	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: HVAC Standards	Section: 23 05 13 Motors Requirements for Mechanical Equipment
		Date: 08/01/21
		Author: Office of Utilities and Engineering
CC: Project Folder		

## PART 1 - INTRODUCTION


### 1.1 PURPOSE

- A. This section is intended to provide motor requirements for Mechanical Equipment. Refer to applicable electrical standards for other requirements.

## PART 2 - GENERAL DESIGN REQUIREMENTS

### 2.1 MOTORS

- A. Unless otherwise specified, motors shall be NEMA Design B, constant speed, self-ventilated squirrel cage induction. Motors shall have 1.15 service factor unless totally enclosed. Motors shall have Class B insulation unless indicated otherwise. Motors shall be warranted by the manufacturer for a minimum period of 2 years.
1. Motors under ½ HP, shall be designed for 120 V, 60 Hz, single phase, unless otherwise specified.
  2. Motors ½ HP and over shall be as required in schedules.
- B. Non-fractional HP Motors
1. Motors shall be totally enclosed-fan cooled (TEFC), and have inverter spike resistant (ISR) magnet wire. Open, drip proof motors included as part of package equipment will be acceptable if protected from moisture and dust infiltration as part of the package equipment assembly.
  2. Motors shall have watertight shaft seals (field replaceable) and condensation drains, or weep holes.
  3. Motor bearings for fan and compressor applications shall be belted load rated.
  4. Grease fittings shall be provided for all non-sealed bearings.
  5. Provide motors with oversized conduit box.
  6. Motors 3HP and above shall have Class F insulation and cast-iron frames and end plates.
  7. Motors 20HP and larger shall have multiple lifting points incorporated in the casing to allow direct lifting to support mounting the motor base in the horizontal or vertical plain with the motor axis remaining horizontal.
  8. For HVAC applications except steam condensate return, motor synchronous speed shall be 1,800 rpm. For steam condensate return pump applications 3,500 RPM may be used if required to meet standard return pressure of 40 psig.
- C. Motors shall be premium efficiency type. They shall conform to NEMA Standard MG-1-12.53a and shall have their efficiencies determined in accordance with IEEE Standard 112 Method B. The NEMA nominal efficiency shall be listed on the motor nameplate.

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- D. Motor inrush current must not create a voltage sag in excess per Yale electrical requirements.
- E. A voltage sag report shall be completed by the Professional on selected projects as determined by the University. Report shall include backup calculations and expected building voltage sag when motor or motors in question are started.
- F. Motors for use with variable frequency drives (VFD's) shall be "inverter-duty" or "drive duty" motors, compatible with the drive to which it is connected. Use of the motor with a VFD shall not adversely affect the operation, useful life, or warranty of the motor.
  - 1. Motors shall have Class F temperature rise; Class H insulation.
  - 2. Motor windings shall be spike resistant to withstand 1,600 peak volts. Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 3. The drive and motor shall be engineered to avoid the occurrence of shaft currents by including a bearing protection ring as per section 23 05 12 – Bearing Protection Ring for motors
  - 4. For motors 100 hp and above a common mode choke (CMC) shall be employed (on all three legs of power feed between the drive and the motor)
  - 5. Motors used with VFD shall have a minimum three (3) year warranty.

Date	Description of Change	Pages / Sections Modified	ID
6/15/16	Entire document	-	mlamore
08/01/21	Section F: Bearing Protection requirements		mlamore