SECTION 16040 - ELECTRIC MOTORS

City of San Diego, CWP Guidelines

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing electric motors with accessories.

1.2 RELATED SECTIONS

A. The WORK of the following Section applies to the WORK of this Section. Other Sections of the specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 16050 Basic Electrical Materials and Methods

1.3 CODES

A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes and City of San Diego Supplements:

1. National Electrical Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	AFBMA 9	Load Ratings and Fatigue Life for Ball Bearings.
2.	AFBMA 11	Load Ratings and Fatigue Life for Roller Bearings.
3.	ANSI/IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators.
4.	IEEE 841	Standard for Petroleum and Chemical Industry—Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 500 HP
5.	NEMA ICS 2	Industrial Control Devices, Controllers and Assemblies.
6.	NEMA ICS 6	Enclosures for Industrial Controls and Systems.
7.	NEMA MG 1	Motors and Generators.
8.	UL 674	Motors and Generators, Electric, for Use in Hazardous Locations, Class I, Groups C and D, Class II, Groups E, F and G.
9.	UL 1004	Motors, Electric

SHOP DRAWINGS AND SAMPLES

B. The following shall be submitted in compliance with Section 01300:

1. Machine name and submitted data on driven machine.
2. Motor manufacturer.
3. Motor type, model and dimensioned drawing.
4. Nominal horsepower.
5. NEMA design.
6. Frame size.
7. Enclosure.
8. Winding insulation class and treatment.
9. Rated ambient temperature.
10. Service factor.
11. Voltage, phase, and frequency rating.
12. Full load current at rated horsepower and indicated voltage.
13. Starting code letter, or locked rotor kVA, and current.
14. Special winding configuration.
15. Rated full load speed.
16. Power Factor at full load.
17. Details of water cooling (if any) for thrust bearings.
18. Motor efficiencies.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. **Conformance**: Electric motors driving identical machines shall be identical.

B. **Rating**: The nominal rated motor horsepower shall be adequate for the driven machine without infringing upon the indicated motor service factor, unless more restrictive motor requirements are specified for a specific equipment item.

C. **Minimum Motor hp:** The motor horsepower shall be not less than the minimum indicated for each driven machine. If the minimum horsepower is not adequate, the motor with the next larger horsepower, circuit breakers, magnetic starters, motor feeder conductors and conduit shall be provided.

D. **Exempt Motors:** Except as otherwise indicated, motors intended for valve operators, submersible pumps and hoists, motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven equipment, part of commercial use or domestic equipment and torque-rated motors shall be motors recommended by the manufacturer for use in the application indicated.

2.2 DESIGN REQUIREMENTS

A. **General:** Electric motors shall comply with ANSI/NEMA MG 1.

B. **NEMA Design:** Except as otherwise indicated, electric motors shall be NEMA Design B, constant speed squirrel-cage induction motors designed for normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value indicated in ANSI/NEMA MG 1. Motors shall be suitable for part-winding, star delta starting, or 2 speed winding, where indicated.

C. **Motor Voltage Ratings:** Motors shall be rated in accordance with the following:

1. Motors below 1/2-hp shall be rated 115 volts, single-phase, 60-Hz. Dual voltage motors rated 115/230-volts, 115/208-volts, or 120-240 volts are acceptable.

2. Motors 1/2-hp and larger shall be rated 460 volts, or 4160 volts, 3-phase, 60-Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable.

D. **Explosion-Proof Motors:** Motors which will be installed in Class I or Class II areas (exposed to flammable vapors, gases, or dust) shall be explosion-proof and shall bear Underwriter's approval on name plate and serial number.

E. **Insulation (Standard Duty Motors):** Standard duty motors shall include Class F insulation, rated to operate at an ambient temperature of 40 degrees C without exceeding Class B temperature rise limits at the motor's nominal rating.

F. **Insulation (Heavy Duty Motors):** Heavy duty motors shall include Class F insulation, rated to operate at an ambient temperature of 50 degrees C without exceeding Class B temperature rise limits at the motor's nominal rating

G. **Motors Installed Outdoors:** Motors 50 Hp or smaller which will be installed outdoors shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15.

H. **Motors larger than 50 hp:** Motors larger than 50 hp which will be installed outdoors shall be Weather-Protected Type II. Motors larger than 50 hp shall have a minimum service factor of 1.15 and 2 cycles of solid, baked epoxy vacuum impregnation and shall include rodent screens.

I. **Motors Installed Indoors:** Except as otherwise indicated, all motors which will be installed indoors shall be open drip-proof with a service factor of 1.15 minimum except that motors larger than 50 hp, located in damp environment (pump and pipe galleries, tunnels, chemical feed and sludge areas) shall have 2 cycles of solid baked epoxy vacuum impregnation.

J. **High Efficiency Motors:** Motors with a nameplate rating of 5 hp and above shall be "high efficiency" units with efficiencies determined by the test set forth in ANSI/IEEE 112, Method B with stray load loss adjustment as modified by NEMA MG 1-12.53(a) and (b).

K. **Efficiency Index:** Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 1-12.53.b. Motor nameplate data shall include the nominal efficiency value.

L. **Minimum Motor Full Load Power Factor:** [0.85] [0.92]

M. **High efficiency Motors:** High efficiency motors shall conform to the following minimum efficiency requirements for full load values:

Motor hp	Synchronous Speed, rpm	Guaranteed Minimum Efficiency (percent) Open	Enclosed
5	3600	86	86
	1800	87	87
	1200	88	88
7-1/2	3600	86	86

	1800	89	89
	1200	88	88
10	3600	89	89
	1800	89	89
	1200	89	89
15	3600	89	89
	1800	90	90
	1200	90	90
20	3600	90	90
	1800	91	91
	1200	90	90
25	3600	90	90
	1800	92	92
	1200	90	90
30	3600	91	91
	1800	92	92
	1200	90	90
40	3600	92	92
	1800	92	92
	1200	92	92
50	3600	91	91
	1800	92	92
	1200	92	92
75	3600	93	93
	1800	94	94
	1200	92	92
100	3600	93	93
	1800	94	94
	1200	93	93
125	3600	94	93
	1800	94	94
	1200	94	94
150	3600	93	93
	1800	95	95
	1200	94	94
200	3600	94	94
	1800	95	95
	1200	94	94
300	3600	95	95
	1800	95	95

N. **Motors for VFD Drives**: Motors for variable frequency drives (VFD) shall be specifically rated for inverter duty and shall be severe duty NEMA MG 1 design A or B, high efficiency, totally enclosed fan cooled (TEFC) with NEMA MG 1 Class F insulation. Winding temperature rise shall be limited to Class B rise when operating over the speed range specified in VFD Section 11033 with the specified load speed/torque characteristic. Six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for motors 100 Hp and larger. Motor insulation shall be designed to meet NEMA MG 1, Part 31 (1600-volt peak at a minimum of 0.1 microsecond rise time). Motors shall conform to IEEE 841. All internal surfaces shall be coated with epoxy paint.

Inverter duty motors shall be specifically certified by the motor manufacturer to be compatible with the VFD to be used with the motor. Inverter duty motors shall be designed to operate over the speed or frequency range specified. Inverter duty motors shall be provided with Type 2 thermal protection as specified in NEMA MG 1-12.53.2.

Inverter duty motors shall be equipped with a shaft-grounding unit mounted on the fan housing with stub shaft extended from the motor shaft. Grounding unit shall be equipped with two brushes, totally enclosed and sealed against environmental contamination.

Where specified, or required by the specified application requirements, inverter duty motors shall be totally enclosed, air-over blower-cooled (TEBC). Blowers shall be driven at constant speed by 460-volt, 3-phase, 60 Hz motors. Blower motor shall be TEFC in conformance with paragraph 16040-2.2 G. Blower and ducting shall be an integral part of the main motor frame. Air intake filter shall be provided. Scroll case shall be cast aluminum or iron, and fan wheel shall be Type 304 stainless steel.

O. **Stator Windings and Resistance Temperature Detectors:** Stator windings shall be copper. Except as otherwise indicated, six 100-ohm platinum resistance temperature detectors (RTDs) shall be provided in the stator windings for motors greater than 250 Hp; and one PTC thermister shall be provided on the stator windings for motors from [50] [60] to 250 Hp.

P. **Space Heaters:** 120 volt space heaters shall be provided on all [15] Hp and larger motors [that may not operate continuously].

2.3 MOTOR BEARINGS

A. **General:** Bearings shall comply with Section 11000.

B. **Standard Duty:** Except as otherwise indicated, motors shall be standard duty and shall include bearings with a minimum L-10 life of 50,000 hours.

C. **Heavy Duty:** Where equipment for heavy duty service is indicated, motors shall be heavy duty and shall include bearings designed for a minimum rated L-10 life of 100,000 hours.

D. **Fractional Horsepower:** Fractional horsepower through 2 hp motors shall be furnished with self lubricated ball bearings.

E. **Horizontal Motors Over 2 hp:** Motors larger than 2 hp shall include relubricatable ball bearings except where vertical pump motors are indicated.

F. **Vertical Motors Over 2 hp:** Vertical motors larger than 2 hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall comply with the manufacturer's recommendations.

G. **Water-Cooled Motors:** If water cooling is required for the thrust bearings, cooling water lines shall be provided with shut-off valve, strainer, solenoid valve, flow indicator, thermometer and throttling valve.

H. **Temperature Detectors:** Except as otherwise indicated, one RTD per sleeve bearing (or vibration switch for ball bearings) shall be provided for motors greater than 250 Hp.

2.4 ACCESSORY REQUIREMENTS

A. **General:** Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall include gaskets.

B. **Lifting Devices:** All motors weighing [50] [265] lb or more shall include lifting devices designed for installation and removal.

C. **Terminal Boxes:** Motors rated at 4160-volts shall have extra large terminal boxes to accommodate stress cone terminations as recommended by cable manufacturers.

D. **Space Heaters:** Except as otherwise indicated, all motors 25 hp and larger shall be furnished with space heaters. Space heater rating shall be 120 volts, single-phase, unless otherwise indicated.

E. **Nameplate:** Motors shall include a permanent, non-corrosive nameplate indelibly stamped or engraved with NEMA Standard motor data, including bearing description and lubrication instructions, insulation class, ambient temperature, and power factor at full load.

2.5 MANUFACTURER

A. Motors shall be manufactured by the following (or equal)~~.~~:

General Electric Company
Louis Allis (Division of Magnatek, Inc.)
U.S. Motors Corporation
Westinghouse Electric Corporation

B. Inverter duty motors shall be manufactured by the following (or equal):

Baldor, Inverter Motor
Reliance, RPM-XT
U.S. Motors, Inverter Grade

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Motors shall be installed in accordance with the manufacturer's installation instructions and written requirements of the manufacturer of the driven equipment.

** END OF SECTION **