SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION:
This section specifies the furnishing, installation and connection of motors for HVAC and steam generation equipment.

1.2 RELATED WORK:
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements common to more than one Section of Division 26.
B. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Starters, control and protection for motors.
C. Section 26 24 19, MOTOR-CONTROL CENTERS: Multiple motor control assemblies, which include motor starters.
D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
E. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT and STEAM GENERATION.
F. Section 23 21 23, HYDRONIC PUMPS.
G. Section 23 22 23, STEAM CONDENSATE PUMPS.
H. Section 23 34 00, HVAC FANS.
I. Section 23 36 00, AIR TERMINAL UNITS.
J. Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.
K. Section 23 64 00, PACKAGED WATER CHILLERS.
L. Section 23 65 00, COOLING TOWERS.
M. Section 23 72 00, AIR-TO-AIR ENERGY RECOVERY EQUIPMENT.
N. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
O. Section 23 74 13, PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS.
P. Section 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT.
Q. Section 23 81 23, COMPUTER-ROOM AIR-CONDITIONERS.
R. Section 23 81 43, AIR-SOURCE UNITARY HEAT PUMPS.
S. Section 23 81 46, WATER-SOURCE UNITARY HEAT PUMPS.
T. Section 23 23 00, REFRIGERANT PIPING.
U. Section 23 82 00, CONVECTION HEATING and COOLING UNITS.
V. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

1.3 SUBMITTALS:
A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
B. Shop Drawings:
   1. Provide documentation to demonstrate compliance with drawings and specifications.
2. Include electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

C. Manuals:
   1. Submit simultaneously with the shop drawings, companion copies of complete installation, maintenance and operating manuals, including technical data sheets and application data.

D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the Resident Engineer:
   1. Certification that the motors have been applied, installed, adjusted, lubricated, and tested according to manufacturer published recommendations.

E. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

SPEC WRITER NOTES:
Designer shall review current published standards references listed below applicable to this specification.

1.4 APPlicable PUBLICATIONS:
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):
   MG 1-2006 Rev. 1 2009 . Motors and Generators

C. National Fire Protection Association (NFPA):
   70-2008 ............... National Electrical Code (NEC)

D. Institute of Electrical and Electronics Engineers (IEEE):
   112-04 ................. Standard Test Procedure for Polyphase Induction Motors and Generators

E. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
PART 2 – PRODUCTS

2.1 MOTORS:

A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.

B. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.

C. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.

//1. Contractor’s Option - Electrically Commutated motor (EC Type):

Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic commutation. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.//


1. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

E. Voltage ratings shall be as follows:

1. Single phase:
   a. Motors connected to 120-volt systems: 115 volts.
   b. Motors connected to 208-volt systems: 200 volts.
   c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.

2. Three phase:
   a. Motors connected to 208-volt systems: 200 volts.
   b. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 208-230/460 volts, dual connection.
   c. Motors, 74.6 kW (100 HP) or larger, connected to 240-volt systems: 230 volts.
   d. Motors, 74.6 kW (100 HP) or larger, connected to 480-volt systems: 460 volts.
   e. Motors connected to high voltage systems (Over 600V): Shall conform to NEMA Standards for connection to the nominal system voltage shown on the drawings.
F. Number of phases shall be as follows:
   1. Motors, less than 373 W (1/2 HP): Single phase.
   2. Motors, 373 W (1/2 HP) and larger: 3 phase.
   3. Exceptions:
      a. Hermetically sealed motors.
      b. Motors for equipment assemblies, less than 746 W (one HP), may be
         single phase provided the manufacturer of the proposed assemblies
         cannot supply the assemblies with three phase motors.

G. Motors shall be designed for operating the connected loads continuously
   in a 40°C (104°F) environment, where the motors are installed, without
   exceeding the NEMA standard temperature rises for the motor insulation.
   If the motors exceed 40°C (104°F), the motors shall be rated for the
   actual ambient temperatures.

   SPEC WRITER NOTES:
   Indicate motor enclosures on equipment
   scheduled on the drawings.

H. Motor designs, as indicated by the NEMA code letters, shall be
   coordinated with the connected loads to assure adequate starting and
   running torque.

I. Motor Enclosures:
   1. Shall be the NEMA types as specified and/or shown on the drawings.
   2. Where the types of motor enclosures are not shown on the drawings,
      they shall be the NEMA types, which are most suitable for the
      environmental conditions where the motors are being installed.
      Enclosure requirements for certain conditions are as follows:
      a. Motors located outdoors, indoors in wet or high humidity
         locations, or in unfiltered airstreams shall be totally enclosed
         type.
      b. Where motors are located in an NEC 511 classified area, provide
         TEFC explosion proof motor enclosures.
      c. Where motors are located in a corrosive environment, provide TEFC
         enclosures with corrosion resistant finish.
   3. Enclosures shall be primed and finish coated at the factory with
      manufacturer's prime coat and standard finish.

J. Special Requirements:
   1. Where motor power requirements of equipment furnished deviate from
      power shown on plans, provide electrical service designed under the
      requirements of NFPA 70 without additional time or cost to the
      Government.
2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.

3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
   b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
   c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.

5. Motors utilized with variable frequency drives shall be rated “inverter-duty” per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.

K. Additional requirements for specific motors, as indicated in the other sections listed in Article 1.2, shall also apply.

L. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 Watts (1 HP) or more shall meet the minimum full-load efficiencies as indicated in the following table. Motors of 746 Watts or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section. Motors not specified as “premium efficiency” shall comply with the Energy Policy Act of 2005 (EPACT).

<table>
<thead>
<tr>
<th>Minimum Premium Efficiencies</th>
<th>Rating kW (HP)</th>
<th>1200 RPM</th>
<th>1800 RPM</th>
<th>3600 RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Drip-Proof</td>
<td>0.746 (1)</td>
<td>82.5%</td>
<td>85.5%</td>
<td>77.0%</td>
</tr>
<tr>
<td></td>
<td>1.12 (1.5)</td>
<td>86.5%</td>
<td>86.5%</td>
<td>84.0%</td>
</tr>
<tr>
<td>Totally Enclosed Fan-Cooled</td>
<td>0.746 (1)</td>
<td>82.5%</td>
<td>85.5%</td>
<td>77.0%</td>
</tr>
<tr>
<td></td>
<td>1.12 (1.5)</td>
<td>87.5%</td>
<td>86.5%</td>
<td>84.0%</td>
</tr>
</tbody>
</table>
## PART 3 - EXECUTION

### 3.1 INSTALLATION:

Install motors in accordance with manufacturer’s recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

### 3.2 FIELD TESTS

A. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before start-up. All shall test free from grounds.

B. Perform Load test in accordance with ANSI/IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.

C. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

### 3.3 STARTUP AND TESTING

A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.
3.4 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

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