CITY OF FORT WAYNE MASTER UPDATED: 11/16/18

SECTION 26 24 19

MOTOR CONTROL CENTERS

1. GENERAL
	1. DESCRIPTION

NTS: When required, insert at No. 1, “and modify existing motor control centers.” Edit to suit the Project.

* + 1. Scope:
			1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install motor control centers (--1--).
		2. Coordination:
			1. To properly size circuit breakers, starters, and control power transformers, obtain motor nameplate data on equipment being furnished under this and other contracts as required.
			2. To properly size control power transformers, obtain data on motor space heater and other accessories.
			3. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before motor control center Work.
		3. Related Sections:

NTS: List below only sections covering products, construction, and equipment specifically identified in this section and specified in another section and directly referenced in this specification. Do not list administrative and procedural division 01 sections.

* + - 1. Section 26 05 05, General Provisions for Electrical Systems
			2. Section 26 05 53, Identification for Electrical Systems.
			3. Section 26 05 73, Electrical Power Distribution System Studies.
			4. Section 26 09 13, Electrical Power Monitoring
			5. Section 26 29 13, Motor Controllers
			6. Section 26 43 00, Surge Protective Devices
	1. REFERENCES

NTS: Retain applicable standards and add others as required.

* + 1. Standards referenced in this Section are:
			1. NEC Article 430, Part VIII, Motor Control Centers
			2. ANSI/IEEE C37.2, Electrical Power System Device Function Numbers and Contact Designations.
			3. ANSI/NETA ATS,Acceptance Testing Specifications for Electrical Power Equipment and Systems*.*
			4. NEMA ICS 18, Motor Control Centers.
			5. NEMA ICS 1, Industrial Controls and Systems: General Requirements.
			6. UL 845, Motor Control Centers.

NTS: Edit article “1.3” below to suit the Project. DO NOT DELETE (NOT USED) ITEMS.

* 1. SUBMITTALS
		1. Action Submittals: Submit the following:
			1. Product Data
				1. Manufacturer specifications, cut sheets, dimensions, and technical data for all components, materials, and equipment proposed for use.
			2. Shop Drawings
				1. Outline and summary sheets with schedules of equipment in each unit.
				2. One-line diagrams indicating circuit breaker sizes, bus rating, motor controller ratings, and other pertinent information to demonstrate compliance with the Contract Documents.
				3. For each motor-control center specified in this Section. Include dimensioned plans, elevations, and component lists. Show ratings, including short-time and short-circuit ratings, and horizontal and vertical bus ampacities.
				4. Unit control schematic and elementary wiring diagrams showing numbered terminal points and interconnections to other units.
			3. Samples (NOT USED)
		2. Informational Submittals:
			1. Certificates (NOT USED)
			2. Delegated Design Submittal (NOT USED)
			3. Test and Evaluation Reports (NOT USED)
			4. Manufacturers’ Instructions
				1. Instructions for shipping, storing and protecting, and handling the materials and equipment.
				2. Installation data for the equipment, including setting drawings, templates, and directions and tolerances for installing anchorage devices.
				3. Instructions for start-up and troubleshooting.
			5. Source Quality Control Submittals
				1. Reports of completed factory testing, including procedures used and test results.
			6. Field Quality Control Submittals
				1. Reports of completed field testing, including procedures used and test results.
			7. Manufacturer Reports
				1. Submit written report of results of each visit to Site by Supplier’s service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
			8. Sustainable Design Submittals (NOT USED)
			9. Special Procedure Submittals (NOT USED)
			10. Qualifications Statements
				1. Independent testing firm.
				2. Manufacturer, when requested by Engineer.
		3. Closeout Submittals. (NOT USED)
			1. Maintenance Contracts (NOT USED)
			2. Operation and Maintenance Data
				1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
				2. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.

Point to point wiring diagram for each bucket shall be provided within each bucket.

* + - * 1. 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.
				2. Comply with Section 01 78 23, Operations and Maintenance Data.
			1. Bonds (NOT USED)
			2. Warranty Documentation
				1. Provide the warranty information as stated within the Contract Documents.
			3. Record Documentation
				1. Provide record documentation as stated within Contract Documents.
			4. Sustainable Design Closeout (NOT USED)
			5. Software (NOT USED)
		1. Maintenance Material Submittals. (NOT USED)

NTS: Edit the required spare parts to suit the Project.

* + - 1. Spare Parts
				1. Furnish, tag, and box for shipment and long term storage the following spare parts and special tools for each motor control center lineup furnished:

|  |  |
| --- | --- |
| **Item** | **Quantity** **per Switchgear Lineup Furnished** |
| 1) Fuses | 10% or a minimum of 3 of each type and size used |
| 2) Indicating lamps | 10% or a minimum of 3 of each type and size used  |
| 3) Touch-up Paint | (2) 12 ounce minimum cans |

* + - 1. Extra Stock Materials
				1. Furnish a list of additional recommended spare parts for an operating period of one year. Describe each part, the quantity recommended and current unit price.
			2. Tools (NOT USED)
	1. QUALITY ASSURANCE
		1. Qualifications:

NTS: Edit or delete paragraph “1”, below, when project requirements prohibit an experience clause.

* + - 1. Manufacturer:
				1. Shall have not less than five years experience of producing equipment substantially similar to that required and shall be able to submit documentation of not less than five installations in satisfactory operation for at least five years each.
				2. Maintain, within 100 miles (160 km) of Project site, service center capable of providing training, parts, and emergency maintenance and repairs.

NTS: Edit paragraph “2”, below, to suit the Project. Consider acceptance testing by independent testing firm for large projects that contain other distribution equipment. When acceptance testing is required, also include testing by manufacturer. For smaller projects, include manufacturer testing only.

* + - 1. Independent Field Testing Firm:
				1. Retain an independent testing firm to perform field acceptance testing of motor control centers.
				2. Testing firm and its assigned personnel shall be experienced in inspecting and testing motor control centers.
				3. Testing Agency Qualifications: In addition to requirements specified in Section 26 01 26 independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be full member company in InterNational Electrical Testing Association (NETA).

NTS: Edit or delete paragraph “B”, below, when not required, or when project involves modifications to motor control centers by different manufacturers.

* + 1. Component Supply and Compatibility:
			1. Obtain materials and equipment included in this Section, regardless of component manufacturer, from one motor control center equipment manufacturer.
			2. Motor control center equipment manufacturer shall review and approve, or shall prepare, all Shop Drawings and other submittals for components furnished under this Section.
			3. Equipment shall be specifically constructed for specified service conditions. Equipment and components shall be integrated into overall motor control center equipment system by motor control center equipment manufacturer.
		2. Regulatory Requirements: Comply with the following:
			1. NEC Article 430, Part VIII. Motor Control Centers.
			2. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.
		3. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers and adjacent surfaces and items, and are based on types and models indicated. Other manufacturers' motor-control centers with equal performance characteristics and complying with indicated maximum dimensions may be considered.
	1. DELIVERY, STORAGE AND HANDLING
		1. Packing, Shipping, Handling, and Unloading:
			1. Packing:
				1. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
				2. Protect mating connections.
				3. Indoor containers shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately..
				4. Cover all openings into enclosures with-vapor inhibiting, water-repellent material.
			2. Upon delivery, check materials and equipment for evidence of water that may have entered equipment during transit.
			3. Handling:
				1. Lift, roll or jack motor control center equipment into locations shown.
				2. Motor control centers shall be equipped to be handled by crane. Where cranes are not available equipment shall be suitable for placement on rollers using jacks to raise and lower the groups.
		2. Storage and Protection:
			1. Store motor control center equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
	2. COORDINATION
		1. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.
		2. Coordinate features, accessories, and functions of each motor controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.
		3. Coordinate communication with control circuits to which they connect.
1. PRODUCTS
	1. MANUFACTURERS
		1. Manufacturers: Provide equipment by one of the following:
			1. Allen-Bradley (Rockwell Automation).
			2. Cutler-Hammer (Eaton).
			3. Siemens.
			4. Square D (Schneider Electric).
	2. MATERIALS

NTS: Edit paragraph “a”, below, to suit the Project.

* + 1. General: Motor control center lineups shall comply with NEMA ICS 18 and be provided as shown with the following ratings:
			1. Service: Voltage rating and number of wires shall be as shown or indicated on the Drawings. Motor control center shall operate from a three-phase, 60 Hertz system.
			2. Wiring: NEMA Class II, Type B.

NTS: Insert at No. 1 the desired NEMA rating: 1, 3R, or 4X/SS.

* + - 1. Enclosure: NEMA (--1--).
				1. Compartments: Modular; individual doors have concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units require disconnect means in off position before door can be opened or closed, except by consciously operating permissive release device.
				2. Interchan geability: Compartments are constructed to remove units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in control center. Units requiring same size compartment are interchangeable, and compartments are constructed to permit ready rearrangement of units, such as replacing 3 single units with unit requiring 3 spaces, without cutting or welding.
				3. Wiring Spaces: Each vertical section of structure with horizontal and vertical wiring has spaces for wiring to each unit compartment in each section, with supports holding wiring in place.
			2. Interrupting Capacity Rating: Motor control center shall have an interrupting capacity rating as shown or indicated on the Drawings. Devices shall be suitable for minimum rating indicated.
			3. Motor control center lineups shall be UL-rated as suitable for service entrance where shown or indicated on the Drawings and as required.
		1. Construction: Provide equipment with the following:
			1. Totally-enclosed structure, dead front, consisting of nominal 20-inch deep, minimum 20-inch wide, 7.5-feet high vertical sections bolted together to form a unit assembly.
			2. Vertical sections shall have side sheets extending the full height and depth of section.
			3. Removable lifting angles for each shipping section.
			4. Two removable floor sills for mounting.
			5. Horizontal wireways top and bottom, isolated from horizontal bus and readily accessible.
				1. Wireway openings between sections shall have rounded corners and rolled edges.
			6. Isolated vertical wireways with cable supports, accessible through hinged doors, for each vertical section.
				1. Wireway shall be separate from each compartment and remain intact when compartment is removed.
			7. All-metal non-conducting parts electrically continuous.
			8. Comply with NEMA ICS 18.

NTS: Edit paragraph “C”, below, to suit the Project.

* + 1. Buses
			1. Material: Tin Plated copper.
			2. Ampacity Ratings:
				1. As indicated for horizontal buses.
				2. 600 amp min for vertical main buses or larger as required for installed units.
			3. Neutral Bus: 100% rated, Insulated, continuous through control center for four-wire services, drilled with lugs of appropriate capacity as required.
			4. Grounding Bus: Full length mounted across the bottom, drilled with lugs of appropriate capacity as required.
			5. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections.
			6. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.
			7. Bus bar connections shall be easily accessible with simple tools.
		2. Unit Compartments:
			1. Provide individual front door for each unit compartment. Fasten door to stationary structure, instead of the unit itself, so that door can be closed when unit is removed.
			2. Starter and feeder unit doors interlocked mechanically with unit disconnect device to prevent unintentional opening of door while energized and unintentional application of power while door is open, with provisions for releasing interlock for intentional access and application of power.
			3. Padlocking arrangement permitting locking disconnect device in the “OFF” position with door closed or open. Equip unit disconnect devices located in the top compartment, compartment sized 12 inches or higher, with extender handle complying with UL 845. Extender handle shall allow disconnect operating handle to be located above NEC’s height limitation of six-feet, seven-inches above floor.
			4. Equip compartments as shown or indicated on the Drawings:
				1. Blank compartments, unused space, and compartments shown or indicated on the Drawings as “SPACE” shall have bus covers and be complete with necessary hardware for future installation of a plug-in unit.
				2. Provide shutters for each compartment that automatically open when unit is inserted and automatically close when unit is removed.
			5. Provide wiring and device identification:
				1. Identify compartment doors, devices, and field wiring in accordance with Section 26 05 53, Identification for Electrical Systems.
				2. Identify internal control conductors with permanent wire markers. Each wire shall be identified by a unique number attached to wire at each termination point.
				3. Identify internal control devices with permanent markers. Each device shall be identified by a unique number attached to each device.
				4. Numbering system for each wire and control device shall be identified on the wiring diagrams in the Shop Drawings and shall reflect the actual designations used in the Work.
				5. Identify internal communication cables with permanent markers. Each cable shall be identified by a unique number attached to each cable.
			6. NEMA 1 minimum motor starter size. Starter units completely draw out type in Sizes 1 and 2 and draw out type after disconnecting power leads only in Sizes 3 and 4.
			7. Motor starters shall be NEMA-rated and include magnetic contactor, with encapsulated magnet coils. Wound coils are unacceptable. Control shall be 120 VAC unless indicated otherwise.

NTS: Edit the starter types in paragraphs “a” through “c”, below, as required for the project. Delete starters not required.

* + - * 1. Starters shall be full-voltage non-reversing unless shown or indicated otherwise on the Drawings.
				2. Reversing Starters:

Single-speed, full-voltage with two contactors and extra interlocking contacts.

* + - * 1. Reduced Voltage Solid-State Starter:

General:

Provide solid-state, step-less, current limiting, soft-start, motor controllers (RVSS) as shown or indicated on the Drawings.

RVSS shall be three-phase type and shall include an overload relay and isolation contactor.

Provide subsystems that will protect RVSS from damage due to over-current and over-voltage.

Current Rating: 115 percent of motor nameplate rated current, continuous, minimum.

Required Features:

Adjustable current limit of not more than 250 percent of motor nameplate full-load current throughout entire motor acceleration period including first three cycles of voltage waveform from instant start signal is engaged.

Adjustable voltage acceleration, from two to 30 seconds.

Adjustable voltage deceleration, from two to 30 seconds.

Phase loss detection.

LED diagnostic indicators.

Static over-current and over-voltage trip.

Phase reversal, line or fuse loss, and under-voltage protection.

Power unit over temperature protection.

Motor inverse time overload protection.

Input line transient over-voltage protection.

Enclosure:

Cooling fans, if required, shall incorporate anti-friction bearings and internal impedance type motor protection.

If cooling fans are used, install in accordance with NEMA ICS 1-110 by motor control center manufacturer.

On start-up, start driven equipment at zero current and allow driven equipment to accelerate to maximum speed without exceeding the set current limit.

On normal shutdowns, ramp driven equipment down at set deceleration rate that is non-regenerative for motor prior to shutdown.

On emergency shutdowns, remove power to motor.

Diagnostic LEDs: Provide LEDs on unit front that indicate the following:

Control power on.

Motor power on.

Motor starting.

Motor fault.

RVSS fault.

Control Outputs:

Control output shall be electrically isolated, dry, normally open SPDT contacts, rated 10 amps at 120 vac.

Provide the following control outputs:

i. Motor running.

ii. Motor fault.

iii. RVSS fault.

* + - 1. Overload Relays: Provide an overload relay for each motor controller. Overload relays shall be in accordance with the following:

NTS: Retain one version of paragraph “a”, below, and delete the other. The preference is for electronic overload relays. The first version is for thermal overload relays, and the second version is for electronic overload relays. Consider providing ground fault protection for motors 200-hp and larger, and for motors considered critical.

* + - * 1. Thermal Overload Relays: Relays shall be thermal, bimetallic type, direct or current sensing. Relays shall include ambient compensation and be equipped with separate heater elements sized for full-load amperes and service factor of actual motors furnished.
				2. Electronic Overload Relays: Relays shall be electronic type. Electronic relays shall be multi-function, adjustable, current sensing, type, and include overload, phase-unbalance, phase-loss, and equipment type ground fault in one package.
				3. Each overload relay shall be manual reset type and shall include provisions for resetting by an insulating button on front of starter unit door.
				4. Each overload relay shall include a normally-open auxiliary contact and a normally-closed auxiliary contact for remote alarm purposes.
				5. Size each overload relay for full-load amperes and service factor of actual motors installed.
			1. Individual control power transformers for all controllers, capacity as required for all control circuit devices, 100 VA minimum, Class A insulation, two primary fuses, 120-volt secondary, one secondary fuse, and the other secondary leg grounded.

NTS: Modify paragraphs “10” through “22”, below, to suit the Project and delete inapplicable paragraphs.

* + - 1. Separate Control: Where control power to starter is from a separate power source, provide control power fuse in unit and equip main disconnect with normally-open contact to isolate control circuit from source when controller disconnect is open.
			2. Motor horsepower shown are preliminary. Circuit breaker trips and controller overload heaters to be coordinated with the actual equipment installed.
			3. Auxiliary contacts, relays, timers as required for specified control functions and those shown on Drawings.
			4. Current Sensing Devices:
				1. Current Switch:

Produces a dry contact output when load current exceeds set point.

Suitable for use measuring current on motor leads of 480-volt, 60 Hertz, up to 100-amp continuous.

Variable trip point and time delay. Trip point settable via calibrated dial.

Monitors currents from 10 mA to 100 AC Amps

Output relay (Form C) rated up to 20 amps

LED trip status indicator

Dead band prevents relay chatter

Contact Material: Silver-cadmium oxide

Mechanical Life: 10 million operations, typical at rated load

Electrical Life: 100,000 operations, typical a6 rated load

* + - * 1. Current Transducer:

Produces four to 20 mA DC output current proportional to the input average RMS AC motor load current.

Loop powered

* + - 1. Controller devices, including spare contacts, shall be wired to numbered terminal blocks.
			2. Terminal blocks for field connections to unit compartments shall be plug-in/pull-apart type. Terminals shall be fully accessible from the front. Terminals shall be mounted near the front of vertical wireway.
			3. Control devices shall be 600-volt heavy duty, NEMA A600. Relays shall have convertible contacts.
			4. Feeder Circuit Breakers: Thermal magnetic type.
				1. Circuit breakers of 100 amp frame or less shall be mounted in a dual mount compartment (two breakers in one space factor) or shall mount in one-half space factor, unless otherwise shown or indicated on the Drawings.
			5. Motor Controller Circuit Breakers: Magnetic trip only motor circuit protectors.
			6. Provide the following diagrams and tables inside of door for each compartment:
				1. Elementary wiring diagram.
				2. Table of overload heater sizes with correct heater highlighted.
				3. Table of motor circuit protector settings with correct setting highlighted.
			7. Where shown or indicated on the Drawings incorporate solid state protective relaying package (SSPRP) into motor starter for motor protection. Unit shall incorporate the ANSI/IEEE C37.2 device function numbers and selectable indications and communication modules indicated below:
				1. Product and Manufacturer:

GE MultiLin SR469 or current model.

NTS: Consult with City representative to determine applicable motor protection devices.

* + - * 1. Motor Protection Device Functions:

Stator winding over-temperature (Device 49).

Short circuit (Device 50).

Motor overload (Device 49/50/51).

Locked rotor - multiple start (Device 48).

Phase reversal (Device 46).

Ground fault (Device 50G/51G).

Mechanical jam.

Unbalance/negative sequence currents (Device 46).

Undercurrent (Device 37).

Motor bearing over-temperature (Device 38).

Thrust bearing over-temperature (Device 38).

Over-voltage (Device 59).

Undervoltage (Device 27).

Voltage sequence (Device 47).

Main trip and lockout output relay (Device 86).

Alarm output relay (Device 74).

* + - * 1. Selectable Indications:

Average motor current.

Average motor temperature.

Motor current for each of the three phases.

Motor temperature readout for six winding RTDs.

Motor thrust-bearing temperature readout for two bearing RTDs.

Ground fault current.

Percent of motor capacity used.

Line-to-line and line-to neutral voltages, all three phases.

Average 15-minute kVA.

Average 15-minute kW.

Average 15-minute kVAR.

Maximum percent full load current since initial startup.

Hottest RTD and temperature since initial startup.

Highest percent current unbalance since initial startup.

Highest ground fault current since initial startup.

Highest motor bearing temperature since initial startup.

Highest load bearing temperature since initial startup.

Maximum line voltage since start.

Minimum line voltage since start.

Number of motor starts attempted.

Number of motor starts completed.

Hours of operation.

Number of trips from each of ten protective functions.

All measured values at the time of a motor trip.

Values that have been loaded for system inputs and trip points.

NTS: Retain one version of paragraph “1.” below. Preference is EtherNet/IP.

* + - * 1. Communication Module:

EtherNet/IP capable of uploading all the above protective function attitudes and the above-listed selectable indications upon being queried by a host PLC connected via Ethernet Field Bus communication port.

Modbus TCP/IP capable of uploading all the above protective function attitudes and the above-listed selectable indications upon being queried by a host PLC connected via Modbus TCP/IP communication port.

NTS: Expand on parameters of the electronic trip units in paragraph “21”, below, when required for features desired.

* + - 1. Main and Tie Circuit Breakers: Thermal magnetic, molded case type, unless shown or indicated otherwise. Where shown or indicated, equip main and tie breakers with key interlocking. Interlocking shall allow only two of the three breakers to be closed at a time. Provide locks and keys as required. Main circuit breakers shall be 100 percent amperage rated. Circuit breakers with frame ratings 800 amps and greater shall be electronic type with adjustable parameters and ground fault protection.

NTS: Coordinate the communication aspects as required to suit the Project and edit article “2.3”, below, accordingly.

* 1. MAIN METERING DEVICE
		1. Provide an energy monitor in accordance with Section 26 09 13 Electrical Power Monitoring and as shown on the Drawings. Each electrical power monitor shall be included and factory-mounted within motor control center by motor control center manufacturer.
		2. Provide Ethernet connection using EtherNet/IP communication protocol.
	2. SURGE PROTECTIVE DEVICES
		1. Provide a surge protective device in accordance with Section 26 43 00, Surge Protective Devices, for each motor control center bus shown on the Drawings. Surge protective devices shall be included and factory-mounted within the motor control center by motor control center manufacturer. Surge protective device monitoring and display shall be visible from the motor control center front.
	3. FEEDER OVERCURRENT PROTECTION

NTS: Choose either “A” or “B” below.

* + 1. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.
			1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
			2. Application Listing: Appropriate for application.
			3. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
			4. Circuit Breakers, 200 A and Larger: Field-adjustable, long-time, short-time, instantaneous, ground (LSIG), and continuous-current settings.
			5. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
			6. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
			7. Shunt Trip: Where indicated or required for ground fault protection trip.
		2. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses, handle lockable.
	1. Control Accessories
		1. Pilot devices shall be 30.5 mm, LED and oil tight.
		2. Pilot Lights: Push to test “Run” and “Stopped” pilot lights.
		3. Pilot Lights shall have lens colors as shown or indicated. Where no color is indicated, provide the following lens colors:

|  |  |
| --- | --- |
| **Color** | **Legend** |
| Red | Running, Open |
| Green | Stopped, Closed |
| Amber | Alarm |
| Blue | Power |
| White | Status |

* + 1. Local Off Remote Selector Switches: Where Indicated.
			1. Maintained position unless specified elsewhere.
			2. Contact Blocks:
				1. Double break silver contacts.
				2. Ac Ratings: 7,200 va make, 720 va break.
				3. Single pole, double throw or double pole, single throw.
				4. Up to six tandem blocks.
			3. Operators:
				1. Number of positions as specified elsewhere.
				2. Standard knob type unless specified elsewhere.
			4. Legend plates as required for type of operation or specified elsewhere.
	1. SOURCE QUALITY CONTROL

NTS: The factory tests specified in paragraph “A”, below, are standard, non-witnessed tests. When witness tests are required, edit this article to include such requirements. Coordinate witness testing with project requirements and edit paragraph “A” to suit the Project.

* + 1. Prior to shipping, perform factory tests on motor control centers. Tests shall include manufacturer’s standard tests and the following:
			1. Physical inspection and checking of components.
			2. Mechanical operation and device functionality tests.
			3. Primary, control, and secondary wiring hi-pot tests.
1. EXECUTION
	1. INSPECTION
		1. Examine conditions under which Work is to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
	2. APPLICATIONS
		1. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
		2. Select horsepower rating of controllers to suit motor controlled.
		3. Push-Button Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.
	3. INSTALLATION
		1. Install materials and equipment at locations shown or indicated on the Drawings. Install equipment on 4” concrete base and with manufacturer’s recommendations and instructions.
		2. Motor control center shall be free standing and installed no closer than 2” to any wall surface.
		3. Openings in top or side of motor control centers for other than conduit entrance are not allowed.
		4. Bundle cable circuits together within enclosures and identify with durable tag secured to cabling twine.
		5. Set motor circuit protectors at lowest setting that allows motor starting without nuisance tripping. Adjust during startup and testing as required to avoid nuisance tripping during operation.
		6. Verify that wiring diagrams on inside of door of each compartment reflect the circuitry actually provided and that correct overload heater size and motor circuit protector setting are noted.
		7. Install in conformance with manufacturer’s recommendations, Laws and Regulations, and the Contract Documents.

NTS: Coordinate with section 01 14 16, Coordination With Owner’s Operations, to specify requirements for connections to existing facilities and maintenance of facility operations during construction. Delete paragraph “H” if not required.

* + 1. Connections to existing facilities shall be in accordance with Section 01 14 16, Coordination with Owner’s Operations and Section 26 05 05, General Provisions for Electrical Systems.
	1. IDENTIFICATION
		1. Identify field-installed wiring and components and provide warning signs according to Section 26 05 53.
	2. CONTROL WIRING INSTALLATION
		1. Install wiring between motor-control devices according to Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables.
		2. Bundle, train, and support wiring in enclosures.
		3. Connect hand-off-automatic switch and other automatic control devices according to indicated wiring diagram or one that is manufacturer approved, where available.
			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. CONNECTIONS
		1. Tighten motor-control center bus joint, electrical connector, and terminal bolts according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A. Mark nuts with paint marker stick after properly tightening bolts.
	4. FIELD QUALITY CONTROL

NTS: Edit paragraph “A” on inspection and testing to suit the project. When acceptance testing is desired, also include manufacturer testing.

* + 1. Site Tests:
			1. Perform field testing and inspection of motor control centers. Inspect and test each motor control center after installation. Testing and inspection shall be in accordance with the manufacturer's recommendations and the Contract Documents, and be performed by manufacturer's factory-trained representative, Inform Owner and Engineer when equipment is correctly installed, prior to testing. Do not energize equipment without permission of Owner.
			2. Test Equipment, Calibration and Reporting: All test equipment, instrument calibration and test reports shall be in accordance with ANSI/NETA ATS.
			3. Perform the following minimum tests and checks before energizing equipment:
				1. Verify all overload and device settings.
				2. Inspect mechanical and electrical interlocks and controls for proper operation.
				3. Check tightness of bolted connections.
				4. Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground.
				5. Measure insulation resistance of each starter, phase-to-phase and phase-to-ground.
				6. Measure insulation resistance of each control circuit with respect to ground.
				7. Perform other tests recommended by equipment manufacturer.

NTS: Delete paragraph “4”, below, when acceptance testing by independent testing firm is not required.

* + - 1. Perform acceptance testing of motor control centers. Inspect and test each motor control center. Testing and inspection shall be performed by the independent testing firm, after completion of field testing specified in Paragraph 3.3.A.3 of this Section.
				1. Visual and Mechanical Inspection: Perform inspection of each motor control center in accordance with ANSI/NETA ATS. Inspection shall include:

Inspect for proper anchorage, damage, and grounding.

Verify all overload and device settings.

Check tightness of bolted connections.

* + - * 1. Electrical Tests: Perform electrical testing of each motor control center in accordance with ANSI/NETA ATS. Testing shall include:

Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground.

Measure insulation resistance of each starter phase-to-phase and phase-to-ground.

Measure insulation resistance of each control circuit with respect to ground.

Test motor overload units by current injection.

Perform operational tests by initiating control devices for proper operation.

Perform contact resistance test and insulation resistance test for each circuit breaker.

Determine long-time, short-time, and instantaneous pick-up and delay as required.

* + 1. Manufacturer’s Services: Provide a qualified, factory trained serviceman to perform the following:
			1. Supervise unloading and installation of equipment.
			2. Instruct Contractor in installing equipment.
			3. Inspect, test, and adjust equipment after installation and ensure proper operation.
			4. Instruct operations and maintenance personnel in operation and maintenance of the equipment.

NTS: Edit visit descriptions as required. Insert at No. 1 the minimum number of on-site hours per visit.

* + - 1. Manufacturer’s technician shall make visits to the Site as follows:
				1. Visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Technician shall test the system as specified in Article 3.3.A of this Section. Technician shall operate and test the system in the presence of Engineer and verify that equipment complies with the Contract Documents and manufacturer’s requirements. Technician shall adjust the system to initial settings as specified in Article 3.4 of this Section. Minimum number of hours on-Site: (--1--) hours.

NTS: Coordinate with section 01 79 23, Instruction of Operations and Maintenance Personnel, to specify the duration of training required, number of sessions, and operating shift for each.

* + - * 1. Visit shall be to instruct operations and maintenance personnel.

Furnish services of manufacturer’s qualified, factory-trained specialists to instruct Owner’s operations and maintenance personnel in recommended operation and maintenance of equipment.

Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

* + - * 1. Technician shall revisit the Site as often as necessary until installation is acceptable.
				2. Furnish services of manufacturer’s factory-trained service technicians to correct defective Work within 72 hours of notification by Owner during the correction period.
			1. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.
	1. ADJUSTING
		1. Calibrate, set, and program all protective devices. Coordinate protective devices furnished under this Section and provide proper settings of devices in accordance with the study performed under Section 26 05 73, Electrical Power Distribution System Studies.
	2. CLEANING
		1. Inspect interior and exterior of motor-control centers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

+ + END OF SECTION + +