

---

**PART 1**      **GENERAL**

**1.1**      **RELATED SECTIONS**

- .1      Section 26 05 00 – Common Work Results - Electrical.

**1.2**      **REFERENCES**

- .1      International Electrotechnical Commission (IEC)
  - .1      IEC 947-4-1-2002, Part 4: Electromechanical Contactors and motor-starters.

**1.3**      **ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Indicate:
  - .1      Mounting method and dimensions.
  - .2      Starter size and type.
  - .3      Layout of identified internal and front panel components.
  - .4      Enclosure types.
  - .5      Wiring diagram for each type of starter.
  - .6      Interconnection diagrams.
- .3      Product Data:
  - .1      Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .4      Shop Drawings:
  - .1      Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
    - .1      Submit drawings stamped and signed by contractor.
    - .2      Provide shop drawings for each type of starter to indicate:
      - .1      Mounting method and dimensions.
      - .2      Starter size and type.
      - .3      Layout and components.
      - .4      Enclosure types.
      - .5      Wiring diagram.
      - .6      Interconnection diagrams.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include operation and maintenance data for each type and style of starter.
- .3 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .4 Extra Materials:
  - .1 Provide listed spare parts for each different size and type of starter:
    - .1 3 contacts, stationary.
    - .2 3 contacts, movable.
    - .3 1 contacts, auxiliary.
    - .4 1 control transformer.
    - .5 1 operating coil.
    - .6 2 fuses.
    - .7 10% indicating lamp bulbs used.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.6 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra Materials:
  - .1 Provide listed spare parts for each different size and type of starter:
    - .1 3 contacts, stationary.
    - .2 3 contacts, movable.
    - .3 1 contacts, auxiliary.
    - .4 1 control transformer.
    - .5 1 operating coil.
    - .6 2 fuses.

- .7 10% indicating lamp bulbs used.

## **1.7 EXTRA MATERIALS**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction Waste Management and Disposal, and with the Waste Reduction Work plan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category.

### **2.2 MANUAL MOTOR STARTERS**

- .1 Single or three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 One Three overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Toggle Key switch pushbutton: NEMA 13 heavy duty oil tight labeled as indicated.
  - .2 Indicating light: NEMA 13 heavy duty oil tight type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

### **2.3 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control disconnect motor circuit interrupter circuit breaker, and provision for:

- .1 Locking in "OFF" position with up to 3 padlocks.
- .2 Independent locking of enclosure door.
- .3 Provision for preventing switching to "ON" position while enclosure door open.

## **2.5 VARIABLE FREQUENCY DRIVES**

- .1 The drives shall be suitable for centrifugal fans and pumps of the ampere ratings scheduled on the drawings.
  - .1 Drives shall have CSA 2 Enclosures; enclosure complete with disconnect switch and line and load reactors.
  - .2 Drives shall have interface panel in the door to the VFD.
- .2 The drives shall be pulse-width-modulated technology with IGBT power electronics to provide adjustable frequency output with the output voltage proportional to output frequency. The drive operation is controlled via an integral microprocessor.
- .3 The drive shall have the following operation features:
  - .1 Input Voltage/Frequency: 600 V 3 phase/60 Hertz.
  - .2 Output Voltage/Frequency: Input voltage/0-500 Hz.
  - .3 Initial Output Current: 250% of load FLA for 2 seconds.
  - .4 Overload Current: 110% of load FLA for 60 seconds.
  - .5 Operating ambient temperature: -10oC to +40oC.
  - .6 Line voltage variation: +10/-15% of nominal voltage.
  - .7 Line frequency variation: 45 - 65 Hz.
  - .8 Efficiency at full-load: at least 96%.
  - .9 Power factor at full-load: at least 0.96.
- .4 The drive shall have the following protective features:
  - .1 Input phase loss initiating automatic shutdown of drive.
  - .2 Input over-voltage protection.
  - .3 Line surge protection.
  - .4 Output short-circuit and ground-fault protection.
  - .5 Drive overload and motor overload protection.
  - .6 Shorted power electronics initiating automatic shutdown of drive through shunt-trip of MCP.
  - .7 Input filter to minimize harmonics, on the input current, to accepted standards.
  - .8 Line reactor, remote location installed at motor leads.
- .5 The drive shall have the following performance features:
  - .1 Critical speed lockout.
  - .2 Adjustable acceleration/deceleration.
  - .3 Ramp stop selection.

- .4 Speed setting inputs: keypad in face panel and 4-20 mA input from remote source.
- .6 Acceptable manufacturers: Allen-Bradley, Cutler-Hammer, Schneider-Square D, Siemens.

## **2.4 FULL VOLTAGE REVERSING MAGNETIC STARTERS**

- .1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Two - 3 pole magnetic contactors mounted on common base.
  - .2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.
  - .3 Three overload relays with heater elements, manual automatic reset.
- .2 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight type and color as indicated.
  - .3 Auxiliary control devices as indicated.

## **2.5 MULTI-SPEED STARTERS**

- .1 2 speed starters of size, type, rating and enclosure type as indicated. Starter suitable for constant torque variable torque constant kW type motor and with components as follows:
  - .1 One-3 pole contactor for each winding for separate winding motors.
  - .2 One-3 pole and one-5 pole contactor for each reconnectable winding for consequent pole type motors.
  - .3 Three overload relays with 3 heater elements and manual reset for each speed.
- .2 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight, type and color as indicated.
  - .3 Auxiliary control devices as indicated.
  - .4 Low speed compelling relay automatic sequence accelerating decelerating relays for each speed.

## **2.6 MAGNETIC STARTER REDUCED VOLTAGE AUTO-TRANSFORMER**

- .1 Auto-transformer starter closed circuit transition type, of size, type, rating and enclosure type as indicated and with following components:
  - .1 Three-3 pole contactors.
  - .2 Auto-transformer with 50%, 65% and 80% 65% and 85% taps.
  - .3 One adjustable pneumatic timing relay.

- .4 One-3 pole manual reset overload device.
- .5 Thermal overload protection of auto-transformers.
- .2 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight type and color as indicated.
  - .3 Auxiliary control devices as indicated.

## **2.7 MAGNETIC STARTER REDUCED VOLTAGE STAR-DELTA**

- .1 Reduced voltage star-delta open transition starter, of size, type, rating and enclosure type as indicated, with components as follows:
  - .1 Two-3 pole delta contactors with auxiliary relays and interlocks.
  - .2 One-3 pole star contactor with auxiliary relays and interlocks.
  - .3 Mechanical interlock to interlock one delta contactor and the star contactor.
  - .4 One timing relay.
  - .5 Three pole manual automatic reset overload relays.
- .2 Reduced voltage star-delta closed transition starter, of size, type, rating and enclosure type as indicated, with components as follows:
  - .1 Two-3 pole delta contactors with auxiliary relays and interlocks.
  - .2 One-3 pole star contactor with auxiliary relay and interlocks.
  - .3 One-3 pole transition contactor.
  - .4 One set of transition resistors.
  - .5 Mechanical interlock, to interlock one delta contactor and the star contactor.
  - .6 One timing relay.
  - .7 Three pole manual automatic reset overload relays.
- .3 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight, type and color as indicated.
  - .3 Auxiliary control devices as indicated.

## **2.8 MAGNETIC STARTER REDUCED**

- .1 Two-step reduced voltage, part winding starter of size, type, rating and enclosure type as indicated, with components as follows:
  - .1 Two-3 pole contactors.
  - .2 Adjustable pneumatic timer.
  - .3 Six manual automatic reset overload relays.

- .2 Three step reduced voltage part winding starter of size, type, rating and enclosure type as indicated, with components as follows:
  - .1 Three-3 pole contactors.
  - .2 One set starting resistors.
  - .3 Six manual automatic reset overload relays.
- .3 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight type and color as indicated.
  - .3 Auxiliary control devices as indicated.

## **2.9 THREE PHASE MANUAL REVERSING STARTER**

- .1 Three phase manual reversing starter of size, type, rating and enclosure type as indicated, with components as follows:
  - .1 Two-3 pole manual motor starters, quick make and break.
  - .2 Six overload relays and manual reset.
  - .3 Mechanical interlock to prevent both switches from closing at same time.
- .2 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight type and colour as indicated.

## **2.10 THREE PHASE MANUAL TWO SPEED SEPARATE WINDING STARTERS**

- .1 Three phase manual two speed separate winding starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Two-3 pole manual motor starters, quick make and break.
  - .2 Six overload relays and manual reset.
  - .3 Mechanical interlock to prevent both switches from closing at same time.
- .2 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight type and colour as indicated.

## **2.11 DC FULL VOLTAGE REVERSING STARTERS**

- .1 DC full voltage non-reversing starters of size, type, rating and enclosure type as indicated, with components as follows:
  - .1 Contactor: single two pole solenoid operated type.
  - .2 Indirectly-heated, manual reset thermal overload relay.

- .2 Accessories:
  - .1 Pushbuttons: standard heavy duty oil tight labelled as indicated.
  - .2 Selector switches: standard heavy duty oil tight labelled as indicated.
  - .3 Indicating lights: standard heavy duty oil tight type and colour as indicated.

## **2.12 DC FULL VOLTAGE REVERSING STARTERS**

- .1 Dc full voltage reversing starter of size, type, rating and enclosure type as indicated, with components as follows:
  - .1 Two contactors: single two pole solenoid operated type, mechanically and electrically interlocked.
  - .2 Indirectly-heated, manual reset thermal overload relay.
- .2 Accessories:
  - .1 Pushbutton Selector switches: standard heavy duty labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight, type and colour as indicated.
  - .3 Auxiliary control devices as indicated.

## **2.13 CONTROL TRANSFORMER**

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## **2.14 ACCESSORIES**

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.
- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

## **2.15 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

## **2.16 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 5 engraved as indicated.



---

**PART 3**      **EXECUTION**

**3.1**            **INSTALLATION**

- .1      Install starters and control devices in accordance with manufacturer's instructions.
- .2      Install and wire starters and controls as indicated.
- .3      Ensure correct fuses and overload devices elements installed.
- .4      Confirm motor nameplate and adjust overload device to suit

**3.2**            **FIELD QUALITY CONTROL**

- .1      Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2      Operate switches and contactors to verify correct functioning.
- .3      Perform starting and stopping sequences of contactors and relays.
- .4      Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5      Factory representative must be present on site to complete set up for initial star-up and commissioning of variable frequency drives.

**3.3**            **CLEANING**

- .1      Clean in accordance with Section 01 74 11 – Cleaning.
  - .1      Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2      Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**