian Electrical Code, Part 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 CSA approved barriers where outlets for more than one system are grouped.
- .6 Outlet boxes for concealed use in frame construction shall be sectional, galvanized, pressed steel; these shall be restricted for use with flexible conduit AC-90 cable (where indicated) or other pliable type cable. The installation of any type of rigid type conduit in sectional boxes is prohibited. Where wire fill dictates larger boxes for outlets, use suitably sized square boxes with raised, square, welded tile ring style extensions. Tile rings shall not be used in surface mounted installations. Plaster type rings are not acceptable.
- .7 All outlet boxes connected to AC90 cabling shall be specifically designed for the purpose. Dual rated boxes are not acceptable.

- .8 Where multiple flush boxes are installed grouped together in metal drywall partitions, they shall be supported between the studs with a box mounting bracket (Caddy RBS or SGB series).

2.2. Sheet Steel Outlet Boxes

- .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 75 x 50 x 63mm or as indicated with a minimum volume of 262,192 cu. Mm (similar to Iberville # BC-3104-LSSAX). 100mm (4 inch) square outlet boxes when more than one conduit enters one side, with extension and tile rings (square, welded type) as required. For use in masonry construction, style MB (S or D) shall be used.
- .2 100 mm square or octagonal outlet boxes for lighting fixtures.
- .3 100mm square outlet boxes with extension and plaster rings for flush mounting special devices in finished plaster or tile walls.

2.3. Masonry Boxes

- .1 Electro-galvanized steel masonry boxes single and multi gang for devices flush mounted in exposed block walls and where indicated.
- .2 Provide a 2-gang deep masonry outlet box for all multimedia outlets, c/w stainless steel cover plates. Minimum dimensions are as follows: 95mm X 96mm X89mm deep. Install Caddy RBS Type mounting bracket.

2.4. Concrete Boxes

- .1 Electro-galvanized sheet steel concrete boxes for flush mounting in concrete with matching extension and plaster rings as required.
- .2 Where wire fill dictates larger boxes than single gang outlets, use suitable sized square boxes, with raised "tile ring" style extension.

2.5. Conduit boxes

- .1 Cast FS Aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.
- .2 Metal type "FS" device plates to be used on all type "FS" boxes unless noted otherwise.

2.6. Rigid Conduit Boxes

- .1 Cast FS or FD ferrous rigid conduit boxes with factory-threaded hubs and mounting feet for surface wiring where rigid conduit other than "EMT" is used.

2.7. Multi-Outlet Boxes

- .1 Electro-galvanized steel barrier pre-ganged multi-outlet boxes for devices with different sources of voltage in the same box.
- .2 The barrier of sheet steel shall not be less than (No. 16 MSG) thick used to divide the space into separate compartments for the conductors of each system. The barrier shall be fastened rigidly to the box.

2.8. Fittings - General

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.

- .3 Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.9. Conduit Supports

- .1 In steel stud framing construction provide for boxes a metal stud clip (Caddy MSF) and a far side support (Caddy 766) or a separate quick mount support (Caddy "H" Series).
- .2 Use adjustable screws gun brackets (caddy "TS" series) where box requires mounting between steel studs.
- .3 Other support systems will be accepted only after review by Departmental Representative.

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 construction material. Remove filling material at completion of project.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 65mm of opening.
- .4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers not allowed.
- .5 At each local switch, receptacle, ceiling or wall fixture, continuous row of fixtures, or system unit (i.e. fire alarm, T.V., etc.) provide and install a standard or twin filler or barrier pressed steel outlet box, unless specifically noted otherwise. All outlet boxes shall be fabricated of galvanized sheet steel and set flush with finished surfaces. They shall be rigidly and securely set.
- .6 All flexible conduit fixture feeds shall originate from the side of the outlet box and not from the box cover, with the exception of the modular furniture connections, which shall be permitted to exit from the cover.
- .7 In locating outlets, take care to allow for radiation, pipes, ducts, etc., and for the variation in arrangement and thickness of finishes, etc. Failure to comply with this will not relieve Contractor from the cost of necessary alterations.
- .8 Allow for the relocation of an outlet up to a dimension of 3m from that indicated on drawings, provided notice is given before roughing-in has been completed.
- .9 Install floor boxes in concrete formwork, prior to concrete pour, securely set to ensure finished collar is flush with the surface of the specified finish flooring.

END OF SECTION

1. General

1.1. Reference Standards

- .1 CSA C22.2 No. 29-M1983 - Panelboards and panelboard enclosures.

1.2. Related Sections

- .1 Division 0
- .2 Division 1
- .3 Division 23
- .4 Division 25
- .5 26 05 00 Common Work Results for Electrical
- .6 26 05 04 Through-Penetration Firestopping for Electrical Systems
- .7 26 05 20 Wire and Box Connectors 0-1000V
- .8 26 05 21 Wires and Cables 0-1000V
- .9 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
- .10 26 28 16 Molded Case Circuit Breakers

1.3. Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Division 1.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4. Operation and Maintenance Manual

- .1 Not Applicable

2. Products

2.1. Panelboards

- .1 Panelboards: product of one manufacturer.
- .2 Type: 600V LT, 3 phase, 4 wire, as indicated.
- .3 Panelboards shall have surface trim and doors finished for surface or flush mounted as shown on drawings, bolt-on circuit breaker type, sized and of types and electrical characteristics as indicated on drawings.
- .4 Cabinets for panelboards shall be minimum number 14 gauge galvanized steel, minimum of 508mm wide and 147mm deep, of dead front construction, and doors shall be single type, 120 degree door swing, with spring latch and lock. Two keys shall be supplied with each panelboard and all shall be keyed alike. Surface mounted panelboards shall be finished in ASA61 baked enamel. Panel bus bars shall be of aluminum with lugs suitable for copper conductor connections.

- .5 Drip Hoods: on all surface mounted panelboards factory installed.
- .6 All 3 phase, 4 wire panelboards rated at 225 amperes or less to have grounding terminal strip supplied and installed by manufacturer capable of terminating a minimum of two #2s, four #6s with balance of terminations to accept #12 conductors.
- .7 All panelboards rated at 225 amperes or less with voltages and phases as indicated on drawings requiring isolated grounding, to be capable of terminating quantities and sizes as indicated on electrical drawings.
- .8 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .9 Ratings: mains, number of circuits, and number and size of main and branch circuit breakers as indicated in panel schedules.
- .10 Neutrals in panels A, B, C and D shall have 200% rated neutrals.

2.2. Breakers

- .1 Breakers: to Section 26 28 16.
- .2 Breakers with thermal magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: When indicated separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker. If main breaker is mounted on the bottom of panel, panel shall be approved for that purpose and shall be so marked.
- .4 Lock-on devices on handles of circuit breakers shall be installed for exit light circuits, fire alarm circuits, CCTV system, alarm monitoring and security, sump pumps to prevent accidental operation.

2.3. Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 4 engraved or as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved or as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

3. Execution

3.1. Installation

- .1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 or as indicated.
- .4 Connect loads to circuits as indicated.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

- .6 Panels shall be installed in an upright position and the bottom of the panelboard shall be located not less than 1000mm above finished floor level where practicable.
- .7 Install a typed directory under transparent cover on the inside of each new panelboard showing the location and load connected to each circuit.
- .8 Wiring in panelboards shall be secured with tie wrap or equivalent means to present a neat workmanlike appearance. Branch circuitry wiring within panelboards shall have approximately 300mm of "slack" wire installed in 150mm loop adjacent to respective breakers where phase conductors terminate. All branch circuit neutral, ground and/or bond conductors to have approximately 300mm of slack wire neatly "looped" prior to terminations taking place. All feeder conductors to be installed in such a manner as to enable "clip on" type capacitive leakage tester to encompass neutral plus phase conductors together. Feeder conductors to be provided with additional slack wire adjacent to termination lugs.
- .9 Panels shall be flush or surface mounted as indicated in the schedule and shall be equipped with all breakers of the amperage and interrupting capacity noted on the drawings.
- .10 Run two 25mm spare conduits up to the ceiling space from each flush panel. Terminate these conduits in a 150 x 150 x 100mm junction box in the ceiling space. Box to have affixed nameplate indicating panel.
- .11 Circuit numbers on drawings do not necessarily correspond to the numbers on the lighting and power panels. Circuits sharing a common neutral shall not be connected to the same phase. Any changes in circuit numbering is to be included on "record drawings". Individual light fixtures fed with two branch circuits are to derive their source from two pole breakers.
- .12 The Lamacoid identification plate on panelboards shall include the voltage phase and wires and amperage (of breaker or fuse protecting it) in addition to the panel designation itself.
- .13 "Labelling" of all branch circuit phase conductors plus neutral and/or bond conductors shall be done with "Panduit" write-on, self laminating labels Nos. PDL-1 and PDL-2 as required or approved equal.
- .14 Maximum size conduits housing 15A or 20A branch circuits to be limited to 25mm in size exiting any panelboard.

3.2. Tests

- .1 Perform tests in accordance with Section 26 05 00.

END OF SECTION