COMMON WORK RESULTS FOR LIQUID HANDLING EQUIPMENT

1. GENERAL

1.1 Requirements

.1 The provisions of this Section shall apply to all equipment except where otherwise indicated.

.2 Substantiating calculations and Drawings shall be provided at the time of submittal.

1.2 Reference Specifications, Codes, and Standards

.1 Equipment shall be in accordance with the latest edition of the following standards, as applicable and as indicated in each equipment Specification:

.1 American Gear Manufacturers Association (AGMA).

.2 ASTM International (ASTM).

.3 American National Standards Institute (ANSI).

.4 American Society of Mechanical Engineers (ASME).

.5 American Water Works Association (AWWA).

.6 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).

.7 American Welding Society (AWS).

.8 National Fire Protection Association (NFPA).

.9 National Electrical Manufacturers Association (NEMA).

.10 Manufacturer's published recommendations and Specifications.

.11 Canadian Standards Association (CSA).

.12 Underwriters Laboratories of Canada (ULC).

.13 ANSI\HI 1.3-2009 American National Standard for Rotodynamic (Centrifugal) Pumps

.2 The following standards are referenced in this Section:

.1 ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250.

.2 ASME B16.5 - Pipe Flanges and Flanged Fittings, NPS1/2 Through NPS 24 Metric/Inch Standard.

.3 ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

.4 ASME B31.1 - Power Piping.

.5 ASME B17.1 – Keys and Keyseats

.6 ASME B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay)

.7 AWWA C206 - Field Welding of Steel Water Pipe.

.8 AWWA D100 - Welded Carbon Steel Tanks for Water Storage.

.9 ASTM A 108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

1.3 Contractor Submittals

.1 Shop Drawings: Furnish submittals in accordance with Section 01 33 00 - Submittals.

.2 Equipment Installation: Complete all documentation as required within Section 01 65 00 – Equipment Installation.

.3 Manuals: Provide manuals as specified within Section 01 78 00 – Closeout Submittals.

.4 Spare Parts List: A spare parts list complete with the name, address, and telephone number of the nearest distributor for each piece of equipment shall be provided. Include current prices for each spare part.

1.4 Quality Control

.1 Costs: Pay all costs of inspection, testing, adjustment, and instruction services performed by Manufacturer's representatives.

.2 Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

.1 Machine Work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts.

.2 All materials shall meet the physical and mechanical properties in accordance with the reference standards.

.3 Machine Finish: The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ASME B46.1. The following finishes shall be used:

.1 Surface roughness not greater than 1.575 µ shall be required for all surfaces in sliding contact.

.2 Surface roughness not greater than 6.25 µ shall be required for surfaces in contact where a tight joint is not required.

.3 Rough finish not greater than 12.5 µ shall be required for other machined surfaces.

.4 Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 0.8 µ.

2. PRODUCTS

2.1 General Requirements

.1 Welding: Unless otherwise indicated, welding shall conform to the following:

.1 AWWA D100.

.2 AWWA C206.

.3 Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.

.4 Welding shall be by the metal-arc method or gas-shielded arc method as described in the AWS "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.

.5 In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 0.8 mm ($^{1}/_{32}$-inch) on the flat.

.2 Protective Coating: Equipment shall be painted or coated unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with food grade grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

.3 Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per Manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

.4 Controls: Equipment and system controls shall be in accordance with Division 40 and Division 46.

2.2 Equipment Supports

.1 Equipment Supports: Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10% of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in Manitoba, unless otherwise indicated.

2.3 Gears & Gear Drives

.1 Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life

of 60,000 hours, and a minimum efficiency of 94%. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used.

.2 Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.

.3 Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.

.4 Material selections shall be left to the discretion of the Manufacturer, provided the above AGMA Standards are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have two (2) positive seals to prevent oil leakage.

.5 Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be provided when necessary.

.6 Where gear drive input or output shafts from one Manufacturer connect to couplings or sprockets from a different Manufacturer, gear drive Manufacturer shall furnish a matching key taped to the shaft for shipment.

.7 Protect process streams from oil and grease leaks/spills.

2.4 Nameplates

.1 Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the Manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.5 Tools and Spare Parts

.1 Tools: Furnish one (1) complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of all supplied equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional Work and manufactured by Snap On, Crescent, Stanley, or approved equal. The set of tools shall be neatly mounted in a labelled toolbox of suitable design provided with a hinged cover.

.2 Spare parts shall be furnished as indicated in the individual equipment Sections. All spare parts shall be suitably packaged and labelled with equipment numbers.

2.6 Equipment Lubricants

.1 Install lubricants for all equipment during storage and prior to initial testing of the equipment.

3. EXECUTION

3.1 Manufacturer's Representative Field Services

.1 Arrange and pay for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

.2 The total number of trips will depend on the Installation Contractor's schedule. The cost of additional trips, if required to fulfill the Contract requirements, will be borne by the Contractor.

3.2 Installation Witnessing

.1 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Manufacturer’s Representative.

.2 The Manufacturer’s Representative shall ensure the equipment is installed as required to provide satisfactory service.

.3 The Manufacturer’s Representative and the Contractor are to cooperate with the Installation Contractor to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01 43 33 – Field Services.

3.3 Equipment Performance Testing

.1 The Contractor shall ensure that all equipment, including all component parts, operates as intended.

.2 The Manufacturer’s Representative shall demonstrate satisfaction of requirements specified herein.

3.4 Training

.1 The Contractor shall provide the services of factory trained instructors for the purpose of training City personnel in the proper operation and maintenance of the equipment. Conform to the requirements of Section 01 43 33 – Field Services.

END OF SECTION

FACTORY APPLIED PROTECTIVE COATINGS

1. GENERAL

1.1 Submissions

.1 With the equipment Shop Drawings, submit details of the factory applied protective coating systems to be applied. This applies to all equipment, valves, piping, tanks, panels and supports being supplied with factory applied protective coatings.

1.2 Quality Assurance

.1 This Specification is intended to be a minimum reference standard. The Contractor may submit for review alternative coating systems for specific items of equipment which provide equal or better corrosion protection and maintenance service than those specified herein.

2. PRODUCTS

2.1 Surface Preparation

.1 Immersion Service: After degreasing, dry blast all ferrous components to a white metal finish in accordance with The Society for Protective Coatings (SSPC)-SP5 to a degree of cleanliness in accordance with NACE International (NACE) No. 1 and obtain a 1.3 mm blast profile.

.2 Non-immersion Service: After degreasing, dry blast all ferrous components to a near white finish in accordance with SSPC-SP10 to a degree of cleanness in accordance with NACE No. 3 and obtain a 1.3 mm blast profile.

2.2 Coating

.1 Provide two (2) coats of high build epoxy coating, 200 micron minimum dry film thickness per coat.

2.3 Assembly

.1 For items which are to be bolted together before shipment, clean surfaces and coat before the parts are assembled.

.2 Continuous weld all welded connections, sealing the mating surface completely. On completion of the welding and fettling, treat all weld seams with phosphoric acid solution. Rinse and thoroughly dry before the prime is applied.

.3 Where dissimilar metals are mated insulate the mating surfaces from one another to provide protection against corrosion. Insulate bolts, nuts, washers, and rivets in a similar manner.

.4 Use 304 stainless steel or better for all nuts, bolts, washers and similar fittings for immersion service. For non-immersion service, use 304 stainless or zinc or cadmium plated nuts, bolts, washers, and similar fittings. Clean and coat the inner face of non-threaded bolt holes as required for other surfaces.

3. EXECUTION

3.1 General

.1 Apply coatings in accordance with coating manufacturer's instructions.

3.2 Inspection

.1 Notify the Contract Administrator two (2) weeks before commencing the protective coating to permit the inspection by the Contract Administrator of the surface preparation and protective coating application.

3.3 Protection

.1 Protect all coated equipment adequately against damage, dust, moisture, and scratching during shipment, off-loading and storage on Site. If, in the opinion of the Contract Administrator, the coating is damaged during shipment to the extent that touch up would not be satisfactory, return and re-coat the equipment at the Contractor's cost.

.2 Make good damage to coatings occurring at any time prior to the application of any further coatings.

3.4 Application Conditions

.1 Apply all factory applied coatings under controlled conditions, in a dust-free atmosphere at a temperature of between 10 and 20°C, and a relative humidity should not exceed 80%.

END OF SECTION

PROCESS PUMP GENERAL REQUIREMENTS

1. GENERAL

1.1 References

.1 ANSI\HI 1.3-2009 American National Standard for Rotodynamic (Centrifugal) Pump

1.2 Submissions

.1 Shop Drawings: Submit in accordance with Section 01 33 00 – Submittal Procedures and Section 43 05 00 - Common Work Results for Liquid Handling Equipment. For all pump Shop Drawings in addition to the requirements of Section 43 05 00, include the following specific details:

.1 Performance curve for the pumping unit(s) superimposed on the system curve for the particular pumping application. With the performance curve, include efficiency isopleths and NPSH required (NPSHR) variation with flow. Where required in the specific pump Sections, the performance curve should be certified in accordance with Hydraulic Institute Standards.

.2 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, description of construction complete with illustrative Drawings, and any other pertinent information.

.3 List of materials of construction, detailing the component parts of the pump(s), their materials of construction, and reference Specifications for those materials.

.4 Required ancillary services including but not limited to electrical, seal water, and drains. The sizes, ratings, and any other pertinent information related to these services.

.5 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for ancillary services (electrical, seal water, drains, etc.).

.6 Start-up instructions including lubricant requirements, electrical requirements, etc.

.2 Operating and Maintenance (O&M) Data: Provide for incorporation in O&M Manual as specified in Section 01 78 00 Submittals. Include the following:

.1 Complete description of operation.

.2 General arrangement and detailed Drawings.

.3 Wiring diagrams for power and control schematics.

.4 Parts catalogues with complete list of repair and replacement parts with Section Drawings, illustrating the connections and the part Manufacturer's identifying numbers.

1.3 Delivery and Storage by Manufacturer’s Representative

.1 Prior to delivery, ensure that the Certificate of Readiness to Install (Form 101) is completed.

.2 Ship pre-assembled to the degree that is possible.

.3 Securely fasten heavy wood blanks to the pump flanges. Use blanks that are larger diameter than the flange. Protect machined surfaces against rusting. Protect threaded connections with threaded plugs or caps. Protect open, plain pipe ends with caps.

.4 Identify any special storage requirements.

1.4 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in the Work.

2. PRODUCTS

2.1 Pump Performance Requirements

.1 Supply pumps that are suitable for continuous duty.

.2 Select impellers for fixed speed pumps that permit operation at an efficiency of within 5% of the efficiency at the BEP.

.3 For variable speed pumps, select pump speed and impeller diameter which allow operation from the Rating Point to the Low Speed Point at efficiencies within 10% of efficiency at the BEP.

.4 Ensure that motors are sufficiently sized to drive pumps at a maximum speed when the head is specified for the low head point.

.5 Supply pumps capable of operating at 30% of the flow at the rated capacity without exceeding the motor horsepower and capable of operating at any point on its characteristic curve, to where that curve intersects the low head point, without exceeding motor power rating.

2.2 Pressure Sensing

.1 Supply guages and pressure sensors for measuring inlet and outlet pressure for each pump.

2.3 Protective Guards

.1 Provide a protective guard for all couplings and keys, drive belts, or other exposed rotating devices. As a minimum, conform to the requirements of Section 43 05 00 - Common Work Results for Liquid Handling Equipment.

2.4 V-Belt Drives

.1 Do not use V-belt drives unless specified.

2.5 Spare Parts

.1 For each pump, provide for one spare mechanical seal or packing kit (as applicable) and one (1) set of pump bearings.

.2 For each centrifugal pump type and size, provide a single impeller, wear plate, suction ring (if replaceable), one pump shaft and nut.

.3 For spare parts for positive displacement pumps, provide as a minimum, one (1) wearing element. Refer to related pump Specifications for the specific spare part requirements.

2.6 Factory Performance Testing

.1 Where required for specific pumps, as noted in the Sections related to those pumps, factory performance test all pumps.

.2 Conduct factory performance testing in compliance with the Hydraulic Institute Standards.

.3 Inform Contract Administrator at least three (3) weeks prior to the factory testing to allow for his attendance.

.4 Certify test results and summarize findings in a short report. Submit report to the Contract Administrator within three (3) weeks of completing factory tests.

.5 Where the pump(s) does not satisfy the specified performance requirements within the tolerances specified by the Hydraulics Institute, redesign, modify, and re-test the pump(s), all at no additional cost.

.6 Do not ship the pump(s) until the test result report has been submitted to the Contract Administrator.

2.7 Factory Finishing

.1 Prepare, prime, and finish coat in accordance with Section 43 09 01 – Factory Applied Protective Coatings, or request deviation for approved equal at Shop Drawing submittal for Manufacturer's standard coating.

2.8 Motors

.1 Provide all motors in accordance with Section 43 22 05 – Process Motors.

3. EXECUTION

3.1 Installation

.1 Comply with the requirements of Section 01 43 33 Field Services.

3.2 Testing

.1 The Contractor shall assist in the field test all pumps greater than or equal to 3.7 kW, and smaller units where noted, to verify performance. The Contractor shall record the results of the testing and provide as required, clarification of testing procedures, or any additional information necessary to complete testing in an appropriate manner.

.2 Test pump(s) at a minimum of three (3) flow conditions, typically corresponding to the rating point flow, 75% of that flow, and 120% of that flow. At each test point, measure flow, pressure, and amperage. In addition, verify run-out conditions.

.3 Field Test Report:

.1 Compile field test results into a report for submittal to the Contract Administrator.

.2 Describe test set-up and measurement devices used to conduct the tests.

.3 For each pump, list the specified performance requirements and field test results. Show field test results (flow, pressure, power draw) superimposed on the performance curve provided with the submissions.

.4 Where field tests do not verify compliance with specified performance requirements; investigate cause for noncompliance, undertake remedial Work as required to bring pump into compliance or replace the pump and all necessary ancillaries, and retest to prove compliance. All Work required to bring the pump into compliance is the responsibility of the Contractor and shall be performed at the Contractor's cost.

END OF SECTION

PROCESS MOTORS

1. GENERAL

1.1 References

.1 The following is a list of standards which may be referenced in this Section:

.1 American Bearing Manufacturers Association (ABMA):

.1 9, Load Ratings and Fatigue Life for Ball Bearings.

.2 11, Load Ratings and Fatigue Life for Roller Bearings.

.2 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 100, Motors and Generators.

.2 CSA C22.2 No. 145, Motors and Generators For use in Hazardous Locations.

.3 CSA C390, Energy Efficiency Test Methods for Three-Phase Induction Motors.

.3 Institute of Electrical and Electronics Engineers (IEEE):

.1 112, Standard Test Procedures for Polyphase Induction Motors and Generators.

.2 114, Standard Test Procedures for Single-Phase Induction Motors.

.3 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.

.4 841, Petroleum and Chemical Industry – Premium Efficiency, Severe Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – Up to and Including 370 kW (500 hp).

.4 NEMA:

.1 MG 1, Motors and Generators.

.2 MG 2, Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.

.3 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 C50.41, Polyphase Induction Motors for Power Generating Stations.

.5 Manitoba Electrical Code.

.6 Underwriters Laboratories Inc. (UL):

.1 1, Standard for Safety Flexible Metal Conduit.

.2 674, Standard for Safety Electric Motors and Generators for Use in Hazardous (Classified) Locations.

.3 2111, Standard for Safety Overheating Protection for Motors.

1.2 Definitions

.1 CISD-TEFC: Chemical industry, severe-duty enclosure.

.2 EXP: Explosion-proof enclosure.

.3 ODP: Open drip-proof enclosure.

.4 TEFC: Totally enclosed, fan cooled enclosure.

.5 TENV: Totally enclosed, non-ventilated enclosure.

.6 WPI: Open weather protected enclosure, Type I.

.7 WPII: Open weather protected enclosure, Type II.

.8 Motor Nameplate Horsepower: The rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

.9 Inverter Duty Motor: Motor meeting all applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.

1.3 Submittals

.1 Action Submittals:

.1 Shop Drawings:

.1 Descriptive information.

.2 Nameplate data in accordance with NEMA MG 1.

.3 Additional Rating Information:

.1 Service factor.

.2 Locked rotor current.

.3 No load current.

.4 Safe stall time for motors 300 horsepower and larger.

.5 Multi-speed load classification (e.g. variable torque).

.6 Variable frequency drive motor load classification (e.g., variable torque) and minimum allowable motor speed for that load classification.

.7 Guaranteed minimum full load efficiency and power factor.

.4 Enclosure type and mounting (e.g. horizontal, vertical).

.5 Dimensions and total weight.

.6 Conduit box dimensions and usable volume as defined in NEMA MG 1 and OESC.

.7 Bearing type.

.8 Bearing lubrication.

.9 Bearing life.

.10 Space heater voltage and watts.

.11 Description, ratings, and wiring diagram of motor thermal protection.

.12 Motor sound power level in accordance with NEMA MG 1.

.13 Maximum brake horsepower required by the equipment driven by the motor.

.14 Description and rating of submersible motor moisture sensing system.

.2 Information Submittals:

.1 Factory test reports, certified for motors 300 horsepower and larger.

.2 Operation and maintenance data.

2. PRODUCTS

2.1 General

.1 Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and any deviations from this Section will be listed in the equipment Specification. Where such deviations occur, they shall take precedence over this Section.

.2 For multiple units of the same type of equipment, furnish identical motors and accessories of a single Manufacturer.

.3 In order to obtain single source responsibility, a drive motor, its driven equipment, and specified motor accessories shall be supplied as a package.

.4 Meet requirements of NEMA MG 1.

.5 Frame assignments in accordance with NEMA MG 13.

.6 Provide motors for hazardous (classified) locations that conform to OESC and have an applied CSA listing mark.

.7 Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.

.8 Lifting lugs on all motors weighing 45 kg or more.

.9 Operating Conditions:

.1 Maximum ambient temperature not greater than 40°C.

.2 Motors shall be suitable for operating conditions without any reduction being required in the nameplate rated horsepower or exceeding the rated temperature rise.

.3 Overspeed in either direction in accordance with NEMA MG 1.

2.2 Horsepower Rating

.1 As designated in motor-driven equipment specifications.

.2 Constant Speed Applications: Brake horsepower of the driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding any service factor.

.3 Variable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any operating condition not to exceed motor nameplate horsepower rating, excluding any service factor.

2.3 Service Factor

.1 1.15 minimum at rated ambient temperature, unless otherwise indicated.

2.4 Voltage and Frequency Rating

.1 System Frequency: 60-Hz.

.2 Voltage Rating: Unless otherwise indicated in motor-driven equipment specifications:

Size	Voltage	Phases
0.37 kW and smaller	115	1
0.56 kW through 298 kW	575	3

.3 Suitable for full voltage starting.

.4 74.6 kW and larger also suitable for solid state reduced voltage starting.

.5 Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90% of motor rated voltage.

2.5 Efficiency and Power Factor

.1 For all motors except single-phase, under 1 horsepower, multispeed, and short-time rated, or motors driving valves:

.1 Efficiency:

.1 Tested in accordance with CSA C390, paragraph 12.59.

.2 Guaranteed minimum at full load in accordance with NEMA MG 1 Table 1, Supplement, or as indicated in motor-driven equipment specifications.

.2 Power Factor: Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.

2.6 Locked Rotor Ratings

.1 Locked rotor kVA Code F or lower, if motor horsepower not covered by NEMA MG 1 tables.

.2 Safe stall time 12 seconds or greater.

2.7 Insulation Systems

.1 Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.

.2 Motors Rated Over 600 V: Sealed windings in accordance with NEMA MG 1.

.3 Three-Phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specifications, Class B or Class F at nameplate horsepower and designated operating conditions, except EXP motors which must be Class B with Class B rise.

2.8 Enclosures

.1 Enclosures to conform to NEMA MG 1.

.2 TEFC and TENV: Furnish with a drain hole with porous drain/weather plug.

.3 EXP:

.1 TEFC listed to meet requirements for Class I, Zone 1 or 2 (as required in the application), Group C and D hazardous locations.

.2 Drain holes with drain and breather fittings.

.3 Integral thermostat opening on excessive motor temperature in accordance with OESC.

.4 Terminate thermostat leads in terminal box separate from main terminal box.

.4 Submersible: In accordance with Article Special Motors.

.5 CISD-TEFC: In accordance with Article Special Motors.

.6 All motors to be minimum TEFC.

2.9 Terminal (Conduit) Boxes

.1 Oversize main terminal boxes for all motors.

.2 Diagonally split, rotatable to each of four 90°positions. Threaded hubs for conduit attachment.

.3 Except ODP, furnish gaskets between box halves and between box and motor frame.

.4 Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19:

Terminal Box Usable Values		
Voltage	**kW**	**Percentage**
Below 600	11.2 through 93	500
Below 600	111 through 224	275
Below 600	261 through 447	225
Above 600	All sizes	200

.5 Terminal for connection of equipment grounding wire in each terminal box.

2.10 Bearings and Lubrication

.1 Vertical Motors:

.1 Thrust Bearings:

.1 Antifriction Plate type (Kingsbury) bearing.

.2 Manufacturer's standard lubrication 74.6 kW and smaller.

.3 Minimum 50,000 hours L10 bearing life.

.2 Guide Bearings:

.1 Manufacturer's standard bearing type.

.2 Manufacturer's standard lubrication 149 kW and smaller.

.3 Minimum 100,000 hours 10 bearing life.

.2 Regreasable Antifriction Bearings:

.1 Readily accessible, grease injection fittings.

.2 Readily accessible, removable grease relief plugs.

.3 Oil Lubrication Systems:

.1 Oil reservoirs with sight level gauge.

.2 Oil fill and drain openings with opening plugs.

.3 Provisions for necessary oil circulation and cooling.

.4 Bearing Isolation: Motors rated for inverter duty shall have electrically isolated bearings to prevent stray current damage.

2.11 Noise

.1 Measured in accordance with IEEE 85 and NEMA MG 1.

.2 Motors controlled by variable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

2.12 Balance and Vibration Control

.1 In accordance with NEMA MG 1, Part 7.

2.13 Equipment Finish

.1 Protect Motor for Service Conditions:

.1 ODP Enclosures: Indoor industrial atmospheres.

.2 Other Enclosures: Outdoor industrial atmospheres, including moisture and direct sunlight exposure

.2 External Finish: Prime and finish coat Manufacturer's standard.

.3 Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.14 Special Features and Accessories

.1 Screen Over Air Openings: Corrosion-resistant on motors with ODP, WPI, and WPII enclosures meeting requirements for Guarded Machine in NEMA MG 1, and attached with stainless steel screws.

.2 Vibration detection relay mounted in NEMA 250, Type 4X enclosure on side of motor, when indicated.

.3 Nameplates:

.1 Raised or stamped letters on stainless steel or aluminum.

.2 Display motor data required by NEMA MG 1, paragraphs 10.39 and 10.40 in addition to bearing numbers for both bearings.

.3 Premium efficiency motor nameplates to also display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

.4 Anchor Bolts: Provide anchor bolts meeting Manufacturer's recommendations and of sufficient size and number for the specified seismic conditions.

2.15 Special Motors

.1 Requirements in this article take precedence over conflicting features specified elsewhere in this Section.

.2 CISD-TEFC:

.1 In accordance with IEEE 841.

.2 TEFC in accordance with NEMA MG 1.

.3 Suitable for indoor or outdoor installation in severe-duty applications including high humidity, chemical (corrosive), dirty, or salty atmospheres.

.4 Motor Frame, End Shields, Terminal Box, and Fan Cover: Cast iron.

.5 Ventilating Fan: Corrosion-resistant, nonsparking, external.

.6 Drain and Breather Fittings: Stainless steel.

.7 Nameplate: Stainless steel.

.8 Gaskets between terminal box halves and terminal box and motor frame.

.9 Extra slinger on rotor shaft to prevent moisture seepage along shaft into motor.

.10 Double shielded bearings.

.11 125,000 hours minimum L10 bearing life for direct-connected loads.

.12 External Finish: Double-coated epoxy enamel.

.13 Coated rotor and stator air gap surfaces.

.14 Insulation System, Windings, and Connections:

.1 Class F insulation, Class B rise or better at 1.0 service factor.

.2 Multiple dips and bakes of nonhygroscopic polyester varnish.

.15 Service Factor:

.1 At 40°C Ambient: 1.15.

.2 At 65°C Ambient: 1.00.

.16 Safe Stall Time Without Injurious Heating: 20 seconds minimum.

.3 Severe-Duty Explosion-Proof: Meet requirements for EXP enclosures and CISD-TEFC motors.

.4 Multispeed: Meet requirements for speeds, number of windings, and load torque classification indicated in the motor-driven equipment specifications.

.5 Inverter Duty Motor:

.1 Motor supplied power by adjustable voltage and variable frequency drives shall be inverter duty rated.

.2 Motor shall be suitable for operation over entire speed range indicated.

.3 Provide forced ventilation where speed ratio is greater than published range for motor being installed.

.4 Motor installed in Class I, Zone 1 or 2 hazardous (classified) locations shall be identified as acceptable for variable speed when used in a these hazardous locations.

2.16 Factory Testing

.1 Tests:

.1 In accordance with CSA C390 for polyphase motors and for single-phase motors.

.2 Routine (production) tests on all motors in accordance with NEMA MG 1, plus no load power at rated voltage and polyphase, rated voltage measurement of locked rotor current. Test multispeed motors at all speeds.

.3 For energy efficient motors, test efficiency at 50, 75, and 100% of rated horsepower:

.1 In accordance with CSA C390 or IEEE 112, Test Method B, and NEMA MG 1, paragraphs 12.59. and 12.60.

.4 Power Factor:

.1 Speed.

.2 Current at rated horsepower.

.3 kW input at rated horsepower.

.4 On motors 74.6 kW and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.

.5 Vibration (balance).

.2 Test Report Forms:

.1 Routine Tests: IEEE 112, Form A-1.

3. EXECUTION

3.1 Installation

.1 In accordance with Manufacturer's instructions and recommendations.

.2 Align motor carefully and properly with driven equipment.

.3 Secure equipment to mounting surface with anchor bolts.

3.2 Field Quality Control

.1 Refer to Section 26 05 00 – Common Work Results for Electrical.

3.3 Supplements

.1 Table supplements, following “End of Section,” are part of this Specification.

.1 Table 1 - Motor Performance Requirements.

END OF SECTION