



# **Motor Starters and Contactors Specification**

Specification 26 29 10

Revision 02

September 2025

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Publication: August 2018  
Revised: March 2023, September 2025  
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## Amendment Record Sheet

<b>Amendment in Clause No.</b>	<b>Date of Amendment</b>	<b>Description of Changes</b>
Cover page	March 2023	Removed 'Capital Projects Group' to update organizational changes.
1.2.3, 1.3.2, 2.5	March 2023	Added 'the latest version of' and updated numbering on Identification and Nomenclature specification
Various	September 2025	Updated format and revised requirements for clarity. Deleted requirements for fuses and fused disconnect switch to eliminate conflict in the specifications. Deleted Variable Speed Drives Motor Starters for new Variable Speed Drives (VFD) specification.

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**1. GENERAL**

**1.1. SCOPE OF WORK**

1.1.1. Labour, Products, equipment, tools, supervision, and services necessary for motor starters Work in accordance with the Contract Documents.

**1.2. DESIGN REQUIREMENT**

1.2.1. The equipment furnished and the equipment installation, wiring methods and materials used shall conform to the latest edition of the Ontario Electrical Safety Code, Electrical Safety Authority (ESA) Bulletins and Supplements issued by the Electrical Safety Authority, and the applicable Metrolinx Standards. In case of any conflicts, the more stringent requirement shall apply.

1.2.2. Design Electrical equipment and systems to all applicable standards of CSA, ULC, IEEE, and ESA.

1.2.3. Design electrical equipment and systems to the latest version of GO DRM.

1.2.4. Design electrical equipment and systems to standards and codes to the latest editions adopted by and enforced by local Authorities Having Jurisdiction (AHJ).

1.2.5. Design products as per item 2.1 of this section.

**1.3. RELATE WORKS**

1.3.1. Section 26 05 00 - Electrical General Requirements.

1.3.2. Section 26 05 53 - Electrical Identification and Nomenclature.

1.3.3. Section 26 23 00 - Low-Voltage Switchgear.

1.3.4. Section 26 13 26 - Metal Clad Switchgear.

1.3.5. Section 26 24 19 - Motor Control Centres.

1.3.6. Section 26 28 23 - Disconnect Switches.

1.3.7. Section 26 28 00 - Circuit Breakers and Fuses.

1.3.8. Section 25 05 10 - Building Automation System.

**1.4. REFERENCE STANDARDS**

1.4.1. Ontario Electrical Safety Code (OESC).

1.4.2. Ontario Building Code (OBC).

- 1.4.3. Metrolinx Standards, Drawings and Specifications.
- 1.4.4. GO Design Requirement Manual (DRM).
- 1.4.5. Metrolinx Electrical Safety Document.
- 1.4.6. CSA Z462, Workplace Electrical Safety.
- 1.4.7. CAN3 C235, Preferred Voltage Levels for AC Systems, 0 to 50,000V.
- 1.4.8. CAN/CSA C22.2 No. 5, Moulded Case Circuit Breakers.
- 1.4.9. CAN/CSA C22.2 No. 14, Industrial Control Equipment for Use in Ordinary (Non-Hazardous) Locations.
- 1.4.10. IEC 947 4 1, Part 4, Contactors and Motor Starters.
- 1.4.11. NEMA, National Electronic Manufacturers Association.
- 1.4.12. NEMA ICS 2-2000 (R2005), Controllers, Contactors and Overload Relays Rated 600 V.

## **1.5. SPARE PARTS**

- 1.5.1. Spare parts for each different size and type of starter provided under Contract.
  - a) 3 contacts, stationary;
  - b) 3 contacts, movable;
  - c) 3 contacts, auxiliary;
  - d) 3 control transformers;
  - e) 3 operating coils;
  - f) 2 fuses for control transformers; and
  - g) 10 % indicating lamp bulbs used.
- 1.5.2. Maintenance Materials
  - a) Keys, tools, special devices, and other related maintenance materials.

## **1.6. TRAINING**

- 1.6.1. Provide training as noted below:
  - a) Operation Training:

- 1) Allow for minimum of 2 hours of total on-site time to train in all aspects of equipment and system operations, per group; and
  - 2) Schedule separate training sessions for each group on separate days.
- b) Maintenance Training:
- 1) Site Electricians: Allow for minimum of 8 hours of total in-class and on-site time to train in all aspects of equipment and system operations, repair, and maintenance.
- c) Provide training for Metrolinx maintenance personnel to depth that troubleshooting and maintenance can be carried out by Metrolinx; and
- d) Training shall be specific to equipment, model number, and version installed. Provide material for each participant and include record drawings and comprehensive operating and maintenance manual for equipment installed.

## **1.7. WARRANTY**

- 1.7.1. A manufacturer's warranty shall be provided for the work of this section with a minimum warranty period of five years after acceptance by Metrolinx.

## **1.8. DELIVERY, STORAGE AND HANDLING**

- 1.8.1. Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- 1.8.2. Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.3. Storage and Handling Requirements
- a) Store materials in accordance with manufacturer's recommendations and in a clean, dry, and well-ventilated area;
  - b) Store and protect contactors from nicks, scratches, and blemishes; and
  - c) Replace defective or damaged materials with new.

## **1.9. SUBMITTALS**

- 1.9.1. Product Data Package:
- a) Submit manufacturer's Product data indicating:
    - 1) Technical data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items, and parts lists;

- 2) Manufacturer's instructions, printed product literature and data sheets for contactors include product characteristics, performance criteria, physical size, finish, and limitations;
- 3) Performance criteria, compliance with appropriate reference standards, characteristics, limitations, and troubleshooting protocol; and
- 4) Product transportation, storage, handling, and installation requirements.

1.9.2. Shop Drawings Package:

- a) Submit manufacturer's Shop Drawings indicating:
  - 1) Mounting method and dimensions;
  - 2) Starter size and type;
  - 3) Layout of identified internal and front panel components;
  - 4) Enclosure types;
  - 5) Complete electrical wiring diagrams for each type and style of starter, including electrical schematics and external field device interconnection;
  - 6) Electrical wiring diagrams with clearly identified terminal numbers, to field connection, power, and control devices such as motor, safety devices, remote push button station, etc.; and
  - 7) PLC Ladder Logic diagram showing complete "Rung" instruction and input/output identification.

1.9.3. Commissioning Package

- a) Submit the following:
  - 1) Commissioning Plan;
  - 2) Commissioning Procedures;
  - 3) Certificate of Readiness; and
  - 4) Attach completed Pre-Start Health and Safety Review Report to the Certificate of Readiness.

1.9.4. Commissioning Closeout Package

- a) Submit the following:
  - 1) Deficiency Report; and
  - 2) Commissioning Closeout Report.

1.9.5. Training

- a) Submit Training Plan, Training Course Material and Training Schedule.

1.9.6. Closeout Submittals Package

- a) Submit the following for incorporation into the Operation and Maintenance:
  - 1) Motor Starters, and Control Unit:
    - i) Operation and maintenance data for each type and style of starter; and
    - ii) Equipment operation and maintenance manuals.
  - 2) Including, but not limited to, the following:
    - i) Instruction books;
    - ii) Recommended renewal parts list; and
    - iii) Provide Ladder Logic (soft copy).

**1.10. QUALITY ASSURANCE**

1.10.1. Refer to Section 26 05 00.

1.10.2. Installers' qualifications: Perform work of this Section by manufacturer-approved skilled, qualified, and experienced workers trained in installation of Work of this Section.

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## 2. PRODUCTS

### 2.1. GENERAL

- 2.1.1. If more than 3 single starters are required, then an MCC shall be used to house the starters and controls.
- 2.1.2. Motor starters shall be able to be controlled and monitored by the BAS and SCADA.
- 2.1.3. Motor controllers shall comply with the applicable standards and codes as shown on the Contract Documents.
- 2.1.4. Motor controllers shall be separately enclosed, unless part of another assembly. For installation in motor control centers, provide plug-in, draw-out type motor controllers up through NEMA Size 4. NEMA Size 5 and above require bolted connections.
- 2.1.5. Motor controllers shall be combination type, with magnetic controller and with one of the following, if required:
  - a) Circuit breaker;
  - b) Motor circuit protector; or
  - c) Disconnecting means, with external operating handle with lock-open padlocking positions and ON-OFF position indicator.
- 2.1.6. A control unit shall start or stop the motor via the motor starter. This control unit shall consist of a Programmable Logic Controller (PLC), basic hard-wired circuitry or other means as indicated on the Contract Documents.
- 2.1.7. Starters feeding external circuits, exposed to lightning, shall include surge arrestor protection.
- 2.1.8. Starter control wiring shall be minimum, gauge 2.5 sq. mm (#14 AWG) RW90 insulated.

### 2.2. MAGNETIC MOTOR CONTROLLERS (STARTERS)

- 2.2.1. Controllers shall be general-purpose, Class A magnetic controller for induction motors rated in horsepower. Minimum size shall be NEMA Size 0.
- 2.2.2. Where combination motor controllers are used, combine the controller device and the disconnect device in a common enclosure.
- 2.2.3. Provide phase loss protection for each controller, with contacts to de-energize the controller upon loss of any phase.

- 2.2.4. Unless otherwise indicated, provide full voltage non-reversing across-the-line mechanisms for motors less than 75 HP, closed by coil action and opened by gravity. For motors 75 HP and larger, provide reduced-voltage or variable-speed controllers. Equip controllers with 120 VAC coils and individual control transformer unless otherwise noted.
- 2.2.5. Hand-Off-Automatic (HOA) switch shall be required. HOA switch shall be operable without opening enclosure door. HOA switch is not required for manual motor controllers.
- 2.2.6. Incorporate into each control circuit a 120 V, electronic time-delay relay (ON delay), minimum adjustable range from 0.3 to 10 minutes, with transient protection. A time-delay relay is not required where HOA switch is not required.
- 2.2.7. Unless noted otherwise, equip each motor controller with not less than two normally open (NO) and two normally closed (NC) auxiliary contacts added as.
- 2.2.8. Provide green (RUN) and red (STOP) pilot lights.
- 2.2.9. Motor controllers incorporated within equipment assemblies shall also be designed for the specific requirements of the assemblies.

### **2.3. MAGNETIC STARTER REDUCED VOLTAGE PART WINDING**

- 2.3.1. Two-step reduced voltage, part winding starter of size, type, rating, and enclosure type as indicated, with components as follows:
- a) Two-3 pole contactors;
  - b) Adjustable electronic timer; and
  - c) Six manual reset overload relays.
- 2.3.2. Three step reduced voltage part winding starter of size, type, rating, and enclosure type as indicated, with components as follows:
- a) Three-3 pole contactors;
  - b) One set starting resistors;
  - c) Six manual reset overload relays; and
  - d) Accessories:
    - 1) Pushbuttons and/or selector switches and indicating lights as indicated;
    - 2) Indicating lights: LED NEMA 12 type and colour as indicated; and
    - 3) Auxiliary control devices as indicated.

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## 2.4. MAGNETIC STARTER REDUCED VOLTAGE STAR-DELTA

- 2.4.1. Reduced voltage star-delta closed transition starter, of size, type, rating, and enclosure type as indicated, with components as follows:
- a) Two-3 pole delta contactors with auxiliary relays and interlocks;
  - b) One-3 pole star contactor with auxiliary relay and interlocks;
  - c) One-3 pole transition contactor;
  - d) One set of transition resistors;
  - e) Mechanical interlock, to interlock one delta contactor and the star contactor;
  - f) One timing relay;
  - g) Three-pole automatic reset overload relays; and
  - h) Accessories:
    - 1) Pushbuttons and/or selector switches and indicating lights as indicated;
    - 2) Indicating lights: LED NEMA 12 type and colour as indicated; and
    - 3) Auxiliary control devices as indicated.

## 2.5. MULTI-SPEED STARTERS

- 2.5.1. Two-speed starters of size, type, rating, and enclosure type as indicated. Starter for variable torque type motor, with components as follows:
- a) One 3-pole contactor for each winding for separate winding motors;
  - b) One 3-pole and one 5-pole contactor for each reconnectable winding for consequent pole type motors; and
  - c) Three overload relays with 3 heater elements and manual reset for each speed.
- 2.5.2. Accessories
- a) Pushbuttons and/or selector switches and indicating lights as indicated;
  - b) Indicating lights: LED NEMA 12 type and colour as indicated; and
  - c) Auxiliary control devices as indicated.

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## 2.6. CONTROL TRANSFORMER

- 2.6.1. 150 VA single-phase, dry-type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed with starter as indicated. Capacity shall be increased where indicated on the Contract Documents.
- 2.6.2. Size control transformer for control circuit load plus 25% spare capacity.
- 2.6.3. Power supply shall be downstream of main disconnect device supplying power to the starter.
- 2.6.4. The secondary shall be fused on one leg and grounded on the other (X2).
- 2.6.5. Primary fuses shall be installed on both legs on all starters.
- 2.6.6. Control fuses shall be HRC type.
- 2.6.7. Accessories
  - a) Pushbutton: LED illuminated, NEMA 12 as required;
  - b) Selector switches: heavy-duty, oil-tight as required; and
  - c) Indicating lights: LED, heavy-duty, oil-tight, type and colour as indicated.

## 2.7. MANUAL MOTOR STARTERS:

- 2.7.1. Single or three-phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - a) Switching mechanism, quick make, and break; and
  - b) One or three overload heaters, manual reset, trip indicating handle.
- 2.7.2. Accessories
  - a) Indicating light: LED NEMA 12 type and colour as indicated.
  - b) Locking tab to permit padlocking in "ON" or "OFF" position.

## 2.8. FULL VOLTAGE MAGNETIC STARTERS

- 2.8.1. Combination magnetic starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - a) Contactor solenoid-operated, rapid-action type;
  - b) Motor overload protective device in each phase, manually reset from outside enclosure. Overload heater elements: Eutectic Alloy;

- c) Wiring and schematic diagram inside starter enclosure in visible location;
- d) Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram; and
- e) Combination type starters to include circuit breaker with operating lever on outside of enclosure to control disconnect.

## **2.9. CIRCUIT BREAKERS (WHERE APPLICABLE)**

- 2.9.1. Bolt-on thermal-magnetic type with a minimum interrupting rating as indicated on the Contract Documents.
- 2.9.2. Equipped with automatic, trip-free, non-adjustable, inverse-time, and instantaneous magnetic trips for less than 400 A. The magnetic trip shall be adjustable from 5x to 10x for breakers 400 A and greater.
- 2.9.3. Additional features shall be as follows:
  - a) A rugged, integral housing of moulded insulating material;
  - b) Silver alloy contacts;
  - c) Arc quenchers and phase barriers for each pole;
  - d) Quick-make, quick-break, operating mechanisms; and
  - e) A trip element for each pole, a common trip bar for all poles, and one operator for all poles.

## **2.10. ENCLOSURES**

- 2.10.1. Enclosures shall be NEMA-type rated 1, 3R, 4X or 12 as required per the installed environment.
- 2.10.2. Enclosure doors shall be interlocked to prevent opening unless the disconnecting means is open. A "defeater" mechanism shall allow for inspection by qualified personnel with the disconnect means closed. Provide padlocking provisions.
- 2.10.3. All metal surfaces shall be thoroughly cleaned, phosphatized, and factory primed prior to applying light gray baked enamel finish.

## **2.11. MOTOR CONTROL CIRCUITS**

- 2.11.1. Shall operate at not more than 120 Volts.
- 2.11.2. The power for the control circuit shall be from the downstream of the breaker supplying power for the motor.

- 2.11.3. Shall be grounded, except where the equipment manufacturer recommends that the control circuits be isolated.
- 2.11.4. For each motor operating over 120 V, incorporate a separate, heavy-duty control transformer within each motor controller enclosure.
- 2.11.5. Incorporate primary and secondary overcurrent protection for the control power transformers.

## **2.12. OVERLOAD RELAYS**

- 2.12.1. Thermal, Induction, Temperature Probe Thermal Relay, Electronic type, as specified. Devices shall be NEMA type.
- 2.12.2. One for each pole.
- 2.12.3. External overload relay reset pushbutton on the door of each motor controller enclosure.
- 2.12.4. Overload relays shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
- 2.12.5. Thermal overload relays shall be tamperproof, not affected by vibration, manual reset, sensitive to single-phasing, and shall have selectable trip classes of 10, 20 and 30.

## **2.13. AUXILLIARY RELAYS**

- 2.13.1. Provide general-purpose industrial-grade auxiliary control relays.
- 2.13.2. Relays shall include a minimum of four (4) contacts and a maximum of eight (8) contacts.
- 2.13.3. Each relay shall have a minimum of one (1) unused normally open and one (1) normally closed contact unless indicated otherwise on the Contract Documents.
- 2.13.4. Relays shall be totally enclosed plug-in type when indicated on the Contract Documents.
- 2.13.5. Operating coil and contact ratings shall suit requirements shown on the Contract Documents.
- 2.13.6. Manufacturers: Allen-Bradley, Square D, Eaton, or approved equivalent.

## **2.14. CONTACTORS**

- 2.14.1. Contactors: to CSA C22.2 No.14.
- 2.14.2. Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Minimum size: NEMA 1.

2.14.3. Operating coil and contact ratings shall suit requirements shown on the Contract Documents.

2.14.4. Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

2.14.5. Include following options in cover:

- a) Red indicating lamp;
- b) Reset; and
- c) Controls as indicated on Contract Documents.

**3. EXECUTION**

**3.1. INSTALLATION**

- 3.1.1. Install starters, control panels, and connect power and control as indicated.
- 3.1.2. Ensure correct control transformer fuses and overload device elements installed.
- 3.1.3. Install starters as a standalone unit or as part of motor control centre in sized buckets as indicated in the Contract Documents. Ground doors in accordance with OESC.
- 3.1.4. Starter components, accessories, and safety requirements shall be identical for standalone or motor control centre installation.
- 3.1.5. Install contactors and connect power wires and auxiliary control devices.
- 3.1.6. Identify contactors with nameplates or labels indicating panel and circuit number.

**3.2. COMMISSIONING**

- 3.2.1. Place As-Built wiring diagram of installed equipment in motor starters.
- 3.2.2. Perform Commissioning in accordance with Metrolinx Standards, manufacturers' recommendations, and NETA standards.
- 3.2.3. Manufacturer's technical representative shall be present for commissioning at no extra cost to Metrolinx.
- 3.2.4. Testing
  - a) Perform starter tests in accordance with Metrolinx Standards and manufacturer's instructions;
  - b) Operational and functional checks of starters, control unit and spare parts;
  - c) Perform starting and stopping sequences of contactors and relays;
  - d) Operational and functional checks of sequence controls, BAS interface, interlocking with other separate related starters, equipment, control devices, operate as indicated in Contract Documents;
  - e) Manufacturer technical representative shall be factory trained with periodic updates and have experience with same model of motor starters, PLC controller (where present) on job site. Sales representatives shall not perform this Work; and

- f) Manufacturer's technical representative shall provide technical direction and assistance in general assembly of equipment, installation as specified in manufacturer's installation instructions, wiring, application-dependent adjustments, and verification of proper operation.

**END OF SECTION**