

SECTION 16485
CONTACTORS – LOW VOLTAGE

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the low voltage (600 volts and below) contactors as specified herein and as shown on the contract drawings.

1.02 REFERENCES

- A. The contactors shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI and UL.

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Master drawing index
 - 2. Dimensioned outline drawings
 - 3. Conduit entry/exit locations
 - 4. Cable terminal sizes
 - 5. Wiring diagrams
 - 6. Nameplate schedule
 - 7. Ratings including:
 - a. Voltage
 - b. Horsepower and/or continuous current
 - 8. Product data sheets.
- B. Where applicable, the following additional information shall be submitted to the Engineer:
 - 1. Busway connection
 - 2. Connection details between close-coupled assemblies
 - 3. Composite front view and plan view of close-coupled assemblies
 - 4. Key interlock scheme drawing and sequence of operations
 - 5. Mimic bus.

1.04 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in paragraph 1.03
 - 2. Wiring diagrams.

1.05 QUALIFICATIONS

- A. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of

installations with similar equipment shall be provided demonstrating compliance with this requirement.



1.06 REGULATORY REQUIREMENTS

1.07 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS


- A. Cutler-Hammer
- B.  _____
- C.  _____

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 LIGHTING CONTACTORS

A. Electrically-Held Lighting Contactors

1. The contactors shall be designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding.
2. Coils shall be of molded construction through 400 amperes, 180 mm frame. All coils to be color-coded through and permanently marked with voltage, frequency and part number.
3. 30 ampere, 45 mm frame contactors shall be suitable for the addition of at least six (6) external auxiliary contacts of any arrangement normally open or normally closed.
4. Contactors above 30 ampere rating shall be suitable for the addition of up to eight (8) external auxiliary contacts of any combination of normally open or normally closed contacts.
5. Contacts shall be equipped with double break alloy contacts. The contactors shall have straight-through wiring.
6. Line and load terminals for 10 to 30 amperes contactors shall have captive screws. Terminals above 30 amperes shall be back-out saddle clamp design.
7. Combination units shall have a flange-mounted handle for NEMA Type 1, 3R, 4X, or 12 enclosures. All enclosures shall have extra space to include or add modifications such as time clock, control power transformer, lightning arrester, or relays.
8. Combination contactors enclosed in a NEMA Type 3R enclosure shall be UL approved for service entrance.

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9. Pilot devices, where indicated, shall be oiltight, flange mounted and transformer-type for extended longer lamp life. Pilot device nameplates shall be engraved phenolic or aluminum.
 10. Combination contactors' operating mechanism shall be flange-mounted have positive, non-teasing (ON/OFF) action. The handle shall be color-coded: red for (ON) and black for (OFF).
 11. Operating handle shall have provisions to lock the handle in the (OFF) position with a minimum of three (3) standard padlocks each having 1/4-inch diameter shackles.
 12. Where indicated, a disconnect switch with double break, rotary blades and quick-make/quick-break action shall be provided. Provide a removable line shield with test probe holes for inspection. Switch shall have readily visible blades in the open (OFF) position. Fusible disconnect switch (through 100 amperes) shall have built-in fuse pullers to provide easier fuse removal.
 13. Fusible disconnect switches shall be UL listed for 100,000 AIC at 480 volts when used with Class R fuses.
 14. Where indicated, a circuit breaker shall be provided. A manual push-to-trip button shall be provided to exercise the trip unit.
 15. Electrically-held lighting contactors NEMA rated for lighting loads up to 400-ampere, 180 mm frame shall be Cutler-Hammer type CN35 Class ECL03 for non-combination, Class ECL12 for fusible combination and Class ECL14 for circuit breaker combination units.
 16. Enclosures shall be NEMA 1 [1] [3R] [4X] [12] as indicated on the drawings
- B. Mechanically-Held Lighting Contactors
1. The contactors shall be designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding.
 2. The C30 contactors shall be rated 20 amperes with 2 to 12 poles as indicated on the drawings. ECL04 contactors shall be rated 300 or 400 amperes and will be 2 or 3 poles as indicated on the drawings.
 3. The contactors shall have an interlock that removes the power from the pickup coil and shall require application of power to release the contactor to the OFF position.
 4. The contactors shall be capable of operating such that it will not switch to OFF during power failure to the control circuit.
 5. The contactor shall be installed in a NEMA 1 enclosure.
 6. Mechanically-held contactors shall be Cutler-Hammer type C30 for 20 ampere rating and type A202 Class ECL04 for 300 and 400 ampere ratings.
- C. Magnetically-Latched Lighting Contactors (for 30 to 200 ampere loads)
1. The contactors shall be designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding.
 2. The contactors shall be capable of being "mechanically latched" with the use of a permanent magnet.
 3. The contactors shall be operated by a (RUN) signal and a (STOP) signal preventing the contactor from switching to (OFF) during control circuit power failures.

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4. Pilot devices, where indicated, shall be oiltight and flange mounted. Pilot lights shall be transformer-type for longer lamp life. Pilot device nameplates shall be engraved phenolic or aluminum.
5. The combination contactors' operating mechanism shall be mounted on the flange and shall have positive, non-teasing ON/OFF action. The handle shall be color-coded: red for (ON) and black for (OFF).
6. Operating handle shall have provisions to lock the handle in the (OFF) position with a minimum of three (3) standard padlocks having 1/4-inch diameter shackles.
7. Where indicated, a disconnect switch with double break, rotary blades and quick-make/quick-break action shall be provided. A line shield with test probe holes for inspection shall be provided. The shield shall be removable. Switch shall have readily visible blades in the open (OFF) position. Fusible disconnect switches (through 100 amperes) shall have built-in fuse pullers to make it easier to remove fuses.
8. Fusible disconnect switches shall be UL listed for 100,000 AIC at 480 volts when used with Class R fuses.
9. Where indicated a circuit breaker shall be provided. A manual push-to-trip button shall be provided to exercise the trip unit.
10. Magnetically-latched contactors shall be Cutler-Hammer type A202 Class ECL04 for non-combination, Class ECL13 for fusible combination, Class ECL15 for circuit breaker combination contactor units.
11. Enclosures shall be NEMA ☛[1] [3R] [4X] [12] as indicated on the drawings

2.03 ELECTROMECHANICAL CONTACTORS

A. Non-reversing and Reversing Contactors.

1. Contactors shall have UL certification to achieve IEC 947, type 2 coordination when subjected to 100,000 ampere short-circuit fault currents.
2. Magnetic contactors through NEMA Size 9 shall be equipped with double break silver alloy contacts.
3. Coils shall be of molded construction through NEMA Size 9.
4. Coils shall be color-coded through size 5 and permanently marked with voltage, frequency and part number.
5. NEMA Size 00 through 2 contactors shall be suitable for adding a minimum of any combination of six (6) normally open or normally closed contacts. Size 3 through 8 contactors shall be suitable for the addition of up to eight (8) external auxiliary contacts of any combination of normally open or normally closed contacts.
6. Enclosures shall be NEMA ☛[1] [3R] [4X] [12] as indicated on the drawings.
7. Across-the-line magnetic contactors for motors up to 1600 hp, 600 volts, 3-phase 2250 amperes 1- or 3-phase shall be Cutler-Hammer Freedom Series Class ECN01 for non-reversing and ECN02 for reversing.

B. Vacuum Contactors

1. Vacuum contactors shall incorporate "low-chop" interrupters and limit chop currents to less than 0.5 amperes. Contact material to be silver tungsten carbide.
2. Interrupters shall have contact wear detection indicators.

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3. Contactors shall have front removable coil and auxiliaries.
4. The contactor coil shall utilize rectified AC current.
5. Provide a “push-to-test” button for sizes 5 and 6.
6. Enclosures shall be NEMA [☛][1] [3R] [4X] [12] as indicated on the drawings.
7. Vacuum contactors shall be Cutler-Hammer Class V201 for non-reversing and Class V211 for reversing.

2.04 MICROPROCESSOR-BASED CONTACTORS

A. Contactors – Advantage Design

1. Provide contactors of the electromechanical type with the coil controlled by an application-specific microprocessor with the following features:
 - a. Microprocessor shall measure control circuit voltage and prevent closing of the coil on voltages below 78V AC and/or voltages above 135V AC.
 - b. Microprocessor shall apply voltage to the coil such that a guaranteed maximum of 2 milliseconds of main contact bounce occurs on contactor closures.
 - c. Microprocessor shall continuously measure coil circuit voltage and current so as to maintain constant coil power at a level to maintain main contact closure and minimize coil power consumption.
 - d. Provide electronic circuitry that isolates the coil from surges.
 - e. Microprocessor shall wait for three (3) half-cycles of control start signal prior to activating a close to prevent starts resulting from momentary voltage spikes, switching transients, fluttering contacts, and shorted programmable logic control outputs. The phase angle of power in the control circuit is to be compared with the phase angle of the input start signal to prevent starts resulting from capacitively coupled or inductively coupled signals.
2. Contactors shall have replaceable fixed and movable contacts.
3. Contactor accessories:
 - a. Contactor to be designed to accommodate two (2) auxiliary contact blocks, each capable of a combination of up to four (4) normally closed or four (4) normally open auxiliary contacts. Contacts to be color-coded, black designating NC and silver designating NO. Contacts to be rated 10 amperes continuous, 7200 VA make, 720 VA break for 120 through 600V AC and 69 VA make and break for 125 through 300V DC. Provide a minimum of one (1) spare NO contact and one (1) spare NC contact in addition to any auxiliary contacts required.
 - b. Provide a mechanical interlock on reversing contactors of the lever-type mechanism with electrical contacts included to prevent closing of one contactor when the other is closed.
 - c. Provide control modules to perform the indicated input/output control functions as shown on the contract drawings. Module to incorporate faceplates having membrane-type pushbuttons, and LEDs. All pushbutton and LED functions shall be furnished with clearly written identification. Control modules shall be provided with 6-foot connection cord and single plug-in wiring to accommodate jack provided in the contactor. Provide, as required, modules available to cover applications including non-reversing and reversing. Modules to be provided with the ability to replace

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conventional “start,” “stop,” “hand,” and “auto,” control functions. Modules to be provided with the ability to replace conventional indicating light status of “run” and “off.”

- d. ☒ Provide a metering module capable of displaying control voltage, status, and current in each phase.

4. Enclosures shall be NEMA ☐ [3R] [4X] [12] as indicated on the drawings.

B. Contactors – *IT*. Design

1. Provide electromechanical type contactors with coil control integrated into a single or dual microcontroller.
2. The contactor shall operate over a temperature range of -40 to 149 degrees F (-40 to 65 degrees C) and shall meet or exceed the following Standards and Certifications: UL, CSA, NEMA ICS1, ICS2, ICS5, IEC 60947-4-1, CE, and KEMA where applicable. Devices shall meet Electromagnetic Compatibility (EMC) Requirements per EMC IEC 61000-4.
3. Provide a microcontroller with the following features:
 - a. Monitor the nominal 24V DC and adjust the Pulse Width Modulation (PWM) accordingly to minimize utilized power and maximize contact sealed force.
 - b. Energizes coil at full voltage and then applies Pulse Width Modulation.
 - c. Monitors user control inputs (i.e., permissive {stop}, forward, reverse, local reset, remote reset, test/test to trip. Control inputs shall be rated 24V DC (3-5 mA) with a plug and unplug lockable control connector.
4. Control voltages:
 - a. The contactor voltage shall be nominal 24V DC from 20 to 28V DC
5. Contactors shall have replaceable fixed and movable contacts, size 1 and larger.
6. Accessories:
 - a. Contactors shall accommodate auxiliary contacts per various maximum combinations of single and dual auxiliaries. Maximum number of circuits shall be six (6) for sizes 1 through 4 and twelve (12) for size 5 starters. Contacts shall be rated ten (10) amperes continuous, 7200 VA make, 720 VA break for 120V AC, 3600 VA make, 360 VA break for 240V AC, 1800 VA make, 180 VA break for 480V AC, 1440 VA make, 144 VA break for 600V AC, and 137.5 VA make and break for 125 through 250V DC. No seal-in auxiliary contacts are required.
 - b. Provide mechanical interlock on reversing contactors of a pivot-type mechanism to prevent closing of one contactor when the other is closed. Coil controller energizes both forward and reverse contactors providing one control point for wiring.
 - c. Provide control modules to perform the indicated input/output control functions shown on the drawings. Module shall incorporate faceplates having membrane type pushbuttons and LEDs. All pushbutton and LED functions shall be provided with clearly written identification. Modules shall be provided with the ability to replace conventional start, stop, hand, and auto control functions. Modules shall be provided with the ability to replace conventional indicating light status of run, off, selector switch pushbutton position.

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7. Microprocessor-based motor contactors shall be Cutler-Hammer *IT*. Series or approved equal.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.02 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.