# GENERAL

##  RELATED DOCUMENTS

### Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

### Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

## SUMMARY

### This section specifies the basic requirements for electrical components which are an integral part of packaged plumbing equipment. These components include, but are not limited to factory installed motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment. In addition, this section covers necessary coordination issues between plumbing and electrical disciplines. All plumbing and electrical construction documents must be completely reviewed by the Plumbing and Electrical Contractors prior to the submission of bids. Any discrepancies in the documents should be brought to the Architect/Engineer's attention at that time. Failure to properly coordinate or review documents in advance of submission of bids will not be valid cause for changes to the overall Contract amount.

### Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.

## REFERENCES

### The design, manufacture, testing and method of installation of all equipment and materials furnished under the requirements of this specification section shall conform to the following:

#### ANSI/NEMA Standard MG 1: Motors and Generators

#### NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.

#### NEMA Standard 250: Enclosures for Electrical Equipment.

#### NEMA Standard KS 1: Enclosed Switches.

#### ANSI/NFPA 70 National Electrical Code.

#### AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

#### AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings.

#### ANSI/IEEE 112 – Test Procedure for Polyphase Induction Motors and Generators.

## SUBMITTALS

### No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, or as required by the individual equipment specification sections.

### Reference Section 22 05 00

## QUALITY ASSURANCE

### Electrical components and materials shall be UL labeled and listed.

# PRODUCTS

## MOTORS

### The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

#### Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

#### Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Minimum service factors shall be as follows:

|  |
| --- |
| **Motor Service Factor Schedule** |
| **Horsepower:** | **3600 RPM:** | **1800 RPM:** |
| 1/6 – 1/3 | 1.35 | 1.35 |
| 1/2 | 1.25 | 1.25 |
| 3/4 | 1.25 | 1.25 |
| 1 – 1.25 | 1.25 | 1.15 |
| 1.5 - 150 | 1.15 | 1.15 |

#### Two‑speed poly-phase motors shall have two separate windings served by a single point electrical connection to the two speed starter. Two speed starters shall be located at the motor location unless otherwise noted.

#### Temperature Rating: Rated for 40 deg. C environment with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).

#### Starting capability: Frequency of starts as indicated by automatic control system, and not less than five (5) evenly timed starts per hour for manually controlled motors.

#### Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

##### Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit each specific application.

##### Bearings: Ball or roller bearings with inner and outer shaft seals; re‑greasable; designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor; for fractional horsepower, light duty motors, sleeve type bearings are permitted.

##### Enclosure Type: Open drip‑proof motors for indoor use where satisfactorily housed or remotely located during operation; guarded drip‑proof motors where exposed to contact by employees or building occupants; weather protected Type I for outdoor use, Type II where not housed.

##### Overload protection: Built‑in thermal overload protection (in accordance with NEC requirements) and, where indicated, an internal sensing device suitable for signaling and stopping the motor at the starter.

#### Noise rating: "Quiet"

#### Efficiency: **"Premium efficiency"** motors, as defined in NEMA MG 1, most recent edition.

#### Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

#### Motors Used With Variable Frequency Drives: Ratings, characteristics, and features coordinated with and approved by drive manufacturer. Motor shall be designed and labeled for use with variable frequency drives. Motor shall be designed with critical vibration frequencies outside the operating range of the drive output and shall be suitable for use throughout speed range without overheating.

#### Motors Used for Wet or Corrosive Duty: Severe duty with cast-iron frame, epoxy finish, stainless steel nameplate, polymer shaft seal, corrosion-resistant fasteners and fan, moisture-resistant windings, and non-wicking leads.

## SHEAVES

### All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.

### When replacing sheaves, use sheaves of at least the originally supplied sizes.

### Contractor shall be responsible for replacement sheaves required to achieve specified performance. Coordinate with testing and balancing of the equipment.

## STARTERS, ELECTRICAL DEVICES, AND WIRING

### Motor-Starter Characteristics: Motor starters shall be compatible with the equipment they serve. In general, motor starter characteristics shall meet the requirements of Division 26 specification sections and as outlined as follows:

### FULL VOLTAGE NON-REVERSING MAGNETIC AND COMBINATION STARTERS

#### Provide magnetic starters for three phase motors in accordance with the requirements listed in the Contract Documents. Motor starters shall be full voltage non-reversing "across the line" magnetic type, rated in accordance with NEMA standard sizes and horsepower ratings. Magnetic starters shall not be less than NEMA size one.

#### Each starter shall have a removable hinged cover capable of being padlocked. Enclosures shall be NEMA 1 general purpose type unless indicated otherwise. Provide watertight and dust tight enclosures for units installed outside, in wet locations, or as indicated on the drawings with the subscript "WP". Starters shall be provided with double break silver alloy contacts. All contacts shall be replaceable without removing wiring or the starter from the enclosure.

#### Magnetic starters shall be provided with the following additional equipment:

##### Overload relays. These shall be an integral part of the motor starter. Overload relays shall have a minimum +10 percent adjustment from the nominal heater rating. Heaters shall be available such that when used with the +10 percent adjustment, a continuous selection of motor full load currents can be obtained through the size limitations of the starter. Overload relays shall be the manual reset type and shall be field convertible from manual to automatic reset. Overload relays shall be melting alloy or bimetallic type. Thermal units shall be of one piece construction and interchangeable. The starter unit shall be inoperative if the thermal unit is removed. Provide 3 overload relays, one for each phase of the three phase starter.

##### Provide fused disconnect switches for combination starters with Class R type fuse rejection clips. If breakers are shown, provide breakers with a minimum of 65,000 RMS symmetrical amps interrupting capacity.

#### Starters shall be suitable for the addition of at least three normally open and three normally closed sets of auxiliary contacts. Provide a minimum of two normally open and two normally closed sets of contacts unless additional contacts are scheduled on the drawings or required for proper control of the equipment.

#### In each magnetic starter, provide a cover mounted hand-off-auto selector switch complete with a manual overload reset button and a red "On" pilot light. Provide a control transformer with a secondary voltage of 120V, complete with primary overload and short circuit protection.

#### Time delay relays with time delay after energization shall be provided for starters indicated, or as required for proper control of equipment. Time delay feature shall be adjustable from 0 to 60 seconds and set as indicated on the drawings.

#### Where combination starters are shown on the drawings, a separate starter and disconnect switch may be substituted at the Contractor's option, provided adequate space is available for the installation.

### MANUAL MOTOR STARTERS

#### Thermal element type manual motor starters for single phase motors: Provide flush mounted units in finished areas and surface mounted units in unfinished areas. Starter shall have NEMA I general purpose enclosure, unless otherwise indicated, and shall be rated for the motor horsepower required.

### MOTOR CONNECTIONS

#### Provide connections to motors in accordance with the requirements listed in the electrical specifications.

#### See Section 26 29 13 for the use of lugs for motor connections.

### CAPACITORS

#### Capacitor features shall include:

##### Individual unit cells.

##### All welded steel housing.

##### Each capacitor shall be internally fused.

##### Non‑flammable synthetic liquid impregnate.

##### Craft tissue insulation.

##### Aluminum foil electrodes

#### KVAR size shall be determined by the Contractor/Supplier and shall correct motor power factor to 95 percent or better and shall be installed on all motors 10 horsepower and larger that have an uncorrected power factor of less than 85 percent at rated load. Power factor correction is not required for motors used in conjunction with variable frequency drives.

## SAFETY SWITCHES

### Furnish and install heavy duty type safety switches, having the electrical characteristics, ratings and modifications shown on the drawings. All switches shall have:

#### NEMA 1 general purpose enclosures unless otherwise noted for all interior applications.

#### NEMA 3R rainproof enclosures unless otherwise noted for all exterior applications.

#### Metal nameplates, front cover mounted that contain a permanent record of switch type, catalog number and H.P. ratings with both standard and time delay fuses.

#### Handle that is padlockable in "OFF" position.

#### Non-teasible, positive quick-make, quick-break mechanism.

#### UL approval and shall bear the UL label.

#### All fusible switches shall have Class R Fuse rejection clips.

## DIVISION-26 RESPONSIBILITY

### Unless otherwise noted, furnish and install single phase starters with thermal overload protection for all single phase motors not indicated as part of the Division 22 responsibility. Furnish and install all full voltage, non-reversing, single speed motor starters for appropriate three phase equipment. Furnish and install disconnect switches for all three phase motors. Provide the following additional equipment as required.

### Provide auxiliary motor starter contacts as shown on the drawings or as required for proper control of equipment.

### Furnish and install all junction boxes.

### Furnish and install all motor power circuit conduit and wiring.

### Install power factor correction capacitors furnished by the Division-22 Contractor.

## DIVISION-22 RESPONSIBILITY

### Furnish and set all motors.

### Furnish combination starter/disconnect units for the following three phase powered equipment items (Starter/disconnect units shall include overload protection according to NEC requirements):

#### Multiple Speed Motors (Multiple speed motor starters shall be furnished with decelerating relays.)

#### Duplex Pumps with Alternator

#### Sewage Ejector Pumps and Sump Pumps

### Furnish and install all electrical control circuit conduits and wiring and control devices required to perform the equipment control functions as specified in Division-22.

### Furnish starters, with thermal overload protection, and disconnects for the following single phase plumbing equipment:

#### Pumps

### Furnish capacitors for power factor correction on all motors furnished under Division-22 in accordance with this Section.

### All electrical equipment provided, including the wiring and installation of electrical equipment shall be in strict accordance with the requirements of this Section and Division-26.

# EXECUTION

## INSTALLATION

### All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

### For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer’s recommendations. Align shafts to manufacturer’s requirements or within 0.002 inch per inch diameter of coupling hub.

### For belt drive motors, mount sheaves on the appropriate shafts per manufacturer’s instructions. Use a straight edge to check alignment of the sheaves. Reposition sheaves as necessary so the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so the belt(s) can be added, and tighten the base so the belt tension is in accordance with the drive manufacturer’s recommendations. Frequently check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

## CONTRACTOR COORDINATION

### It is the responsibility of the Contractor and all Subcontractors to coordinate scope to ensure that all required electrical connections and control connections are provided in accordance with all specification sections. The Architect/Engineer is not responsible for determining which Contractor or Subcontractor will provide particular items.

### Unless otherwise indicated on drawings, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with this specification section and the following schedule.

| **ITEM** | **FURNISHED****BY** | **SET BY** | **POWER WIRING** | **CONTROL WIRING** |
| --- | --- | --- | --- | --- |
| Equipment Motors | MC | MC | EC | UNL BSM |
| Motor Control Centers | EC | EC | EC | UNL BSM |
| Unit Mounted Motor Starters, Contactors, Disconnect Switches, Thermal Overloads And Heaters | MC | MC | EC | UNL BSM |
| Loose Motor Starters, Contactors, Disconnect Switches, Thermal Overloads And Heaters | EC | EC | EC | UNL BSM |
| Pushbutton Stations And Safety Stop Switches – Air Handling Systems And Hydronic Systems | EC | EC | NA | UNL BSM |
| Variable Speed Drives And Associated Safety Disconnects (with appropriate fuses) | UNL BSM | EC | EC | UNL BSM |
| Temporary Heating/Cooling And Connections | GC | MC/EC | EC | MC/EC |
| Thermostats And Terminal Controls – Line Voltage | UNL BSM | EC | EC | EC |
| Chillers and Boilers | MC | MC | EC | MC |
| Computer Room Air Conditioning and Controls | MC | MC | EC | MC |
| DX Split Systems Controls | MC | MC | EC | MC |
| Room Controls Transformer Panels | UNL BSM | EC | EC | UNL BSM |
| Thermostats And Terminal Unit Controls – Low Voltage | UNL BSM | UNL BSM | UNL BSM | UNL BSM |
| Air Terminal Units And Hydronic Reheat Coils | MC | MC | NA | NA |
| Air Terminal Units And Electric Reheat Coils | MC | MC | EC | NA |
| Lab Room and Fume Hood Air Terminal Units | MC | MC | NA | UNL BSM |
| Lab Fume Hood Monitors and/or Controllers | UNL BSM | NA | NA | UNL BSM |
| Air Compressors and Air Dryers | MC | MC | EC | NA |
| Pneumatic Control Air Mains | MC | MC | NA | NA |
| Pneumatic Control Device Terminations | NA | NA | NA | TerminationUNL BSM |
| Building Automation System Control Panels | UNL BSM | UNL BSM | EC | UNL BSM |
| Air Handling And Hydronic Systems Controls | UNL BSM | UNL BSM | NA | UNL BSM |
| Air Handling Systems Pressure Sensors | UNL BSM | UNL BSM | NA | UNL BSM |
| Automatic Control Damper Actuators | UNL BSM | UNL BSM | NA | UNL BSM |
| Automatic Control Dampers AHU Economizer | UNL BSM | MC | NA | UNL BSM |
| Air Handling Systems Air Flow Stations | UNL BSM | UNL BSM | NA | UNL BSM |
| Smoke/Fire Dampers | MC | MC | EC | UNL BSM |
| Automatic Flow Control Devices | MC | MC | NA | NA |
| Automatic Control Valves And Actuators | UNL BSM | MC | NA | UNL BSM |
| Hydronic Systems Temperature Sensor Wells | UNL BSM | MC | NA | UNL BSM |
| Hydronic And Steam Systems Pressure Taps | MC | MC | NA | NA |
| Hydronic And Steam Systems Pressure Sensors | UNL BSM | MC | NA | UNL BSM |
| Hydronic Systems Automatic Makeup Systems | MC | MC | EC | UNL BSM |
| Chilled Water Btu Meters | UNL UTIL | MC | EC | UNL BSM |
| Heating Water Flow Meters | UNL UTIL | MC | NA | UNL BSM |
| Steam Condensate Meters | UNL UTIL | MC | EC | UNL BSM |
| Steam Condensate Level Alarm | MC | MC | NA | UNL BSM |
| Sump and Sewage Pump Level Alarm | MC | MC | EC | UNL BSM |
| Water Purification Systems | MC | MC | EC | EC |
| Card Access Conduit | EC | EC | EC | NA |
| Card Access Cabling – Line Voltage | EC | EC | EC | EC |
| Card Access Cabling – Low Voltage | UNL BSM | NA | NA | UNL BSM |
| Card Access Building Controllers | UNL BSM | UNL BSM | EC | UNL BSM |
| Card Access Network Connections | GC | GC | NA | NA |
| Card Access Door Controllers | UNL BSM | UNL BSM | EC | UNL BSM |
| Card Access Door Hardware | GC | GC | EC | UNL BSM |
| Card Access Handicap Door Hardware | GC | GC | EC | UNL BSM |
| Handicap Door Hardware (No Card Access) | GC | GC | EC | EC |
| Card Access Readers | UNL BSM | GC  | EC | UNL BSM |
| Card Access Door Position Switch | UNL BSM | GC | EC | UNL BSM |
| Fire Alarm Panels | UNL BSM | UNL BSM | EC | UNL BSM |
| Fire Alarm Communications Circuits | GC | GC | NA | NA |
| Fire Alarm Detectors, Pull Stations, Horns & Strobes | UNL BSM | UNL BSM | EC | UNL BSM |
| Fire Alarm Cabling and Conduit | UNL BSM | UNL BSM | EC | UNL BSM |
| Fire Alarm Relays | UNL BSM | UNL BSM | EC | UNL BSM |
| Room Lighting and Occupancy Sensing | EC | EC | EC | EC |
| Room Occupancy Sensing HVAC Interface | EC | EC | EC | UNL BSM |
|  |  |  |  |  |

END OF SECTION 22 05 13