

SECTION 16443

MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section

1.2 SUMMARY

- A. This Section includes motor-control centers for use on ac circuits rated 600 V and less
- B. Related Sections include the following:
 - 1. Section 16289 for low-voltage power, control, and communication surge suppressors

1.3 SUBMITTALS

- A. Product Data: For each type of controller and each type of motor-control center, include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes
- B. Shop Drawings: For each motor-control center
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following
 - a. Each installed unit's type and details
 - b. Nameplate legends
 - c. Short-circuit current ratings of buses and installed units
 - d. Vertical and horizontal bus capacities
 - e. UL listing for series rating of overcurrent protective devices in combination controllers
 - f. Features, characteristics, ratings, and factory settings of each motor-control center unit
 - 2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller. Coordinate control system arrangements with facility SCADA system PLC control system design
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited. Show motor-control center layout and relationships between electrical components and adjacent structural and

mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements

- D. Operation and Maintenance Data: For motor-control centers, all installed devices, and components to include operation and maintenance manuals for normal and emergency operating conditions. In addition to items specified in Section 01740 include the following
 - 1. Routine maintenance requirements for motor-control centers and all installed components
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices
- E. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs
- B. Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use
- D. Comply with NFPA 70
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated
- B. Handle motor-control centers according to the following
 - 1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts"
 - 2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers"

1.6 COORDINATION

- A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels
- B. Coordinate size and location of concrete and other structural bases. Drill anchor-bolt inserts into concrete bases. Coordinate drilling templates for structural steel supports. Concrete, reinforcement, and formwork requirements are specified in Division 3; structural steel requirements are specified in Section 05120
- C. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect
- D. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following
 - 1. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group
 - 2. Alternative equipment acceptable only upon approval of the Owner and Engineer

2.2 MOTOR-CONTROL CENTERS

- A. Wiring: NEMA ICS 3, Class I, Type A
- B. Enclosures: NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location
 - 1. Outdoor locations: NEMA 250, Type 3R
 - 2. Pumping and Disinfection Building: NEMA 250, Type 12
 - 3. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device
 - 4. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding
 - 5. Wiring spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place

- C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location

2.3 BUSES

- A. Material: Plated hard-drawn copper, 98 percent conductivity
- B. Ampacity Ratings: As indicated for horizontal and vertical main buses
- C. Neutral Buses: Full size
- D. Equipment Ground Bus: Noninsulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure
- E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent
- F. Short-Circuit Withstand Rating: Same as short-circuit current rating of section

2.4 FUNCTIONAL FEATURES

- A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center
- B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated
 1. Install units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions
 2. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section
 3. Equip units in Type B and Type C motor-control centers with pull-apart terminal strips or drawout terminal boards for external control connections
 4. Controller disconnecting means: Factory-assembled combination disconnect and controller
 - a. Circuit-breaker disconnecting means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes
- C. Overcurrent Protective Devices: Individual feeder-tap units through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions
- D. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units

- E. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare"

2.5 ACROSS-THE-LINE CONTROLLERS

- A. Manual Controller: NEMA ICS 2, general purpose, Class A, with toggle action and overload element
- B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated
 - 1. Control circuit: 120 V; obtained from integral control power transformer with a control power source of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity
 - 2. Overload relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 10 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle

2.6 REDUCED-VOLTAGE CONTROLLERS

- A. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors
 - 1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds
 - 2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage
 - 3. LED indicators showing motor and control status, including the following conditions
 - a. Control power available
 - b. Controller on
 - c. Overload trip
 - d. Loss of phase
 - e. Shorted silicon-controlled rectifier
 - 4. Automatic voltage-reduction controls to reduce voltage when motor is running at light load
 - 5. Motor running contactor operating automatically when full voltage is applied to motor
 - 6. Manufacturers: Refer to paragraph 2.1 of this Section

2.7 VARIABLE FREQUENCY DRIVES

- A. Refer to Section 16269 for VFD Specification

2.8 FEEDER OVERCURRENT PROTECTION

- A. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable trip setting for circuit-breaker frame sizes 250 A and larger
 - 1. Adjustable instantaneous-trip circuit breakers: Magnetic trip element with front-mounted, field-adjustable trip setting
 - 2. Electronic trip unit circuit breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings
 - a. Instantaneous trip
 - b. Long- and short-time pickup levels
 - c. Long- and short-time time adjustments
 - d. Ground-fault pickup level, time delay, and I^2t response
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors
 - 2. Application listing: Appropriate for application; Type HACR for heating, air-conditioning, and refrigerating equipment

2.9 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type. LED pilot lights. Include pilot lights indicating "RUN" and "FAULT" conditions, as a minimum
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open
- D. Control Relays: Auxiliary and adjustable time-delay relays
- E. Elapsed Time Meters: Heavy duty with digital readout in hours and tenths of hours
- F. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features
 - 1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V
 - 2. Switch-selectable digital display of the following:
 - a. Phase currents, each phase: Plus or minus 1 percent
 - b. Phase-to-phase voltages, three phase: Plus or minus 1 percent
 - c. Phase-to-neutral voltages, three phase: Plus or minus 1 percent
 - d. Three-phase real power: Plus or minus 2 percent
 - e. Three-phase reactive power: Plus or minus 2 percent

- f. Power factor: Plus or minus 2 percent
 - g. Frequency: Plus or minus 0.5 percent
 - h. Integrated demand with demand interval selectable from 5 to 60 minutes:
Plus or minus 2 percent
3. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door
- G. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting. Provide for all three phase motor controllers

2.10 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested, motor-control centers before shipping

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances, and other conditions affecting performance
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 APPLICATIONS

- A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions
- B. Select horsepower rating of controllers to suit motor controlled

3.3 INSTALLATION

- A. Anchor each motor-control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor-control center mounting surface
- B. Install motor-control centers on concrete bases or structural steel supports as indicated on the Drawings

3.4 CONCRETE AND STRUCTURAL STEEL BASES

- A. Coordinate size and location of all bases. Verify structural requirements with structural engineer

3.5 IDENTIFICATION

- A. Identify motor-control center, motor-control center components, and control wiring according to Section 16075
- B. Operating Instructions: Frame printed operating instructions for motor-control centers, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of motor-control centers

3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Section 16120
- B. Bundle, train, and support wiring in enclosures
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position
 - 2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties
- B. Ground equipment according to Section 16060

3.8 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows
 - 1. Test insulation resistance for each motor-control center element, bus, component, connecting supply, feeder, and control circuit
 - 2. Test continuity of each circuit
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment
 - 2. To assist in field testing of equipment including pretesting and adjusting of solid-state controllers
 - 3. Report results in writing
- C. Perform the following field tests and inspections and prepare test reports

1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's operation and maintenance personnel to adjust, operate, and maintain components of motor-control centers including solid-state controllers

END OF SECTION