

University Contact: Electrical Services, Maintenance &  
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## SECTION 26 24 19 MOTOR-CONTROL CENTERS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Low-voltage (600 V and less) standard (non-arc-resistant) NEMA motor control centers.
  
- B. Motor control center units:
  - 1. Feeder units.
  - 2. Combination magnetic motor starter units.
  
- B. Overcurrent protective devices for motor control centers and associated units, including overload relays.
  
- D. Motor control accessories:
  - 1. Auxiliary contacts.
  - 2. Pilot devices.
  - 3. Control and timing relays.
  - 4. Control power transformers.
  - 5. Control terminal blocks.

#### 1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
  
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
  
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
  
- D. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

E. Section 262923 - Variable-Frequency Motor Controllers.

### 1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 402 - Standard for Installing and Maintaining Motor Control Centers; 2014.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).
- G. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers; 1995 (Reaffirmed 2008).
- H. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.
- I. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
- J. NEMA ICS 18 - Motor Control Centers; 2001 (Reaffirmed 2007).
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 845 - Motor Control Centers; Current Edition, Including All Revisions.

- N. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

#### 1.4 GENERAL REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
  - 2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
  - 3. Coordinate the work to provide motor controllers and associated wiring suitable for interface with control devices to be installed.
  - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
- B. Provide phase loss protection for all 3 phase motors.
- C. All motors greater than 20 horsepower shall have power factor correction, with a targeted result of 94-97%.
- D. Motors controlled by a variable frequency drive (VFD), refer to standard Section 26 29 23.

#### 1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor control centers, enclosures, units, overcurrent protective devices, and other installed components and accessories.
- B. Shop Drawings: Indicate dimensions, voltage, bus ampacities, unit arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of motor control centers and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- C. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Motor Control Centers - Basis of Design: Square D.
  
- B. Motor Control Centers - Other Acceptable Manufacturers:
  - 1. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
  - 2. Rockwell Automation, Inc.; Allen-Bradley Products: [ab.rockwellautomation.com/#sle](http://ab.rockwellautomation.com/#sle).
  - 3. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
  - 4. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).

### 2.2 MOTOR CONTROL CENTERS

- A. Provide motor control centers consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
  
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
  
- C. Description: Dead-front standard (non-arc-resistant) type motor control center assemblies complying with NEMA ICS 18, and listed and labeled as complying with UL 845; ratings, configurations and features as indicated on the drawings.
  
- D. Configuration:
  - 1. Arrangement: Front-mounted units only (no rear-mounted units or back-to-back configuration).
  - 2. NEMA Classification and Wiring Type: NEMA ICS 18, Class II, Type B (B-T for units size 3 or smaller).
  
- E. Service Conditions:
  - 1. Provide motor control centers and associated components suitable for operation under the following service conditions without derating:
  - 2. Provide motor control centers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
  
- F. Short Circuit Current Rating:
  - 1. Provide motor control centers and associated units with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.

2. Label equipment utilizing series ratings as required by NFPA 70.
- G. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- H. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pull box as indicated or as required to facilitate installation of incoming feed.
- I. Bussing:
1. Horizontal Main Bus: Size for a maximum temperature rise of 117 degrees F over an ambient temperature of 104 degrees F, in compliance with NEMA ICS 18 and UL 845 requirements.
  2. Vertical Bus: Minimum size of 300 A, in compliance with NEMA ICS 18 requirements.
  3. Provide fully rated neutral lug pad in incoming section where neutral is indicated, with a suitable lug for each feeder and branch circuit requiring a neutral connection.
  4. Provide solidly bonded equipment ground bus through full length of motor control center, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  5. Phase and Neutral Bus Material: Copper.
  6. Ground Bus Material: Copper.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
    - a. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
    - b. Main and Neutral Lug Type: Mechanical.
- K. Enclosures:
1. Comply with NEMA ICS 6.
  2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  3. Finish: Manufacturer's standard unless otherwise indicated.
- L. Future Provisions:
1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2. Arrange and equip horizontal bus and ground bus to accommodate future installation of additional motor control sections.
- M. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
- O. Owner Metering: Comply with Section 25 05 00.
- P. Instrument Transformers:
1. Comply with IEEE C57.13.
  2. Select suitable ratio, burden, and accuracy as required for connected devices.
  3. Current Transformers: Connect secondaries to shorting terminal blocks.
  4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

## 2.3 MOTOR CONTROL CENTER UNITS

- A. Feeder Units: Circuit breaker type.
- B. Combination Magnetic Motor Starter Units:
1. Description: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
  2. Configuration: Full-voltage non-reversing type unless otherwise indicated.
  3. Disconnects: Circuit breaker type.
    - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
    - b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
    - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
  4. Overload Relays: Bimetallic thermal type unless otherwise indicated.
  5. Pilot Devices Required:
    - a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
    - b. Single-Speed, Non-Reversing Starters:
      - 1) Pushbuttons: START-STOP (Start-Flush with Bezel, Stop-Slightly above the Bezel).
      - 2) Selector Switches: HAND/OFF/AUTO.
      - 3) Indicating Lights: Red ON, Green OFF.
- C. Solid-State Reduced-Voltage Motor Starter Units. Replacement of existing units Only.

- D. Variable-Frequency AC Drive Units: Comply with Section 26 29 23.

## 2.4 OVERCURRENT PROTECTIVE DEVICES

### A. Overload Relays:

1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
  - a. Employ automatic reset or remote reset where indicated.
  - b. Do not employ automatic reset with two-wire control.
6. Bimetallic Thermal Overload Relays:
  - a. Interchangeable current elements/heaters.
  - b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
  - c. Trip test function.
7. Solid-State Overload Relays:
  - a. Adjustable full load current.
  - b. Phase loss protection.
  - c. Phase imbalance protection.
  - d. Ambient temperature insensitive.
  - e. Thermal memory.
  - f. Trip test function.
  - g. Provide isolated alarm contact.

### B. Circuit Breakers:

1. Interrupting Capacity (not applicable to motor circuit protectors):
  - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
  - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Motor Circuit Protectors:
  - a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
  - b. Provide field-adjustable magnetic instantaneous trip setting.

- c. Provide the following features and accessories where indicated or where required to complete installation:
  - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  - 3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
- 3. Molded Case Circuit Breakers:
  - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
    - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
    - 2) Provide electronic trip circuit breakers where indicated.
  - b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
  - c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
    - 1) Provide the following field-adjustable trip response settings:
      - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      - (b) Long time delay.
      - (c) Short time pickup and delay.
      - (d) Instantaneous pickup.
      - (e) Ground fault pickup and delay where ground fault protection is indicated.
  - d. Provide the following circuit breaker types where indicated:
    - 1) 100 Percent Rated Circuit Breakers: Listed for application within the motor control center where installed at 100 percent of the continuous current rating.
    - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
  - e. Provide the following features and accessories where indicated or where required to complete installation:
    - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
    - 3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.



## 2.5 MOTOR CONTROL ACCESSORIES

- A. Auxiliary Contacts:
  - 1. Comply with NEMA ICS 5.
  - 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each starter unit, minimum.
  
- B. Pilot Devices:
  - 1. Comply with NEMA ICS 5; heavy-duty type.
  - 2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
  - 3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
  - 4. Indicating Lights: Push-to-test type unless otherwise indicated.
  - 5. Provide LED lamp source for indicating lights and illuminated devices.
  
- C. Control and Timing Relays:
  - 1. Comply with NEMA ICS 5.
  - 2. Provide number and type of relays indicated or required to perform necessary functions.
  
- D. Control Power Transformers:
  - 1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus 10 VA spare capacity.
  - 2. Include primary and secondary fuses.
  
- E. Control Terminal Blocks: Include 25 percent spare terminals.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
  
- B. Install motor control centers in accordance with NECA 1 (general workmanship), NECA 402, and NEMA ICS 2.3.
  
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any draw out devices.

- D. Install motor control centers plumb and level.
- E. Unless otherwise indicated, mount motor control centers on properly sized 4 inch high concrete pad.
- F. Provide grounding and bonding in accordance with Section 260526.
- G. Install all field-installed devices, components, and accessories.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.
- J. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 05 73.
- K. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- L. Provide filler plates to cover unused spaces.
- M. Identify motor control centers in accordance with Section 26 05 53.

PART 4 END OF SECTION