

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No. 1, Overhead Systems.
 - .3 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .4 International Electrical Testing Association Inc. (NETA)
 - .1 NETA ATS, Acceptance Testing Specifications – For Electrical Power Distribution Equipment and Systems.

1.3 DEFINITIONS

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

1.4 DESIGN REQUIREMENTS

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

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

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

1.6 QUALITY ASSURANCE

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

1.7 SYSTEM STARTUP

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

1.8 OPERATING INSTRUCTIONS

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

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

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

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings.

2.3 WARNING SIGNS

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

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamacoid 3 mm thick plastic engraving sheet matt white finish face, black core, lettering accurately aligned and engraved into core [mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Engineer prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved with equipment tag.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.

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

	Prime	Auxiliary
Low Voltage AC	Black	
Medium Voltage AC	Orange	
Low Voltage DC	Black	
Admin LAN – Ethernet	Yellow	
Admin LAN – Ethernet Trunk	Red	
Operational LAN – Ethernet	White	
Operational LAN – Ethernet Trunk	Violet	
Digital Telephone	Blue	
Armoured Fiber Optic	Orange	
Fiber Optic in Corrugated Conduit	Orange	Conduit
Fiber Optic	Black	
Serial Connection	Grey	
Control Cables	Grey	
Instrumentation Cables	Grey	
Instrument Transformer Cables	Grey	
Fire Alarm	Red	

2.8 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.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

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

3.2 NAMEPLATES AND LABELS

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

3.3 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor or finished grade to centreline of equipment unless specified or indicated otherwise.

- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
 - .1 Panelboards: as required by Code or as indicated.
 - .2 Circuit breakers: as required by Code or as indicated.
 - .3 Metering facilities: as required by Code, or by Manitoba Hydro Metering Standards, or as indicated.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.5 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads 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 1.25% below rated voltage of equipment when equipment is in operation.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on transformers and motor starters, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests.
 - .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 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.
 - .5 Test all cables rated over 600 V using a Very Low Frequency (VLF) Tan Delta test, voltage level of test shall be in accordance with cable manufacturer's recommendations.
 - .1 Check resistance to ground before energizing.
 - .6 Perform acceptance testing in accordance with NETA ATS
- .3 Record results of all tests and submit results to Engineer for approval.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 CSA International
 - .1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings
 - .2 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMJ-J-543-ANCE-03)
- .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating)
- .4 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors
 - .2 Clamp for stranded copper conductors
 - .3 Stud clamp bolts
 - .4 Bolts for copper conductors
 - .5 Sized for conductors as indicated
- .4 Clamps or connectors for armoured cable, TECK cable and flexible conduit, as required to: CAN/CSA-C22.2 No.18
- .5 Other products shall be as indicated on drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Inform Engineer of unacceptable conditions immediately upon discovery.

- .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.2 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 all tests in accordance with CAN/CSA-C22.2 No.65
 - .2 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 26 05 00 – Common Work Results for Electrical.
- .3 Section 26 05 20 – Wire and Box Connectors (0-1000 V)
- .4 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 CSA C22.1 Canadian Electrical Code Part 1
- .3 CSA C22.2 No 0.3 Test Methods for Electrical Wires and Cables
- .4 CSA C22.2 No 38 Thermoset Insulated Wires and Cables
- .5 CSA C22.2 No 51-14 Armoured Cables
- .6 CSA C22.2 No 75 Thermoplastic Insulated Wires and Cables
- .7 CSA C22.2 No. 131 Type TECK 90 Cable
- .8 CSA C22.2 No 239 Control and Instrumentation Cables
- .9 CSA C22.2 No 2556 Wire and Cable Test Methods
- .10 FM Global 5-31 Datasheet for Cables and Bus bars
- .11 ASTM B8-11 Standard Specification for Concentric-Lay - Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- .12 ASTM B33-10 Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
- .13 ICEA S-73-532 Standard for Control, Thermocouple Extension and Instrumentation Cable
- .14 IEC 60227 Polyvinyl Chloride Insulated Cables of Rated Voltages up to and including 450/750 V
- .15 IEC 60228 Conductors of Insulated Cables

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG for power circuits rated 120 volts AC or higher, and 18 AWG for instrumentation analog 4-20mA circuits rated 24 VDC and below.

- .2 Copper conductors: size as indicated, with 600 or 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Ethylene propylene rubber EP
 - .2 Chemically cross-linked polyethylene type RW90 XLPE
 - .3 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 300 mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.
 - .2 Explosion-proof, approved for TECK cable.

2.3 CONTROL CABLES

- .1 Type: LVT: soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
- .2 Type: 600 V, 7 stranded annealed copper conductors, with size and quantity of pairs or triads as indicated:
 - .1 Insulation: PVC.
 - .2 Shielding: metalized tapes over each pair or triad of conductors.
 - .3 Overall covering: with sheath of aluminum interlocked armour and jacket over sheath of PVC.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at pull boxes, and termination points.
- .5 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels or within cable trays spaced in accordance with CSA-C22.1 CEC.
- .2 Cables installed underground shall be in accordance with CSA-C22.1 and as indicated on drawings.
- .3 Provide 100% cable spacing for parallel feeders.
- .4 Provide 25% to 100% cable spacing for cables installed within cable trays.
- .5 Cables are to be securely supported by straps, spaced in accordance with CSA-C22.1 CEC, or as indicated on drawings, or as described above.

3.4 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in cable troughs or underground.
- .2 Control cable shield to be grounded at source end only.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41, Grounding and Bonding Equipment.
 - .3 CSA C22.2 No. 65, Wire Connectors

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations.
 - .2 Store and protect connectors and terminations from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper compression connectors to CSA C22.2No. 65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.
- .3 All other connectors and terminations shall be as indicated on drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and terminations installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 – Electrical Common Work.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .3 CSA International
 - .1 CSA C22.1, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 EQUIPMENT

- .1 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
- .2 Grounding conductors: bare, stranded copper, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, copper conductors, size as indicated.
- .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate for presence of damage or other unacceptable conditions.
 - .2 Inform Engineer of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 All exposed ground connections to be coated with Glyptal or approved equal.
- .5 All connections between ground conductors, ground bus, ground plates, and ground lugs shall be a compression connection.
- .6 All connections to structural steel, rebar, or miscellaneous structural steel shall be a bolted connection.
- .7 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .8 Soldered joints not permitted.
- .9 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.3 ELECTRODES

- .1 Bond all grounding systems and electrodes together.
- .2 Use size 2 AWG copper conductors for all bonding and grounding connections unless indicated otherwise on drawings.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary 600 V, 480 V, and 208 V systems.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to all equipment installed under this contract.

3.6 FIELD QUALITY CONTROL

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure, NEMA Type 4 enclosure rating, hinged door with stainless steel screw down clamps on 3 sides or door, hasp and staple for padlocking, external mounting brackets for wall-mounting, oil resistant gasket, ANSI 61 grey polyester powder paint finish inside and out, sized to suit all cable entry and terminations.
- .2 Junction boxes for well/irrigation pumps shall be as indicated on drawings.

2.2 CABINETS

- .1 Construction shall be as follows:
 - .1 Type 4 enclosure rating
 - .2 12 gauge sheet steel
 - .3 Seams continuously welded and ground smooth
 - .4 Body stiffeners for added strength as required
 - .5 Floor stands welded to enclosure
 - .6 Continuous hinge on all doors with stainless steel hinge pin
 - .7 Minimum 2 doors with three-point latch and lockable operating handles with 2 keys
 - .8 Heavy-duty lifting eyes
 - .9 Oil resistant door gaskets
 - .10 Interior panel for mounting equipment complete with panel supports
 - .11 ANSI 61 grey polyester powder paint finish inside and out
 - .12 Sized to suit all equipment installed within

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

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

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster 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 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to

accommodate short or long ear duplex and single receptacles. Minimum depth: 73 mm for receptacles and communication outlets.

- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16, 21 and 27 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices shall be used in all outdoor applications or wet locations.
- .2 Cast aluminum boxes shall be hazardous location rated where required. Refer to hazardous location plan drawings.

2.7 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.
- .5 Provide hazardous location conduit seals where required. Refer to hazardous location plan drawings.

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 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 All conduit seals for hazardous locations shall be installed in accordance with manufacturers instructions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 23 10 - Excavating, Trenching and Backfilling.
- .2 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 Canadian Standards Association, (CSA International)
- .3 Insulated Cable Engineers Association, Inc. (ICEA)

Part 2 Products

2.1 CABLE PROTECTION

- .1 38 x 140 mm planks pressure treated with 5% pentachlorophenol solution, water repellent preservative where indicated on drawings.

2.2 MARKER TAPE

- .1 Underground warning tape Installed in same vertical alignment with cables as indicated on drawings, heavy-duty B-720 polyethylene material with over-coated graphics, 4.0 mil thick, 150 mm wide, black lettering on red background, text to indicate "CAUTION BURIED ELECTRIC LINE BELOW".

Part 3 Execution

3.1 DIRECT BURIAL OF CABLES

- .1 After sand bed specified in Section 31 23 10 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
- .2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.
 - .1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.
- .4 Minimum permitted radius at cable bends in accordance with manufacturer's instructions.
- .5 Cable separation:

- .1 Maintain 75 mm minimum separation between cables of different circuits or as indicated on drawings.
- .2 Maintain 300 mm horizontal separation between low and high voltage cables.
- .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
- .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
- .5 When cables cross other underground piping or utilities maintain 300 mm vertical separation.
- .6 After sand protective cover specified in Section 31 23 10 - Excavating, Trenching and Backfilling, is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks to cover length of run where indicated on drawings.

3.2 CABLE INSTALLATION IN DUCTS

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

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests.
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

- .6 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing at 100% of original factory test voltage in accordance with manufacturer's recommendations.
 - .4 Leakage Current Testing.
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - .1 ANSI/IEEE 386-[95(R2001)], Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C2-[M91], Single-Phase and Three Phase Distribution Transformers, Types ONAN and LNaN.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.
- .3 Submit shop drawings and indicate:
 - .1 Anchoring method and dimensioned foundation template.
 - .2 Dimensioned cable entry locations.
 - .3 Dimensioned cable terminations.
- .4 Identified internal and external component layout on assembly drawing.
- .5 Insulating liquid capacity.
- .6 Quality Assurance Submittals: submit following in accordance with Section [01 45 00 - Quality Control].
 - .1 Certificates: submit production certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Closeout Submittals:
 - .1 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Include insulating liquid maintenance data.
 - .3 Include list of recommended spare parts.

1.4 MAINTENANCE

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 EQUIPMENT

- .1 Three phase dead front pad mounted distribution transformers: to CSA C227.4.
- .2 Separable insulated connectors for power distribution systems above 600 V: to ANSI/IEEE 386.
- .3 Oil filled pad mounted distribution transformers complete with primary and secondary cable compartments, primary fused options and accessories to form complete factory assembled, self contained, steel fabricated for mounting on concrete pad.
- .4 Transformer to be filled with oil prior to shipment. Field filling transformer with oil is not acceptable.
- .5 High voltage bushings or high voltage bushing wells for connection to distribution system through separable insulated connectors for dead front operation.
- .6 Separable insulated connectors.
- .7 Spade type low voltage terminals.
- .8 Connectors for primary and secondary cables.
- .9 Primary protection oil immersed fuse.
- .10 Separate padlocking for primary compartment door.
- .11 Load break inserts for elbow connectors.
- .12 Stays to hold compartment doors in 110 degrees open position.

2.2 TRANSFORMER TR-1 CHARACTERISTICS

- .1 Primary voltage: 600 V, 60 Hz, delta connected, 3 phase, un-grounded.
- .2 Secondary voltage: 2400 V, wye connected, 3 phase, 3 wire, neutral grounded.
- .3 Capacity: 45 kVA.
- .4 Basic impulse level: 60 kV.
- .5 Maximum rms short-circuit: 50 times base current for 2 cycles.
- .6 Impedance: not more than 5%

2.3 TRANSFORMER TR-2 & TR-3 CHARACTERISTICS

- .1 Primary voltage: 2400 V, 60 Hz, delta connected, 3 phase, un-grounded.
- .2 Secondary voltage: 480 V, wye connected, 3 phase, 3 wire, neutral grounded.

- .3 Capacity: 15 kVA.
- .4 Basic impulse level: 60 kV.
- .5 Maximum rms short-circuit: 50 times base current for 2 cycles.
- .6 Impedance: not more than 5%

2.4 VOLTAGE TAPS

- .1 Four-2.5% taps, 2-FCAN, 2-FCBN for transformer TR-1.
- .2 Two-5% taps, 1-FCAN, 1-FCBN for transformer TR-2 and TR-3.

2.5 TAP CHANGER

- .1 Externally operated off-load tap changer, with provision for padlocking on 3 phase units.

2.6 ACCESSORIES

- .1 Liquid temperature thermometer without contacts.
- .2 Liquid level gauge without contacts.
- .3 Pressure relief device.
- .4 25 mm drain valve.
- .5 25 mm filler plug.

2.7 GROUNDING

- .1 Copper grounding bus.
- .2 Connectors for grounding #2 AWG conductor.

2.8 FINISH

- .1 Finish exterior of unit in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.9 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate showing information in accordance with CSA C2.

2.10 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results for Electrical.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSPECTION

- .1 Check factory made connections of transformer unit for mechanical security and electrical continuity.
- .2 Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

3.3 INSTALLATION

- .1 Ensure pad is fully installed before transformer is installed.
- .2 Set and secure transformer unit in place, rigid, plumb and square.
- .3 Make connections.
- .4 Connect transformer unit ground bus to system ground.
- .5 Set taps to produce rated secondary voltage at no-load.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20 degrees C.
 - .1 High voltage to ground with secondary grounded for duration of test.
 - .2 Low voltage to ground with primary grounded for duration of test.
 - .3 High to low voltage.
- .3 Inspect primary and secondary connections for tightness and for signs of overheating.
- .4 Inspect and clean bushings and insulators.
- .5 Check oil level and temperature indicators.
- .6 Set transformer taps to rated voltage as specified.
- .7 Inspect for oil leaks and excessive rusting.
- .8 Inspect oil level.
- .9 Check fuses for correctness of type and size.
- .10 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 CSA International
 - .1 CSA C22.2 No.193, High-Voltage Full-Load Interrupter Switches.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for interrupter switches and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for interrupter switches for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 LOAD INTERRUPTER SWITCH

- .1 Load Interrupter Switch: to CSA C22.2 No.193.
- .2 3 pole, quick-make, quick-break assembly, stored energy operating mechanism, manual operated, assembled on welded steel base.

- .3 Continuous full load rating: 200 A, interrupting rating: 12.5 kA, symmetrical 5 kV for 2 seconds.
- .4 Voltage rating: 5 kV.
- .5 60 kV BIL.
- .6 Interphase barriers.
- .7 Non-removable operating handle c/w provision for pad locking.
- .8 Power fuses: 7E rated.
- .9 Enclosure: CSA Enclosure 3R.
- .10 Include viewing windows that permits full view of the position of all three switch blades.
- .11 Interlocks with features as follow:
 - .1 Fuse is only accessible after switch is opened.
 - .2 Switch can be closed only after fuse access door is closed.

2.2 FABRICATION

- .1 Factory assemble and adjust 3 pole gang operated switch, operating assembly, interphase barriers and interlocks.

2.3 ACCEPTABLE MATERIAL

- .1 The following manufacturers and series are considered acceptable:
 - .1 Schneider Electric – MiniBreak Load Interrupter Switch
 - .2 S & C Electric – PMH-5

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for interrupter switches installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Engineer of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install load interrupter switches.
- .2 Check switch contact resistance with low resistance meter.
- .3 Megger switch across each pole, from pole to pole, and from pole to ground.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4, Enclosed Switches.
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 size as indicated.
- .2 Provision for padlocking in off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 CSA International
 - .1 CSA C22.2 No.14, Industrial Control Equipment.
- .3 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1, Industrial Control and Systems: General Requirements.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held with poles to suit. Coil rating: 120 VAC (or as required by wiring schematics) . Contact rating: 120 V, 10 A minimum or 24 VDC, 5 A minimum as required.
- .3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 120 V (or as required by wiring schematics), 10 A minimum or 24 VDC, 5 A minimum as required.

2.2 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 OPERATOR CONTROL STATIONS

- .1 Enclosure: CSA Type 4, surface mounting:

2.4 PUSHBUTTONS

- .1 Heavy duty, oil tight. Operator extend type. Black, with 2-NO and 2-NC contacts rated at 120 V, 10 A minimum, AC, labels as indicated. Stop pushbuttons coloured red, labelled as indicated.

2.5 SELECTOR SWITCHES

- .1 Maintained 2 or 3 position as required, labelled as indicated, heavy duty, oil tight, standard operators, contact arrangement as indicated, rated 120 V, 10 A minimum or 24 VDC, 5 A minimum as required.

2.6 INDICATING LIGHTS

- .1 Heavy duty, oil tight, full voltage, LED type, lens colour: as indicated, supply voltage: 120 V AC, lamp voltage: 120 V AC, labels as indicated.

2.7 CONTROL AND RELAY PANELS

- .1 CSA Type 4 sheet steel enclosure with hinged padlockable access door with gasket, accommodating relays timers, labels, as indicated, factory installed and wired to identify terminals.

2.8 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 600 V, 60 Hz ac.
- .3 Secondary: 120 V, AC.
- .4 VA Rating: as required by load plus 20%.
- .5 Primary fuse: sized as required by transformer.
- .6 Secondary fuse: as required by loads.
- .7 Close voltage regulation as required by magnet coils and solenoid valves.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.
 - .2 Inform Engineer of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

3.2 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, control devices and interconnects.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.
- .3 Section 26 29 03 – Control Devices.

1.2 REFERENCES

- .1 All standards listed refer to latest edition adopted by the local inspection authority.
- .2 National Electrical Manufacturer's Association (NEMA)
 - .1 NEMA Standards Publication ICS 2: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to NEMA ICS 2-2000.

2.2 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.

- .2 Electronic motor overload protective device to monitor each phase, adjustable motor full load amps, shall monitor phase loss in addition to motor overload current, manually reset from outside enclosure.
- .3 Wiring and schematic diagram inside starter enclosure in visible location.
- .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Pushbuttons and selector switches: in accordance with Section 26 29 03, labelled as indicated.
 - .2 Indicating lights: in accordance with Section 26 29 03 and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.3 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with primary and secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.4 ACCESSORIES

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.
- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION