

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No. 1-10, Overhead Systems.
 - .3 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

1.2 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.

1.3 DESIGN
REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Electrical 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 and French.
- .4 Use one nameplate or label for each language.

1.4 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS where applicable.
- .3 Shop drawings:
 - .1 Submit product data.
 - .2 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .3 Submit copies of drawings and product data to authority having jurisdiction.
 - .4 If changes are required, notify Owner Representative of these changes before they are made.

- .4 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 certificate of acceptance from authority having jurisdiction upon completion of Work to Owner's Representative.
- .5 Manufacturer's Field Reports: submit to Owner's Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 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.
- .2 Site Meetings:
 - .1 In accordance with project requirements.
 - .2 Site Meetings: schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

- .4 Contractor to provide Owner's Representative with a safety inspection certificate from the provincial electrical safety inspection authority.

1.6 DELIVERY,
STORAGE AND
HANDLING

- .1 Material Delivery Schedule: provide Owner's Representative with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.7 SYSTEM STARTUP

- .1 Instruct Owner's Representative's 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 Post instructions where directed.

- .4 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

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: conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WIRING TERMINATIONS

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

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamicoid 3 mm, matt white finish face, black core, lettering accurately aligned and engraved into core.

.2 Sizes as follows:

NAMEPLATE SIZES

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

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.

- .3 Wording on nameplates and labels to be approved by Owner's Representative 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 as directed by Owner's Representative.
- .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.
- .10 Each receptacle is to have an Lamacoip label indicating panel source and circuit number. Label to be affixed to device by two sided tape, dyno tape label acceptable.

2.5 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.

2.6 CONDUIT AND CABLE IDENTIFICATION

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

- .4 All junction box covers are to carry ID for the circuits contained therein. Panel ID and circuit number for each conduit.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue
Communication Systems		
Fire Alarm	Red	
Emergency	Red	Blue
Voice		
Other	Red	Yellow
Security Systems		

2.7 FINISHES

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

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 For motor fan assemblies being removed and not replaced, all controls and wiring is to remain for future use. Install a suitably rated junction box to replace the motor junction box, cap and secure the wiring inside the box. Lock out the starter as per the Owner's requirements.
- .2 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .3 Do not install panels, contactors or other electrical equipment in janitors closets.
- .4 Cutting, patching, core drilling and related costs shall be the responsibility of each individual trade.

3.2 NAMEPLATES AND LABELS .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

.2 Use of rivets or self tapping screws to fasten identification to electrical equipment is not permitted, use double sided tape.

3.3 CONDUIT AND CABLE INSTALLATION .1 Install conduit and sleeves prior to pouring of concrete.
.1 Sleeves through concrete: sized for free passage of conduit, and protruding 50 mm.
.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.5 FIELD QUALITY CONTROL .1 Conduct the following tests.
.1 Power distribution system including phasing, voltage, grounding and load balancing.
.2 Circuits originating from branch distribution panels.
.3 Lighting and its control.
.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
.5 Systems: fire alarm system and communications.
.6 Insulation resistance testing:
.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
.3 Check resistance to ground before energizing.
.2 Carry out tests in presence of Owner's Representative.
.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

- .4 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.
- .5 Any testing agency for electrical systems shall be independent and qualified per INETA (international electrical testing association.)

3.6 CLEANING

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

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.18 (various).
 - .2 CSA C22.2 No.65-03, Electrical Connectors.
 - .2 National Electrical Manufacturers Association (NEMA)
- 1.2 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials.
 - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal of paper, plastic, polystyrene, corrugated cardboard, and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Owner's Representative.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
 - .2 Fixture type splicing connectors to: 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 EEMAC 1Y-2 NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Bolts for aluminum conductors.
 - .6 Sized for conductors tubes as indicated.
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- .4 Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 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.
 - .3 Install bushing stud connectors in accordance with NEMA.

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic waste in designated containers.
- .2 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .4 Rigid PVC conduit: to CSAC22.2 No. 211.2.

2.2 CONDUIT FASTENINGS

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

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for NPS 1 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT. Fittings to be insulated throat compression type, set-screws are not acceptable.

2.4 FISH CORD

- .1 Polypropylene.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Replace all liquid tight flexible metal conduit for the motors within the scope of work for this project.
 - .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .3 Use flexible metal conduit for connection to motors in dry areas.
 - .4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
 - .5 Install conduit sealing fittings in hazardous areas. Fill with compound.
 - .6 Minimum conduit size for lighting and power circuits is 21 mm and 27 mm for communications wiring.
 - .7 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .8 Mechanically bend steel conduit over 19 mm dia.
 - .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .10 Install fish cord in empty conduits.
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- .11 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.
- .14 Neutrals are to be counted when calculating conduit fill.

3.2 SURFACE
CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED
CONDUITS

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

PART 1 - GENERAL

1.1 REFERENCES .1 International Electrotechnical Commission (IEC)
.1 IEC 947-4-1-2002, Part 4: Electromechanical
contactors and motor-starters.

1.2 ACTION AND .1 Provide submittals in accordance with Section
INFORMATIONAL
SUBMITTALS .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 product data sheets.

1.3 CLOSEOUT .1 Provide maintenance materials in accordance with
SUBMITTALS Section 01 78 00 - Closeout Submittals.
.2 Submit operation and maintenance data for each
type and style of motorstarter for incorporation
into maintenance manual.
.3 Extra Materials:
.1 Provide listed spare parts for each
different size and type of starter.
.1 1 overload heater per starter.

1.4 DELIVERY, .1 Deliver, store and handle in accordance with
STORAGE AND
HANDLING .2 Deliver materials to site in original factory
packaging, labelled with manufacturer's name,
address.
.3 Packaging Waste Management: remove for reuse and
return by manufacturer of pallets crates padding
and packaging materials.

PART 2 - PRODUCTS

2.1 MATERIALS .1 Overload relay heater elements: Class 20, Type W, ratings as shown on the drawings for use with Allen Bradley 509-BOD starters.

2.2 VARIABLE-SPEED DRIVES .1 Configuration: update the existing ABB ACH550-BD-06A1-6 VFD to operate a 3 HP 1800 RPM 600 V. The VFD is currently operating a 2 HP motor. Controls and communications are to remain the same as currently configured.

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

2.4 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 as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Replace existing overload relay heater elements, return existing to Owner.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses and breakers 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.

3.3 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

