

SECTION 26 29 13

~~~ PROJECT NOTE ~~~~~

ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE ARCHITECT OF RECORD PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS.

REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.

~~~ END OF PROJECT NOTE ~~~~~

ENCLOSED CONTROLLERS

PART 1 - GENERAL

PART 2 -

~~~ PROJECT NOTE ~~~~~

CONTROLLER TYPES TO BE COORDINATED WITH PROJECT SCOPE AND EQUIPMENT ASSOCIATED WITHIN OTHER DISCIPLINES. COORDINATE ALL REQUIREMENTS WITH EQUIPMENT.

~~~ END OF PROJECT NOTE ~~~~~

2.01 SECTION INCLUDES

- A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
 - 1. Magnetic motor starters.
 - 2. Manual motor starters.
 - 3. Motor-starting switches without overload protection.
- B. Overcurrent protective devices for motor controllers, including overload relays.
- C. Control accessories:
 - 1. Auxiliary contacts.
 - 2. Pilot devices.
 - 3. Control and timing relays.
 - 4. Control power transformers.
 - 5. Control terminal blocks.

2.02 REFERENCE STANDARDS

- A. Chicago Electrical Code - Municipal Code of the City of Chicago, Building/Electrical Code Requirements; 2018.

- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).
- F. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.
- G. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
- H. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- I. NEMA MG 1 - Motors and Generators; 2017.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- L. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- M. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

2.03 ADMINISTRATIVE 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 the Chicago Electrical Code.
 - 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 controllers and associated wiring suitable for interface with control devices to be installed.
 - 4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 6.

~~~ PROJECT NOTE ~~~~~

**INTERRUPTION OF EXISTING ELECTRICAL SERVICES TO BE USED FOR REMODELING PROJECTS ONLY.**

~~~ END OF PROJECT NOTE ~~~~~

- 7. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Board or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated.
 - a. Notify Architect/Engineer of Record and Board's Representative not fewer than seven (7) working days in advance of proposed interruption of electrical service.

- b. Do not proceed with interruption of electrical service without Architect/Engineer of Record's and Board's Representative written permission.
- 8. Notify Architect/Engineer of Record of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

2.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device.
- C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed controllers 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.
 - 4. Include documentation of listed series ratings.
 - 5. Include documentation demonstrating selective coordination.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field Quality Control Test Reports.
- F. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
 - 1. Include nameplate data of actual installed motors and associated overload relay selections and settings.
 - 2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.
 - 3. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller 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.
 - 4. 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 current
 - 5. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Board's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Electronic Trip Circuit Breakers: Provide one (1) portable test set.
 - 3. Indicating Lights: Two (2) of each different type.

4. See Section 26 28 13 - Fuses for requirements for spare fuses and spare fuse cabinets.

2.05 QUALITY ASSURANCE

- A. Comply with the Chicago Electrical Code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and that maintains within 50miles of project site a service center capable of providing training, parts, and emergency maintenance and repairs.
- D. Installer Qualifications: Company with minimum five years documented experience of successful installation on projects utilizing motor controllers similar to that required for this project.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Chicago Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

2.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

2.07 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.
- B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Board or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Architect/Engineer of Record and Board Representative no fewer than seven days in advance of proposed interruption of electrical service.
 2. Indicate method of providing temporary utilities.
 3. Do not proceed with interruption of electrical service without Architect/Engineer of Record and Board Representative's written permission.

PART 3 - PRODUCTS

3.01 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Siemens Industry, Inc: www.usa.siemens.com.
- E. Source Limitations: Furnish enclosed motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.
 - 1. Motor-starting switches without overload protection may be produced by the same manufacturer as the wiring devices used for this project.

3.02 ENCLOSED CONTROLLERS

- A. Provide enclosed controller assemblies 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: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.
- D. Service Conditions:
 - 1. Provide controllers and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude:
 - 1) Class 1 Km Equipment (devices utilizing power semiconductors): Less than 3,300 feet.
 - 2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
 - b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
 - 2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Starters shall be manual type for motors 1/3 HP and smaller and magnetic type motors 1/2 HP and larger.
- F. Contracts shall open each underground connection to the motor.
- G. Starter contact shall be twin-break, silver-to-silver, renewable contacts with one set of contacts for each phase.
- H. Short Circuit Current Rating:
 - 1. Provide controllers 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 - Power System Studies.
 - 2. Listed series ratings are acceptable, except where not permitted by motor contribution according to the Chicago Electrical Code..

3. Label equipment utilizing series ratings as required by the Chicago Electrical Code.
- I. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.
- K. Enclosures:
 1. Comply with NEMA ICS 6.
 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - c. Kitchen Areas: Type 4X, stainless steel.
 - d. Other Wet or Damp Locations: Type 4.
 - e. Hazardous (Classified) Locations: Type 7C , as required for the classification of the installed location.
 3. Finish: Manufacturer's standard unless otherwise indicated.
- L. 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.
 - 5.

~~~ PROJECT NOTE ~~~~~

**VERIFY CONTROLLERS TO BE USED WITHIN THE SCOPE OF PROJECT (I.E. SINGLE-SPEED, NON-REVERSING). MODIFY BELOW TO INCLUDE / EXCLUDE STARTERS AND ACCESSORIES REQUIRED.**

~~~ END OF PROJECT NOTE ~~~~~

- M. Magnetic Motor Starters: Combination type unless otherwise indicated.
 1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
 2. Noncombination Magnetic Motor Starters: NEMA ICS 2, Class A noncombination motor controllers with magnetic contactor(s) and overload relay(s).
 3. Configuration: Full voltage, non-reversing unless otherwise indicated..
 - 4.

~~~ PROJECT NOTE ~~~~~

**VERIFY MINIMUM NEMA SIZE FOR STARTER REQUIRED FOR PROJECT IS NOT BELOW 0**

~~~ END OF PROJECT NOTE ~~~~~

5. Minimum Starter Size: NEMA Size 0.
6. Use of non-standard starter sizes smaller than specified standard NEMA sizes is not permitted.
7. Disconnects: Circuit breaker type.
 - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required. NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - 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.

- d. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
- e. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
- 8. Overload Relays: Bimetallic thermal type, melting alloy and solid state unless otherwise indicated.
 - a. Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 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.
 - b. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- 9. 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.
 - 2) Selector Switches: HAND/OFF/AUTO.
 - 3) Indicating Lights: Green ON, Red OFF.
 - c. Single-Speed, Reversing Starters:
 - 1) Pushbuttons: FOR-REV-STOP.
 - 2) Selector Switches: FOR/OFF/REV.
 - 3) Indicating Lights: Green FOR, Green REV, Red OFF.
 - d. Two-Speed Starters:
 - 1) Pushbuttons: FAST-OFF-SLOW.
 - 2) Selector Switches: SLOW/OFF/FAST.
 - 3) Indicating Lights: Green FAST, Red OFF, Amber SLOW.
- 10. 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
- 11.

~~~ PROJECT NOTE ~~~~~  
**VERIFY MANUAL STARTERS TO BE WITHIN THE SCOPE OF THE PROJECT (FRACTIONAL, INTEGRAL). MODIFY BELOW TO INCLUDE / EXCLUDE FOR SCOPE OF PROJECT.**  
~~~ END OF PROJECT NOTE ~~~~~

- N. Manual Motor Starters:
 - 1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s) and "quick-make, quick breaker" toggle action.
 - 2. Configuration: Non-reversing unless otherwise indicated.
 - 3. Marked to show whether unit is "OFF", "ON", or "TRIPPED".
 - 4. Where the motor is interlocked and controlled by another device, the motor starter shall be marked "Hand-Off-Auto".
 - 5. Fractional-Horsepower Manual Motor Starters:
 - a. Furnish with toggle operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type with heater rating clearly indicated.
 - c. Provide means for locking operator in the OFF position.
 - d. Single pole for 120 Volt, two pole for 208 Volt operation.
 - e. Trip-free toggle operated with on-off-reset position clearly indicated with neon pilot light for run indication.
 - f. Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 20 tripping characteristics. Provide one overload for single pole

- switch and two overloads for two pole switch. Sensor shall match to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.
6. Integral-Horsepower Manual Motor Starters:
 - a. Furnish with toggle or pushbutton operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type.
 - c. Provide means for locking operator in the OFF position.
 - d. Provide auxiliary contact where indicated; normally open (NO) or normally closed (NC) as indicated or as required.
 - O. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.
 - P. Reduced-Voltage Enclosed Controller: 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 ten (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. Shorting contactor:
 - a. A microprocessor shall control the operation of the shorting contactor via an output relay.
 - b. The shorting contractor shall close, shorting the thyristors after the motor current is below 130% of motor FLA and voltage is below nominal voltage (indicating ramp complete), and open on a stop command to allow deceleration ramp.
 7. Motor must be automatically protected from solid state component failure by one of the following means:
 - a. Shunt trip coil to trip disconnect in the event of a controller fault condition including a shorted thyristor.
 - b. Isolation contactor that opens when the motor is stopped or when the controller detects a fault condition including a shorted thyristor.
 - c.

~~~ PROJECT NOTE ~~~~~  
**SELECTION OF OVERCURRENT PROTECTIVE DEVICES TO BE COORDINATED WITH EQUIPMENT BEING SERVED AND USAGE.**

~~~ END OF PROJECT NOTE ~~~~~

3.03 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 the Chicago Electrical Code; 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 manual reset unless otherwise 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.
 - d. Provide isolated alarm contact where indicated.
 7. Melting Alloy Thermal Overload Relays:
 - a. Interchangeable current elements/heaters.
 - b. Provide isolated alarm contact where indicated.
 8. Solid-State Overload Relays:
 - a. Selectable inverse-time trip class rating; available ratings of Class 10, 20, and 30, minimum.
 - b. Adjustable full load current.
 - c. Phase loss protection.
 - d. Phase imbalance protection.
 - e. Ground fault protection.
 - f. Ambient temperature insensitive.
 - g. Thermal memory.
 - h. Repeat Trip Accuracy: Plus/minus 2 percent, minimum.
 - i. Trip test function.
 - j. Provide isolated alarm contact.
 - k. Provide communication capability where indicated: Compatible with system indicated.
- 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) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - 3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - 4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - 5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
 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; 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.
 - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - 2) Provide interchangeable trip units where indicated.
- 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 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) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - 3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - 4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - 5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
 - 6)

~~~ PROJECT NOTE ~~~~~  
**SELECT ITEMS FOR PROJECT SPECIFIC OR ITEM SPECIFIC ACCESSORIES REQUIRED FOR MOTOR / EQUIPMENT BEING CONTROLLED**

~~~ END OF PROJECT NOTE ~~~~~

3.04 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 magnetic motor starter, minimum.
- B. Pilot Devices:
 1. Comply with NEMA ICS 5; heavy-duty type.
 2. Nominal Size: 30 mm.
 3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
 4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
 5. Indicating Lights: Push-to-test type unless otherwise indicated.
 6. 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.
 3. Timing Relays: Electronic.
 - a. Adjustable Timing Range: As required for application.
 4. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
- D. Control Power Transformers:
1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus 25 percent spare capacity.
 2. Include primary and secondary fuses.
- E. Control Terminal Blocks: Include 25 percent spare terminals.
- F. 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.
- G. Elapsed Time Meters: Heavy duty with digital readout in hours.
- H. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.
- I. 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.
- J. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

PART 4 - EXECUTION

4.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings of enclosed controllers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

4.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install controllers in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and the Chicago Electrical Code.
- D. Provide required support and attachment components in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.
 1. Install freestanding equipment on concrete bases. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

- E. Install enclosed controllers plumb and level.
- F. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- 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 controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and the Chicago Electrical Code.
- 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 - Power System Studies.
- K. Identify enclosed controllers in accordance with Section 26 05 53 - Identification for Electrical Systems.
- L. Install wiring between enclosed controlled according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables. Buckle, train, and support wiring in enclosures.
- M. 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 enclosed controller 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.

4.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required, except for the following:
 - 1. Verify motor-running protection.
 - 2. Perform insulation-resistance tests on all control wiring with respect to ground.
 - 3.

~~~ PROJECT NOTE ~~~~~  
**VERIFY MINIMUM AMPERAGE FOR TESTING**  
~~~ END OF PROJECT NOTE ~~~~~

- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than 100 amperes. Tests listed as optional are not required, except for the following:
 - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
 - 2. Test functions of the trip unit by means of secondary injection.
- E. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

4.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

4.05 STARTUP AND REPORTING

- A. Comply with NETA ATS Article 7.16.
- B. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
 - 2. Report results in writing.
- D. Pretesting: On completing installation of the system, perform the following preparations for tests:
 - 1. Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by the manufacturer.
 - 2. Make continuity tests of circuits.
 - 3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
 - 4. Provide manufacturer's instructions for installation and testing of motor control devices to test personnel.
- E. Visual and mechanical inspection: Include the following inspections and related work:
 - 1. Motor-Control Device Ratings and Settings: Verify that ratings and settings as installed are appropriate for final loads and final arrangement and parameters. Recommend final protective-device ratings and settings where differences are found. Use accepted revised ratings or settings to make the final system adjustments. Prepare and submit load current and overload relay heater list.
 - 2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current project drawings.
 - 3. Exercise and perform operational tests of mechanical components and other devices in accordance with manufacturer's instructions.
 - 4. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.
 - 5. Clean devices using manufacturer's approved methods and materials.
 - 6. Verify proper fuse types and ratings in fusible devices.
- F. Electrical Tests: Perform the following in accordance with manufacturer's instructions:
 - 1. Insulation resistance test of motor control devices conducting parts to the extent permitted by the manufacturer's instructions. Insulation resistance less than 10 megohms is not acceptable.
 - 2. Use primary current injection to check performance characteristics of motor-circuit protectors and for overload relays of controllers for motors 15 horsepower and larger.

Trip characteristics not within manufacturer's published time-current tolerances are not acceptable.

3. Make adjustments for final settings of adjustable-trip devices.
4. Test auxiliary protective features such as loss of phase, phase unbalance and undervoltage to verify operation.
5. Check for improper voltages at terminals in controllers that have external control wiring when controller disconnect is opened.

G. Correct deficiencies and retest motor control devices. Verify by the system tests that specified requirements are met.

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

4.06 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

4.07 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. Demonstration: Demonstrate proper operation of controllers to Board, and correct deficiencies or make adjustments as directed.

C. Training: Train Board's personnel on operation, adjustment, and maintenance of enclosed controllers and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of four (4) hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.
5. Schedule training with at least seven (7) days advance notice.

4.08 PROTECTION

A. Protect installed enclosed controllers from subsequent construction operations.

END OF SECTION 26 29 13