

SECTION 26 29 00 LOW VOLTAGE CONTROLLERS, MOTOR

PART 1 - GENERAL

1.1 SCOPE

- A. NEMA and horsepower rated manual motor starters and switches for single and three phase induction type motors rated up to 20 Hp @ 575 VAC.
- B. NEMA rated magnetic non-combination and combination starters for single and three phase induction type motors rated up to 900 Hp @ 575 VAC.
- C. NEMA rated electromechanical reduced voltage starters for three phase induction type motors rated up to 700 Hp @ 575 VAC.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this section.

1.3 SUBMITTALS

- A. Submit shop drawings and product data for approval and final documentation in the quantities listed according to the Conditions of the Contract. All transmittals shall be identified by customer name, customer location and customer order number.

1.4 RELATED STANDARDS

- A. The motor controllers shall be manufactured and tested according to the latest applicable standards of the following agencies:
 - 1. NFPA 70 – National Electrical Code.
 - 2. CSA C22.2 No. 14, Industrial Control Equipment.
 - 3. NEMA ICS 2 – Controllers, Contactors and Overload Relays.
 - 4. NEMA ICS 5 – Control Circuit and Pilot Devices.
 - 5. NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
 - 6. UL 508, Industrial Control Equipment.
 - 7. Unit(s) must be certified by the following agencies
 - 8. UL
 - 9. CSA or cUL

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm with at least 60 years experience in manufacturing motor controllers.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in factory labeled packages.
- B. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from potential damage from weather and construction operations. Store so condensation will not form on or in controller and if necessary, apply temporary heat where required to obtain suitable service conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Motor Controllers shall be manufactured by Siemens or pre-approved equal. Approved manufacturers are as follows:
 - 1. SIEMENS
 - 2. []

2.2 MANUAL CONTROLLERS (SIEMENS CLASS 11 OR EQUAL)

A. Overview

1. Description: Horsepower rated manually operated, full voltage **[starter with integral ambient compensated bimetal overload relay] [switch] and [standard] [low voltage]** protection.
2. Adjustment Dial: For setting to motor FLA (starter only)
3. Short Circuit Protection: Integral short circuit trip at 13 times the max setting of the FLA or rated current. Furthermore, manual starter shall be rated as a Type E self-protected manual combination starter (up to 22 Amps) per UL508.
4. Ambient Compensation: Up to 140oF
5. Phase Loss Protection: Trips faster on a phase loss condition.
6. Test Trip Function.
7. Enclosure: NEMA ICS 6, Type **[1]**.

2.3 FRACTIONAL HORSEPOWER MANUAL STARTERS (SIEMENS CLASS SMF OR EQUAL)

A. Overview

1. Description: NEMA ICS 2, AC & DC general purpose Class A manually operated **[Non-Reversing] [Duplex] [Two Speed]** Starters, full-voltage with thermal overload units, for fractional horsepower induction motors, **[toggle] [key]** operator **[and [red] [green] pilot light]**.
2. Enclosure: NEMA ICS 6, Type **[Open] [1-Surface Mount] [1- Flush Mount] [3R] [4] [7/9] [12]**.

B. Accessories

1. Handle Guard Kit with Padlock Provision
2. Emergency Off Actuator

2.4 MANUAL SWITCHES (SIEMENS CLASS MMS & MRS OR EQUAL)

A. Overview

1. Description: NEMA ICS 2, AC & DC general purpose Class A manually operated **[Non-Reversing] [Two Speed] [Reversing]** full-voltage switch without thermal overload unit, for low horsepower induction motors, **[toggle] [key]** operator **[and [red] [green] pilot light]**.
2. Enclosure: NEMA ICS 6; Type **[Open] [1-Surface Mount] [1- Flush Mount] [3R] [4] [7/9] [12]**.

B. Accessories

1. Handle Guard Kit with Padlock Provision
2. Emergency Off Actuator

2.5 NON-REVERSING MAGNETIC MOTOR CONTROLLERS (SIEMENS CLASS 14 OR EQUAL)

A. Overview

1. Description: NEMA ICS 2, AC general purpose Class A magnetic controller for induction motors rated in horsepower. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
2. Size: **[00] [0] [1] [1¾] [2] [2½] [3] [3½] [4] [] [as scheduled] [as indicated]**.
3. Poles: **[2] [3] [*4], [as scheduled] [as indicated]**. *Optional auxiliary power pole may be utilized with 3 pole contactor to obtain 4 poles.
4. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
5. Contact inspection and replacement shall be possible without disturbing line or load wiring.
6. Coil type: Pull out design, encapsulated Class A construction.

7. Coil operating voltage: **[[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
8. Wiring: Straight-through wiring with all terminals clearly marked.
9. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
10. Enclosure: NEMA ICS 6, Type **[Open] [1] [3R] [4] [4X] [12] [], [as indicated] [as required to meet conditions of installation].**

B. Accessories

1. Pilot Devices: NEMA ICS 5, cover-mounted type or flange-mounted 30mm type based upon enclosure selection. Contacts shall be rated NEMA B600 for cover-mounted devices and NEMA A600 for flange-mounted 30mm devices.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal-in contact.
3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[_ VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and] secondary** and connect non-fused leg of secondary to enclosure.

2.6 REVERSING MAGNETIC MOTOR CONTROLLERS (SIEMENS CLASS 22 OR EQUAL)

A. Overview

1. Description: NEMA ICS 2, AC general purpose Class A reversing magnetic controller for induction motors rated in horsepower. Contactors are mechanically and electrically interlocked to prohibit both the FORWARD contactor and REVERSE contactor from being energized simultaneously. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
2. Size: **[00] [0] [1] [1¾] [2] [2½] [3] [3½] [4] [] [as scheduled] [as indicated]**.
3. Poles: **[2] [3] [*4], [as scheduled] [as indicated]**. *Optional auxiliary power pole may be utilized with 3 pole contactor to obtain 4 poles.
4. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide

- b. Totally enclosed in contactor housing
- c. Double break, 45° wedge action operation with gravity dropout.
- 5. Contact inspection and replacement shall be possible without disturbing line or load wiring.
- 6. Coil type: Pull out design, encapsulated Class A construction.
- 7. Coil operating voltage: **[[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
- 8. Wiring: Straight-through wiring with all terminals clearly marked.
- 9. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
- 10. Enclosure: NEMA ICS 6, Type **[Open] [1] [3R] [4] [4X] [12] [] [as indicated] [as required to meet conditions of installation].**

B. Accessories

- 1. Pilot Devices: NEMA ICS 5, cover-mounted type or flange-mounted 30mm type based upon enclosure selection. Contacts shall be rated NEMA B600 for cover-mounted devices and NEMA A600 for flange-mounted 30mm devices.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
- 2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal-in contact and electrical interlocks.
- 3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and] secondary** and connect non-fused leg of secondary to enclosure.

2.7 TWO-SPEED MAGNETIC MOTOR CONTROLLERS (SIEMENS CLASS 30 OR EQUAL)

A. Overview

- 1. Description: NEMA ICS 2, AC general purpose Class A multi speed magnetic controller for induction motors rated in horsepower. Contactors are mechanically and electrically interlocked to prohibit both the LOW speed contactor and HIGH-speed contactor from being energized simultaneously. Starters to control **[1-Winding] [2-Winding]** motors of the **[Constant Torque] [Variable Torque] [Constant Horsepower]** type **[with integral time delay transition between LOW and HIGH speeds]**. Half size starters are not

referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.

2. Size: **[0] [1] [1¼] [2] [2½] [3] [3½] [4] [as scheduled] [as indicated]**.
3. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
4. Contact inspection and replacement shall be possible without disturbing line or load
5. Coil type: Pull out design, encapsulated Class A construction.
6. Coil operating voltage: **[[120] [240] [480] []] volts single voltage, [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
7. Wiring: Straight-through wiring with all terminals clearly marked.
8. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
9. Enclosure: NEMA ICS 6, Type **[Open] [1] [3R] [4] [4X] [12] [] [as indicated] [as required to meet conditions of installation]**.

B. Accessories

1. Pilot Devices: NEMA ICS 5, cover-mounted type or flange-mounted 30mm type based upon enclosure selection. Contacts shall be rated NEMA B600 for cover-mounted devices and NEMA A600 for flange-mounted 30mm devices.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact and electrical interlocks.
3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[_VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and] secondary** and connect non-fused leg of secondary to enclosure.

2.8 NON-REVERSING DISCONNECT SWITCH TYPE COMBINATION MAGNETIC MOTOR CONTROLLERS (SIEMENS CLASS 17 OR EQUAL)

A. Overview

1. Description: NEMA ICS 2, AC general purpose Class A combination magnetic controller for induction motors rated in horsepower. Unit shall contain a disconnect switch with color coded externally operated handle. Handle shall give positive visual indication of ON/OFF status and be lockable in the ON or OFF positions with up to three padlocks. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
2. Disconnect Switch: **[Select a or b below]**
 - a. **[Non-Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with visible blades].**
 - b. **[Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with fuse block and fuse clips. Fuse clips will be designed to accommodate [UL 198E, Class [RK1] [RK5]] [UL 198C, Class J] fuse clips that accept [250] [600] volt, [dual element] current limiting, [time delay] [one-time] fuses. Short-circuit current rating: 100,000 RMS amperes up to 600 volts when protected with Class R fuses].**
3. Size: **[0] [1] [1¼] [2] [2½] [3] [3½] [4] [] [as scheduled] [as indicated].**
4. Poles: **[2] [3], [as scheduled] [as indicated].**
5. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
6. Contact inspection and replacement shall be possible without disturbing line or load
7. Coil type: Pull out design, encapsulated Class A construction.
8. Coil operating voltage: **[[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
9. Wiring: Straight-through wiring with all terminals clearly marked.
10. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
11. Enclosure: NEMA ICS 6, Type **[1] [3R] [4] [4X] [12] [] [as indicated] [as required to meet conditions of installation].**

B. Accessories

1. Pilot Devices: NEMA ICS 5, flange-mounted oil-tight 30mm type. Contacts shall be rated NEMA A600.

- a. Pushbutton: **[Start-Stop] []**
- b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
- c. Indicating Light(s): **[Red Run] [Green Off] []**
- 2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact.
- 3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and] secondary** and connect non-fused leg of secondary to enclosure.

2.9 CIRCUIT BREAKER TYPE COMBINATION MAGNETIC MOTOR CONTROLLERS (SIEMENS CLASS 18 OR EQUAL)

A. Overview

- 1. Description: NEMA ICS 2, AC general purpose Class A combination magnetic controller for induction motors rated in horsepower. Unit shall contain a circuit breaker employing adjustable magnetic trip settings and a color coded externally operated handle. Handle shall give positive visual indication of ON/OFF status and be lockable in the ON or OFF positions with up to three padlocks. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
- 2. Size: **[0] [1] [1¼] [2] [2½] [3] [3½] [4] []**, **[as scheduled] [as indicated]**.
- 3. Poles: **[2] [3]**, **[as scheduled] [as indicated]**.
- 4. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
- 5. Contact inspection and replacement shall be possible without disturbing line or load
- 6. Coil type: Pull out design, encapsulated Class A construction.
- 7. Coil operating voltage: **[[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
- 8. Wiring: Straight-through wiring with all terminals clearly marked.
- 9. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
- 10. Enclosure: NEMA ICS 6, Type **[1] [3R] [4] [4X] [12] [] [as indicated] [as required to meet conditions of installation]**.

11. Short-circuit current rating:
 - a. Controller sizes 00-4 (100kA @480V RMS symmetrical and 25kA @600V RMS symmetrical)
 - b. Controller sizes 5-6 (100kA @480V RMS symmetrical and 42kA @600V RMS symmetrical)

B. Accessories

1. Pilot Devices: NEMA ICS 5, flange-mounted oil-tight 30mm type. Contacts shall be rated NEMA A600.
 - a. Pushbutton: **[Start-Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact.
3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[_ VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and secondary]** and connect non-fused leg of secondary to enclosure.

2.10 REVERSING DISCONNECT SWITCH TYPE COMBINATION MAGNETIC MOTOR CONTROLLERS (SIEMENS CLASS 25 OR EQUAL)

A. Overview

1. Description: NEMA ICS 2, AC general purpose Class A reversing combination magnetic controller for induction motors rated in horsepower. Contactors are mechanically and electrically interlocked to prohibit both the FORWARD contactor and REVERSE contactor from being energized simultaneously. Unit shall contain a disconnect switch with color coded externally operated handle. Handle shall give positive visual indication of ON/OFF status and be lockable in the ON or OFF positions with up to three padlocks. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
2. Disconnect Switch: **[Select a or b below]**
 - a. **[Non-Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with visible blades].**
 - b. **[Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with fuse block and fuse clips. Fuse clips will be designed to accommodate [UL 198E, Class [RK1] [RK5]] [UL 198C, Class J] fuse clips that accept [250] [600] volt, [dual element] current limiting, [time delay] [one-time] fuses. Short-circuit current rating: 100,000 RMS amperes up to 600 volts when protected with Class R fuses].**
3. Size: **[0] [1] [1¼] [2] [2½] [3] [3½] [4] [] [as scheduled] [as indicated]**.
4. Poles: **[2] [3], [as scheduled] [as indicated]**.
5. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
6. Contact inspection and replacement shall be possible without disturbing line or load
7. Coil type: Pull out design, encapsulated Class A construction.
8. Coil operating voltage: **[[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
9. Wiring: Straight-through wiring with all terminals clearly marked.
10. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:

- (1.) Phase loss by tripping within 3 seconds, selectable
- (2.) Ground fault, selectable
- (3.) Phase imbalance, selectable
- b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
- 11. Enclosure: NEMA ICS 6, Type **[1] [3R] [4] [4X] [12] [] [as indicated] [as required to meet conditions of installation]**.

B. Accessories

- 1. Pilot Devices: NEMA ICS 5, flange-mounted oil-tight 30mm type. Contacts shall be rated NEMA A600.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
- 2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact.
- 3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and secondary and connect non-fused leg of secondary to enclosure]**.

2.11 REVERSING CIRCUIT BREAKER TYPE COMBINATION MAGNETIC MOTOR CONTROLLERS (SIEMENS CLASS 26 OR EQUAL)

A. Overview

- 1. Description: NEMA ICS 2, AC general purpose Class A reversing combination magnetic controller for induction motors rated in horsepower. Contactors are mechanically and electrically interlocked to prohibit both the FORWARD contactor and REVERSE contactor from being energized simultaneously. Unit shall contain a circuit breaker employing adjustable magnetic trip settings and a color coded externally operated handle. Handle shall give positive visual indication of ON/OFF status and be lockable in the ON or OFF positions with up to three padlocks. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
- 2. Size: **[0] [1] [1¼] [2] [2½] [3] [3½] [4] [] [as scheduled] [as indicated]**.
- 3. Poles: **[2] [3], [as scheduled] [as indicated]**.
- 4. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
- 5. Contact inspection and replacement shall be possible without disturbing line or load.
- 6. Coil type: Pull out design, encapsulated Class A construction.
- 7. Coil operating voltage: **[[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
- 8. Wiring: Straight-through wiring with all terminals clearly marked.
- 9. Overload Relay

- a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
 10. Enclosure: NEMA ICS 6, Type **[1] [3R] [4] [4X] [12] []**, **[as indicated] [as required to meet conditions of installation]**.
 11. Short-circuit current rating:
 - a. Controller sizes 00-4 (100kA @480V RMS symmetrical and 25kA @600V RMS symmetrical)
 - b. Controller sizes 5-6 (100kA @480V RMS symmetrical and 42kA @600V RMS symmetrical)
- B. Accessories
1. Pilot Devices: NEMA ICS 5, flange-mounted oil-tight 30mm type. Contacts shall be rated NEMA A600.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
 2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact.
 3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[_ VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and secondary]** and connect non-fused leg of secondary to enclosure.
- 2.12 MULTI-SPEED DISCONNECT SWITCH TYPE COMBINATION MAGNETIC MOTOR CONTROLLERS – MULTI-SPEED (SIEMENS CLASS 32 OR EQUAL)
- A. Overview
1. Description: NEMA ICS 2, AC general purpose Class A multi speed combination magnetic controller for induction motors rated in horsepower. Contactors are mechanically and electrically interlocked to prohibit both the LOW speed contactor and HIGH-speed contactor from being energized simultaneously. Starters to control **[1-Winding] [2-Winding]** motors of the **[Constant Torque] [Variable Torque] [Constant Horsepower]** type **[with integral time delay transition between LOW and HIGH speeds]**. Unit shall contain a disconnect switch with color coded externally operated handle. Handle shall give positive visual indication of ON/OFF status and be lockable in the ON or OFF positions with up to three padlocks. Half size starters are not referenced

- in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
2. Disconnect Switch: **[Select a or b below]**
 - a. **[Non-Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with visible blades].**
 - b. **[Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with fuse block and fuse clips. Fuse clips will be designed to accommodate [UL 198E, Class [RK1] [RK5]] [UL 198C, Class J] fuse clips that accept [250] [600] volt, [dual element] current limiting, [time delay] [one-time] fuses. Short-circuit current rating: 100,000 RMS amperes up to 600 volts when protected with Class R fuses].**
 3. Size: **[0] [1] [1¼] [2] [2½] [3] [3½] [4] [] [as scheduled] [as indicated].**
 4. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
 5. Contact inspection and replacement shall be possible without disturbing line or load
 6. Coil type: Pull out design, encapsulated Class A construction.
 7. Coil operating voltage: **[[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.**
 8. Wiring: Straight-through wiring with all terminals clearly marked.
 9. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
 10. Enclosure: NEMA ICS 6, Type **[1] [3R] [4] [4X] [12] [], [as indicated] [as required to meet conditions of installation].**
- B. Accessories
1. Pilot Devices: NEMA ICS 5, flange-mounted oil-tight 30mm type. Contacts shall be rated NEMA A600.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
 2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact.

3. Control Power Transformers: [480] [240] [] volt primary and [120] [] volt secondary, [] VA minimum, in each motor starter [as scheduled]. Provide fused [primary and] secondary and connect non-fused leg of secondary to enclosure.

2.13 MULTI-SPEED CIRCUIT BREAKER TYPE COMBINATION MAGNETIC MOTOR CONTROLLERS – MULTI-SPEED (SIEMENS CLASS 32 OR EQUAL)

A. Overview

1. Description: NEMA ICS 2, AC general purpose Class A multi speed combination magnetic controller for induction motors rated in horsepower. Contactors are mechanically and electrically interlocked to prohibit both the LOW speed contactor and HIGH-speed contactor from being energized simultaneously. Starters to control [1-Winding] [2-Winding] motors of the [Constant Torque] [Variable Torque] [Constant Horsepower] type [with integral time delay transition between LOW and HIGH speeds]. Unit shall contain a circuit breaker employing adjustable magnetic trip settings and a color coded externally operated handle. Handle shall give positive visual indication of ON/OFF status and be lockable in the ON or OFF positions with up to three padlocks. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
2. Size: [0] [1] [1¼] [2] [2½] [3] [3½] [4] [] [as scheduled] [as indicated].
3. Power Contacts shall be:
 - a. Composed of silver-cadmium-oxide.
 - b. Totally enclosed in contactor housing
 - c. Double break, 45° wedge action operation with gravity dropout.
4. Contact inspection and replacement shall be possible without disturbing line or load
5. Coil type: Pull out design, encapsulated Class A construction.
6. Coil operating voltage: [[120] [240] [480] [] volts single voltage,] [[120/240] [240/480] volts dual voltage,] [60] [] Hz.
7. Wiring: Straight-through wiring with all terminals clearly marked.
8. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
9. Enclosure: NEMA ICS 6, Type [1] [3R] [4] [4X] [12] [], [as indicated] [as required to meet conditions of installation].
10. Short-circuit current rating:

- a. Controller sizes 00-4 (100kA @480V RMS symmetrical and 25kA @600V RMS symmetrical)
 - b. Controller sizes 5-6 (100kA @480V RMS symmetrical and 42kA @600V RMS symmetrical)
- B. Accessories
- 1. Pilot Devices: NEMA ICS 5, flange-mounted oil-tight 30mm type. Contacts shall be rated NEMA A600.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
 - 2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact.
 - 3. Control Power Transformers: **[480] [240] []** volt primary and **[120] []** volt secondary, **[VA minimum, in each motor starter] [as scheduled]**. Provide fused **[primary and] secondary** and connect non-fused leg of secondary to enclosure.
- 2.14 ELECTROMECHANICAL REDUCED VOLTAGE MOTOR CONTROLLER (SIEMENS CLASS 36 NON-COMBINATION TYPE, CLASS 37 COMBINATION TYPE OR EQUAL)
- A. Overview
- 1. Description: NEMA ICS 2, AC general purpose Class A electromechanical reduced voltage controller for induction motors rated in horsepower. Half size starters are not referenced in NEMA standards. They conform to specified regulatory requirements and shall be utilized where possible to reduce costs.
 - 2. Starter Type: **[Select a, b or c below]**
 - a. Autotransformer Type
 - 1.) Three coil transformer
 - 2.) 50, 65 and 80% voltage taps
 - 3.) Closed circuit transition
 - 4.) Adjustable starting time
 - b. Wye-Delta Type
 - 1.) **[Closed] [Open]** transition
 - 2.) Adjustable starting time
 - c. Part-Winding Type
 - 1.) Adjustable starting time
 - 3. Controller type: **[Select a or b below]**
 - a. **[Non-Combination]**
 - b. [Combination]
 - 1.) **Unit shall contain a color coded externally operated handle. Handle shall give positive visual indication of ON/OFF status and be lockable in the ON or OFF positions with up to three padlocks.**
 - 2.) **Disconnect Type: [Select a, b or c below]**
 - a.) **Non-Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with visible blades.**
 - b.) **Fusible Switch Assembly: NEMA KS 1, enclosed knife switch with fuse block and fuse clips. Fuse clips will be designed to accommodate [UL 198E, Class [RK1] [RK5]] [UL 198C, Class J] fuse clips that accept [250] [600] volt, [dual element] current limiting, [time delay] [one-time] fuses. Short-circuit current rating: 100,000 RMS amperes up to 600 volts when protected with Class R fuses.**
 - c.) **Circuit breaker employing adjustable magnetic trip settings**
 - (1.) **Short-circuit current rating:**
 - (a.) **Controller sizes 00-4 (100kA @480V RMS symmetrical and 25kA @600V RMS symmetrical)**

- (b.) **Controller sizes 5-6 (100kA @480V RMS symmetrical and 42kA @600V RMS symmetrical)**
4. Size: **[0] [1] [1¼] [2] [2½] [3] [3½] [4] [5] [6] [] [as scheduled] [as indicated]**.
 - a. Power Contacts shall be:
 - b. Composed of silver-cadmium-oxide.
 - c. Totally enclosed in contactor housing
 5. Double break, 45° wedge action operation with gravity dropout.
 6. Contact inspection and replacement shall be possible without disturbing line or load
 7. Coil type: Pull out design, encapsulated Class A construction.
 8. Coil operating voltage: **[match motor voltage] [_ Volts] [60] [50] Hz**.
 9. Control voltage: **[120V with CPT] [[120V] [24V] [_V] separate source]**
 10. Wiring: Straight-through wiring with all terminals clearly marked.
 11. Overload Relay
 - a. Solid State:
 - 1.) Trip current rating will be established by selection of overload relay and shall be adjustable, minimum 4 to 1 current range. The overload relay shall have selectable trip classes conforming to NEMA Trip Class 5, 10, 20 and 30.
 - 2.) The overload relay shall provide
 - a.) Protection against:
 - (1.) Phase loss by tripping within 3 seconds, selectable
 - (2.) Ground fault, selectable
 - (3.) Phase imbalance, selectable
 - b.) Components
 - (1.) 1 N.O. & 1 N.C. contacts
 - (2.) Self-powered
 - (3.) Ambient insensitive
 - (4.) Built-in remote test
 - (5.) Automatic/manual reset modes
 - (6.) Mechanical and electrical test functions
 - (7.) Conformal coated circuit board
 - (8.) Visible trip indicator
 - (9.) Provisions for panel and DIN rail mounting without requiring adaptors
 - (10.) Provisions to accept a tamper guard
 - (11.) Repeat accuracy <1%
 - (12.) Auxiliary contact terminal boards, finger safe and removable.
 12. Enclosure: NEMA ICS 6, Type **[1] [3R] [4] [4X] [12] [], [as indicated] [as required to meet conditions of installation]**.
- B. Accessories
1. Pilot Devices: NEMA ICS 5, flange-mounted oil-tight 30mm type. Contacts shall be rated NEMA A600.
 - a. Pushbutton: **[Start – Stop] []**
 - b. Selector Switch: **[Hand/Off/Auto] [Off/On] []**
 - c. Indicating Light(s): **[Red Run] [Green Off] []**
 2. Auxiliary Contacts: NEMA ICS 5 rated A600, **[1] [2] []** normally open and **[1] [2] []** normally closed contacts in addition to the seal in contact.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install all equipment in accordance with the contract drawings and manufacturers recommendations and manuals.
- B. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.

- C. Install fuses in fusible switches.
- D. Solid state overload relays shall be dial set to match installed motor characteristics.
- E. Adjust all circuit breakers, switches, access doors and operating handles for free mechanical and electrical operation as described in manufacturer's instructions.
- F. Clean interiors of all enclosed electrical equipment to remove construction debris, dirt and shipping materials.
- G. Repaint scratched or marred exterior surfaces to match original finish.

3.2 ADJUSTMENTS AND CLEANING

- A. The Contractor shall perform necessary field adjustments to place the equipment in final operating condition. The settings shall be in accordance with the approved protective device coordination study or as directed by the Engineer.

3.3 TESTING

- A. Perform factory and installation tests in accordance with applicable NEC, NEMA and UL requirements.

3.4 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

END OF SECTION