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**COMMON WORK RESULTS FOR ELECTRICAL**

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**1. GENERAL**

**1.1 Intent**

- .1 Provide complete, fully tested and operational electrical systems as required by the drawings, to meet the requirements described herein, and in complete accordance with current edition of applicable codes and ordinances.
- .2 Contract documents and Drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .3 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of the Contract.
- .4 Install equipment generally in locations and routes shown. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.
- .5 Install equipment to provide access and ease of maintenance.
- .6 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the City. Uncrate equipment, move in place and install complete; start-up and test.
- .7 'Provide' shall mean 'supply and install'.

**1.2 Coordination of Work**

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make reference to electrical, mechanical, process, controls, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

**1.3 References**

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
  - .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms.

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**1.4 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.

**1.5 Design Requirements**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, 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.

**1.6 Action and Informational Submittals**

- .1 Submit for review single line electrical diagrams under plexiglass and locate near MCC-1.
- .2 Shop drawings:
  - .1 Provide submittals in accordance with 01 33 00 – Submittal Procedures.
  - .2 Submit drawings and product data to authority having jurisdiction in format required by authority having jurisdiction.
  - .3 If changes are required, notify Contract Administrator of these changes before they are made.
- .3 Quality Control:
  - .1 Provide CSA certified or cUL listed equipment and material.
  - .2 Where CSA certified or cUL listed equipment and material is not available, submit such equipment and material to inspection authorities 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 – FIELD QUALITY CONTROL.
  - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.

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- .4 Manufacturer's Field Reports: submit to Contract Administrator 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.
- .5 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 in accordance with authorities having jurisdiction as per the conditions of Manitoba 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.
  - .3 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .6 Site Meetings:
  - .1 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, 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.

**1.7 Delivery, Storage and Handling**

- .1 Material Delivery Schedule: provide Contract Administrator with schedule upon award of Contract.

**1.8 System Startup**

- .1 Instruct Contract Administrator 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.

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**1.9 Operating Instructions**

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

**2. PRODUCTS**

**2.1 Materials and Equipment**

- .1 Material and equipment to be CSA certified or cUL listed. Where CSA certified or cUL listed material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 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.

**2.3 Warning Signs**

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

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**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 labels as follows:

- .1 Labels shall be as follows:

	<u>BACKGROUND</u>	<u>LETTERS</u>
208 Volt Normal	White	Black
208 Volt Essential	Blue	White
600 Volt Normal	Green	White
600 Volt Essential	Yellow	Black

Panel sample: Transformer TR#1  
 600-480V  
 3Ø, 3W  
 Fed by 5D6-100

- .2 3 mm thick plastic lamacoid name plates, mechanically attached with self tapping screws, to be attached to the front face of the following equipment:

**NAMEPLATE SIZES**

Size	Dimensions	Lines	Letter Height
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

- .1 Wording on labels to be approved by Contract Administrator prior to manufacture.
- .2 Identify equipment with Size 3 labels as directed by Contract Administrator.
- .3 Terminal cabinets and pull boxes: indicate system and voltage.
- .4 MCCs: designation, voltage
- .5 Starters, contactors, disconnects: designation, voltage, circuit, load controlled
- .6 Panelboard: designation, voltage, bus capacity
- .7 Transformers: indicate capacity, primary & secondary voltages and source of supply
- .8 Receptacles, junction boxes: Lamacoids or plastic tape labels to indicate complete panel number and circuit number, separated by a hyphen.

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**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 Conductors Colour Scheme:

Equipment Grounding – Green  
 Neutral Conductor – White

347/600 Volt System	120/208 Volt System
Phase A – Orange	Phase A – Red
Phase B – Brown	Phase B – Black
Phase C – Yellow	Phase C – Blue

- .1 Maintain phase sequence and colour coding throughout.

**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. Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

SYSTEM	PRIME	AUXILIARY
High Voltage 1	Yellow	Purple
347/600 V Normal	Sand	
347/600 V Emergency	Sand	White
120/208 V Normal	Grey	
120/208 V Emergency	Grey	White
Telephone	Lt. Green	
Security Systems	Dk. Brown	
Fire Alarm System	Red	

**2.8 Single Line Diagram**

- .1 Provide and mount framed as-built single line diagram to be located adjacent to main electrical equipment. Use clear plexiglass cover. Diagram to be 914 mm x 600 mm minimum.

**2.9 Finishes**

- .1 Finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .2 Finish all cabinets, panelboards, switchboards, equipment cabinets, cable trays, etc. in ANSI 61 grey enamel unless otherwise specified.
- .3 Apply primer on all items, which are to be finished on the job.

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- .4 Touch-up all damaged painted finishes with matching lacquer, or, if required by the Contract Administrator, completely repaint damaged surface.

**3. EXECUTION**

**3.1 Installation**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

**3.2 Nameplates and Labels**

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

**3.3 Conduit and Cable Installation**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

**3.4 Location of Outlets**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 10 feet, and information is given before installation.

**3.5 Mounting Heights**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights from finished floors to centre of device unless indicated otherwise or a conflict exists.
  - .1 Local switches: 1400 mm.
  - .2 Wall receptacles:
    - .1 General: 300 mm.

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- .2 Above top of continuous baseboard heater: 200 mm.
- .3 Above top of counters or counter splash backs: 175 mm.
- .4 In mechanical rooms: 1400 mm.
- .3 Panelboards (to top of cover): 2000 mm, as required by Code or as indicated.

**3.6 Sealing of Wall and Floor Openings**

- .1 All conduit and cable entries through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade shall be sealed to prevent passage of moisture, dust, gasses, flame, or to maintain pressurization.
- .2 Openings shall be sealed when all wiring entries shown on drawings have been completed.
- .3 Sealing material to be fire resistant and not contain any compounds which will chemically affect wiring jacket or insulating material. Cable penetrations through fire separations shall be sealed.

**3.7 Coordination of Protective Devices**

- .1 Contractor shall provide fault current and coordination study for entire distribution system from qualified coordination study provider. Study must be completed before switchgear shop drawings are submitted. Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

**3.8 Field Quality Control**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests:
  - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.



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- .3 Motors, heaters 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.
  - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Contract Administrator.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

**3.9 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.

**END OF SECTION**