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(See 6.10)

MILITARY SPECIFICATION

MOTORS, 60-HERTZ, ALTERNATING CURRENT, INTEGRAL-HORSEPOWER, SHIPBOARD USE

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for 60-hertz (Hz), three-phase, alternating current (ac) motors for shipboard use in frame sizes not less than 182.

1.2 Classification. Motors furnished in accordance with this specification have the following services as specified (see 6.2):

Services.

Service A - Heavy-duty, high-impact, shock-resistant motors for driven auxiliaries which are essential to the Military effectiveness of a ship.

Service C - Commercial marine motors for driven auxiliaries which are not essential to the Military effectiveness of a ship.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, SEA 03R42, Naval Sea Systems Command, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6105

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

J-W-1177	- Wire, Magnet, Electrical, General Specification.
FF-B-171	- Bearings, Ball, Annular (General Purpose).
QQ-B-654	- Brazing Alloys, Silver.
GGG-P-781	- Puller Mechanical Puller Attachment, Mechanical, and Puller Set, Mechanical.

MILITARY

MIL-M-14	- Molding Compounds, Thermosetting.
MIL-S-901	- Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for.
MIL-E-917	- Electric Power Equipment, Basic Requirements (Naval Shipboard Use).
MIL-S-1222	- Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws and Nuts.
MIL-E-2036	- Enclosures for Electric and Electronic Equipment.
MIL-B-3743	- Brush, Electrical Contact.
MIL-P-15024	- Plates, Tags, and Bands for Identification of Equipment.
MIL-P-15024/5	- Plates, Identification.
MIL-E-16298	- Electric Machines Having Rotating Parts, Accessories and Associated Support Items: Packaging of.
MIL-T-16366	- Terminals, Electric Lug and Conductor Splices, Crimp-Style.
MIL-L-17331	- Lubricating Oil, Steam Turbine and Gear, Moderate Service.
MIL-B-17931	- Bearings, Ball, Annular, for Quiet Operation.
MIL-F-18240	- Fastener Element, Self-Locking, Threaded Fastener, 250°F Maximum.
MIL-L-19140	- Lumber and Plywood, Fire-Retardant Treated.
MIL-R-21248	- Rings, Retaining (Tapered and Reduced Section Type).
MIL-S-22473	- Sealing, Locking, and Retaining Compounds: (Single-Component).
MIL-I-24092	- Insulating Varnishesand Solventless Resins for Application By the Dip Process.

MILITARY (Continued)

MIL-C-24707 - Castings, Ferrous, General Specification for.
MIL-C-24707/1 - Castings, Ferrous, for Machinery and Structural Applications.
MIL-C-24707/5 - Castings, Ductile Iron and Austenitic Ductile Iron.
MIL-I-24178 - Insulation Tape, Electrical, Semi-Cured Thermosetting Resin Treated Glass, Armature Banding, Naval Shipboard.
DOD-G-24508 - Grease, High Performance, Multi-purpose. (Metric)
MIL-M-24738 - Monitors, High Temperature Motor Protection
MIL-R-83248 - Rubber, Fluorocarbon Elastomer, High Temperature, Fluid and Compression Set Resistant.

STANDARDS

FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.

MILITARY

MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
MIL-STD-740-1 - Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment.
MIL-STD-740-2 - Structureborne Vibratory Acceleration Measurements and Acceptance Criteria of Shipboard Equipment.
MIL-STD-2037 - Procedure to Obtain Certification for Electric Motor Sealed Insulation Systems

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

9 - Load Ratings and Fatigue Life for Ball Bearings
20 - Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design.

(Application for copies should be addressed to the American Bearing Manufacturers Association, Inc., 1101 Connecticut Ave. NW, Washington, DC 20036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 47 - Standard Specification for Ferritic Malleable Iron Castings. (DoD adopted)
A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware. (DoD adopted)

ASTM - Continued

A 216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service. (DoD adopted)

A 321 - Standard Specification for Steel Bars, Carbon, Quenched and Tempered.

A 489 - Standard Specification for Carbon Steel Lifting Eyes. (DoD adopted)

A 677 - Standard Specification for Nonoriented Electrical Steel, Fully Processed Types.

A 683 - Standard Specification for Nonoriented Electrical Steel, Semiprocessed Types.

A 757 - Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service.

B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes. (DoD adopted)

B 23 - Standard Specification for White Metal Bearing Alloys (Known Commercially as "Babbitt Metal").

B 26 - Standard Specification for Aluminum-Alloy Sand Castings. (DoD adopted)

B 30 - Standard Specification for Copper-Base Alloys in Ingot Form.

B 505 - Standard Specification for Copper-Base Alloy Continuous Castings.

B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel. (DoD adopted)

D 4727 - Standard Specification for Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding. (DoD adopted)

(Application for copies should be addressed to the American Welding Society, Inc., 550 N.W. LeJune Road, Miami, FL 33126.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.3.

3.2 Reliability. Bearings shall be selected to provide a calculated B-10 life of not less than 10,000 hours. Bearing life shall be calculated in accordance with ABMA 9 for single bearings and unless otherwise specified (see 6.2), in accordance with MIL-B-17931 for duplex bearings. Bearing life extension factors, identified in ABMA 9, shall not be used in bearing life calculations.

3.3 Materials, parts and processes. Unless otherwise specified herein, materials, parts, and processes shall be in accordance with MIL-E-917.

3.3.1 Hazardous material. Materials and parts containing asbestos, cadmium, lithium, mercury, radioactive materials, or materials giving off toxic fumes under operation shall not be used.

3.3.2 Recovered materials. Unless otherwise specified herein, all equipment, material and articles incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification.

3.3.3 Material compatibility. Materials which (through outgassing or other physical phenomena) cause deterioration of other materials or degradation of equipment performance shall not be used.

3.4 Safety. Unless otherwise specified herein, safety shall be in accordance with MIL-E-917. The equipment shall provide protection for personnel against accidental contact with moving parts and voltages in excess of 30 volts root mean square (Vrms) or 30 volts direct current (Vdc).

3.5 Requirements. Motors shall be as specified in 3.5.1 and 3.5.2 (see 6.3 and appendix B).

3.5.1 General. Service A and service C motors shall meet the requirements of 3.5.1.1 through 3.5.1.38.

3.5.1.1 Voltage and frequency variation. Motors shall operate in accordance with the requirements of this specification at rated voltage and frequency. Motors shall perform satisfactorily when operated with a variation in voltage or frequency as follows:

(a) Plus or minus 10 percent of rated voltage, with rated frequency.
(b) Plus or minus 5 percent of rated frequency, with rated voltage.
(c) A combined variation in voltage and frequency of 10 percent (sum of absolute values) of rated values, provided the frequency variation does not exceed plus or minus 5 percent of rated frequency.

3.5.1.2 Rated voltage and frequency. Motors shall operate with the following rated voltages and frequencies, as specified (see 6.2):

(a) Voltage
    (1) 220 volts alternating current (Vac).
    (2) 440 Vac.
    (3) Special.
(b) Frequency
    (1) 60 Hertz
    (2) Special

3.5.1.3 Ambient temperature. Motors shall operate in accordance with this specification in the following ambient temperature as specified (see 6.2):

(a) 40 degrees Celsius (°C).
(b) 50°C.
(c) 65°C.
(d) 70°C.
(e) 80°C or more.

3.5.1.4 Winding. Motors shall be wound by use of preformed or mush wound coils without recourse to special equipment beyond that normally available at field electric repair facilities. Motor windings shall have an integral number of turns per coil or shall be half-turn windings.

3.5.1.5 Air gap. Motors shall be constructed for a minimum air gap of not less than 0.0025 inch per inch of rotor outside diameter except a minimum air gap of 0.012 inch for rotor diameters 4.8 inches or less.

3.5.1.6 Duty and duty cycle. Duty of motors shall be continuous, intermittent, varying, or short-time, as specified (see 6.2), for the applicable performance requirement (see 3.6.11.1 through 3.6.11.4). Motors of other than continuous duty shall have a defined duty cycle (see 6.2(g)).

3.5.1.7 Thermal protection. When specified (see 6.2), motors shall be provided with thermal protection for the stator windings. A minimum of two thermal sensors per phase, located in the same pole-phase group, shall be imbedded in the stator winding. The pole-phase groups, with sensors, shall be equally spaced about the stator diameter. Sensor leads shall be flexible and shall be secured to the coilhead at a location near where they will exit the coilhead to prevent force from being transmitted to the sensor. For one sensor per phase, the lead length extending beyond the point where they are secured to the coilhead shall be coiled and tied to the coilhead. When specified (see 6.2), motors shall be provided with a minimum of one thermal sensor in contact with each bearing outer ring. Where the sensors used are thermistors, thermal protection shall be provided in accordance with MIL-M-24738. Thermal sensors shall be monitored with one sensing network (monitor) that shall energize an alarm or de-energize the motor control within plus or minus 5°C of the set point of the thermal sensor.

3.5.1.8 Enclosures. Enclosures shall be in accordance with class 2 of MIL-E-2036: for submarine applications, see 3.5.2.5.1; for degrees of enclosure greater than totally enclosed, except for explosionproof, also see 3.5.1.21. Air-over (AO) enclosures such as TEAO, SPTAO and EXPAO shall meet the requirements of

MIL-E-2036 for enclosures TE, SPT, and EXP, respectively. Unless otherwise indicated in the duty cycle (see 3.5.1.6), submersible motors shall operate continuously in air. Submersible motors that operate continuously in air may have a frame size in accordance with the provisions for totally enclosed (TE) motors (see figures 1 through 4). Enclosures shall be one of the following types as specified (see 6.2 and 6.6.4):

Dripproof protected - DPP
Spraytight - SPT 1/
Spraytight fan-cooled - SPTFC 1/
Spraytight air-over - SPTAO 1/
Watertight - WT 2/
Totally enclosed air-over - TEAO
Totally enclosed - TE
Totally enclosed fan cooled - TEFC
Explosionproof air-over, group D - EXPAO
Explosionproof, group D - EXP
Explosionproof, fan cooled, group D - EXPFC
Submersible (3 ft) - SUB3 3/
Submersible (15 ft) - SUB15 3/
Submersible (50 ft) - SUB50 3/

1/ Shaft leakage shall be prevented without the use of shaft rubbing seals. Slingers shall be non-corrodible and non-sparking. The fit between slinger and shaft shall prevent leakage along the shaft without fillers (see MIL-E-2036).
2/ The enclosure shall have as a minimum a single-faced, continuously lubricated, non-corrodible, shaft seal without shaft rubbing element.
3/ The enclosure shall have as a minimum a double-faced, continuously lubricated, non-corrodible, shaft seal without shaft rubbing element.

3.5.1.9 Speed. The rated speed in revolutions per minute (r/min) or rated speed range in r/min shall be as specified (see 6.2). The speed shall be constant, multi, adjustable, varying, or adjustable varying as specified (see 6.6.8 through 6.6.8.5), as specified (see 6.2).

3.5.1.10 Standard horsepower (hp) ratings. Motors shall be furnished in the following standard hp ratings, as specified (see 6.2):

1/2	2	10	30	75	200	400
3/4	3	15	40	100	250	450
1	5	20	50	125	300	500 and
1-1/2	7-1/2	25	60	150	350	above

3.5.1.11 Design and types. Motors shall be of the following types and designs, as specified (see 6.2 and 6.6.5 through 6.6.7):

Squirrel-cage induction:
Design A.
Design B.
Design B7.
Design C.
Design D.
Design F.
Design FF.
Wound-rotor induction:
Collector-ring starting.
Collector-ring starting and running.
Induction starting and running.
Synchronous.

3.5.1.12 Full-load power factor, designs A, B, and B7.

3.5.1.12.1 Single speed induction motors. The full-load power factor for single speed induction motors shall be not less than 0.80 except for single speed induction motors 15 horsepower and less, or single speed induction motors with synchronous speeds of 900 r/min and less, which shall be not less than 0.70. Motors with synchronous speeds of 600 r/min and less need not conform to this requirement.

3.5.1.12.2 Multispeed induction motors. The full-load power factor for the high speed of a multispeed induction motor shall be not less than 0.05 below that of a motor of the single speed rating.

3.5.1.13 Structureborne noise. The following factors shall be considered by the contractor in the design of the motors to meet the requirements of 3.6.3.2:

(a) Precision machining of rolling, rubbing, and fitting parts.
(b) Maximum effort during the production phase to minimize corrections required during the final balancing phase.
(c) Provisions for in-place balancing of rotating parts and access for in-place balancing.
(d) Sharp cutoffs and turbulence avoided in the air cooling system. Ventilation ducts and housings damped to prevent flow-excited vibration.
(e) Most favorable combination of the following:

(1) Number of slots per pole.
(2) Proximity of the slot frequency to the natural frequency of the magnetic frame.
(3) Skewing of stator or rotor slots.
(4) Magnetic core and tooth flux densities.
(5) Frequency and amplitude of structureborne noise to accommodate noise limits specified for the auxiliary and motor assembly.

3.5.1.14 Mechanical fasteners. Mechanical fasteners shall be in accordance with MIL-E-917. Thread engagement for mechanical fasteners, where mating materials are similar or dissimilar, shall be in accordance with FED-STD-H28 (see MIL-E-917).

3.5.1.15 Mechanical balance. The rotating assemblies of motors shall be mechanically balanced at all loads and speeds in the operating range to meet the required levels of balance and structureborne noise. Mechanical balance correction shall be effected by the following methods:

(a) Balance ring(s) shall be provided when super-precision levels of balance are specified and shall be in accordance with MIL-E-917 and the following. Balance rings shall be located outboard of the bearings and shall provide a fine adjustment for balance correction. Other balancing methods, as described in subparagraph (b) below, shall be used to obtain the majority of the balance correction.

(b) The following methods of balance correction are listed in their order of preference:

(1) Weight removal.

(2) Weight addition, weights shall be securely attached to the rotating assembly.

a. Bolts and washers shall be corrosion resistant. Bolts shall be securely attached when a corrosion resistant, split-ring lockwasher and one of the following methods of attachment are used.

1. Bolts or nuts with nylon inserts in accordance with MIL-F-18240, type P or N, if temperature conditions permit.
2. Thread locking compound in accordance with MIL-S-22473.
3. Welding of bolt head to steel plate. Bolts shall not be directly welded to rotor laminations. The split-ring lockwasher shall be substituted for by one of the locking methods indicated above.

b. When correcting imbalance with bolts and washers, the stack height of washers placed under a bolt head, including the lockwasher, shall be limited to that which shall provide no less than the minimum thread engagement between the bolt and the threaded hole in accordance with FED-STD-H28 (see MIL-E-917).

c. Steel weights, securely welded. Weights shall not be welded directly to rotor laminations.

(c) For wound rotating assemblies, the use of solder on banding wire is permissible subject to the following limitations:

(1) Diameter of the rotor does not exceed 16 inches.

(2) Peripheral speed does not exceed 6,500 feet per minute at synchronous speed.

(3) Armature cores are balanced before the windings are inserted.

(4) Only tinned banding wire is used.

(5) The solder does not cover an arc of more than 25 percent of the circumference of the armature measured on the banding wire unless satisfactory to the Command or agency concerned (where the manufacturer prebalances the armature and takes care in placing the windings in the slots to reduce unbalance due to the axial misalignment of the coils, this value may be increased to 33 percent if satisfactory to the Command or agency concerned).
(6) Thickness of solder over banding wire does not exceed 3/32 inch, and in no case extends past the center of the air gap.

3.5.1.16 Armature and coil banding using glass. Semi-cured thermosetting resin treated glass insulation tape may be used for armature and coil banding in lieu of steel wire banding. Glass banding materials and methods of application shall be in accordance with MIL-I-24178.

3.5.1.17 Field coils. Coils shall be thoroughly insulated from adjacent, conducting and grounded parts. They shall be secured to prevent motion of the coil with respect to the poles or other parts when the motor is operating. Coils of the same type shall be interchangeable.

3.5.1.18 Collector rings (where used).

3.5.1.18.1 Material. Collector rings shall be of copper, brass, bronze, corrosion-resistant steel, or other corrosion resistant alloys. Rings shall run true, have a smooth polished surface, and be free from porosity or hard spots.

3.5.1.18.2 Construction. Rings, with their insulation, shall be of solid construction throughout to insure against their becoming loosened or eccentric during the life of the motor. They shall be secured to the shaft or spider by interference fit or by keying. Minimum interference fits for ring assembly, shell to shaft, shall be as shown in table I. The securing method used shall prevent both rotational and axial movement.

3.5.1.18.3 Wearing depth. The minimum wearing depth of collector rings, shall be as shown in table II.

3.5.1.19 Brush rigging.

3.5.1.19.1 Accessibility. Brush holders shall be readily accessible for adjustment and replacement of brushes and springs. It shall not be necessary to remove the end brackets to adjust the brush holders or replace the brushes.

3.5.1.19.2 Mounting of collector ring brush holders. Collector ring brush holders shall be mounted on insulated studs attached to the end brackets.

3.5.1.19.3 Alignment. Brush holders shall be mounted and aligned so that brushes are parallel to the shaft and do not extend beyond the edge of the collector ring.

3.5.1.19.4 Clearance. Brush holders or brush rigging shall be adjustable so that the optimum clearance between the brush holder and collector ring can be maintained throughout the useful life of the collector ring.

3.5.1.20 Mounting. Motors shall be configured for mounting either in the horizontal or vertical position as specified (see 6.2). Mounting feet or flanges, as specified (see 6.2), shall have machined mounting surfaces and shall be provided with round holes for mounting bolts (for submarine application see 3.5.2.5.2 and 3.5.2.5.3).

TABLE I. Fit of collector ring assembly.

Shaft diameter at collector ring assembly section (inches)	Minimum interference fit (inch)
Over 0 to 2, inclusive	0.0003
Over 2 to 3, inclusive	.0006
Over 3 to 4, inclusive	.0009
Over 4 to 5, inclusive	.0013
Over 5 to 6, inclusive	.0015
Over 6 to 7, inclusive	.0019
Over 7 to 8, inclusive	.0024
Over 8 to 9, inclusive	.0028
Over 9 to 10, inclusive	.0037
Over 10 to 11, inclusive	.0042
Over 11 to 12, inclusive	.0046
Over 12 to 13, inclusive	.0051
Over 13 to 14, inclusive	.0056
Over 14 to 15, inclusive	.0061
Over 15 to 16, inclusive	.0065
Over 16 to 17, inclusive	.0070

TABLE II. Minimum wearing depth of collector rings.

Collector ring diameter (inches)	Reduction in diameter (inch)
4 and under	1/4
Over 4 up to 6, inclusive	1/2
Over 6 up to 8, inclusive	5/8
Over 8 up to 12, inclusive	3/4
Over 12 up to 15, inclusive	7/8
Over 15	1

3.5.1.21 End shields (explosionproof and explosionproof, fan-cooled motors excluded). An accurate shoulder joint shall be provided between the frame and end shields. When specified (see 6.2), the end shields shall provide for the rotation of the shields through 90 degrees or 180 degrees in either direction to allow for bulkhead or underside suspension of the motor. Resilient-gaskets shall not be placed between any bearing support member or bearing end cap and the frame or end shield. For spraytight, watertight, and submersible motors, the contact surfaces

between the enclosing covers (ex. outer bearing caps) and the motor frame or end shields and between the frame and end shields shall be free from fins, burrs, or other imperfections detrimental to watertightness. The contact surfaces shall provide the necessary degree of watertightness by creating a tight metal to metal fit or shall be provided with O-rings suitably retained and treated with graphite on the contact surface to prevent sticking. The use of sealants to create watertightness is prohibited.

3.5.1.22 Frames and covers. The finished motor frame shall be one piece. Loose spacers or any form of frame extension not welded or permanently attached to the frame or end shield shall not be used to extend the length of the frame. End shields shall be secured to the frame with not less than four hexagonal head or socket-head screws or bolts. Motor construction shall be based on the use of bolts or screws of tensile strength not greater than that for grade 5 in accordance with MIL-S-1222. Through bolts may be used to secure the end brackets to the frame of motors built in a frame size 215 or smaller, except for explosionproof enclosures. Bolts shall be fitted with lockwashers in accordance with MIL-E-917. For motors with brushes, openings of adequate size and number shall be provided to give easy access to and a direct view of collector rings and brushes while the motor is in operation. These openings shall be provided with substantial transparent plastic covers and fastenings. Enclosing covers (hand-hole or access-hole covers) shall be readily removable. Engaging bolts or locking devices shall be attached to the frame, end shield, or covers as the construction permits in such manner as to prevent the bolts or locking devices from being misplaced or dropped into the machine during repair operations. Motors shall be provided with a means to permit easy removal of end shields by any of the following methods (for submarine applications see 3.5.2.5.7 through 3.5.2.5.9):

(a) Knock off lugs integral with end bracket.
(b) Holes drilled and tapped in end shield for use of jacking bolts.
(c) Recess in frame to permit contact of drift with end shield flange.

3.5.1.22.1 Vertical fan-cooled motor covers. Vertical fan-cooled motors shall be furnished with a solid cover over the fan assembly to prevent personnel injury and to prevent foreign particles from falling into the fan.

3.5.1.22.2 Aluminum frames and end shields. Except for non-magnetic applications, aluminum alloys shall not be used for motor frames or end shields. Where used, aluminum shall be hard anodized. End shields shall not support the total weight of the motor driven auxiliary. Steel inserts shall be provided for all threaded positions and bearing housings.

3.5.1.23 Shafts. Unless otherwise specified (see 6.2) a shaft extension with keyway shall be provided and shall be in accordance with figures 1, 2, 3, and 4, as applicable (for submarine applications see 3.5.2.5.6).

3.5.1.24 Bearings. For additional bearing requirements refer to 3.5.2, as applicable.

3.5.1.24.1 Types of bearings. Unless otherwise specified (see 6.2), bearings shall be the ball type.

3.5.1.24.2 Ball bearing lubrication. Except as determined in accordance with 3.5.2.1.5.1, ball bearings shall be grease lubricated.

3.5.1.24.2.1 Lubrication and preservation. Where grease is used, the following shall occur prior to the motor leaving the plant of manufacture:

(a) The correct amount of clean lubricant shall be added to the grease reservoirs.
(b) The piping and grease passages leading to the grease reservoirs shall be filled with clean grease.
(c) A thin coat of clean grease shall be applied to the surfaces of the grease reservoir.

Grease shall be in accordance with DOD-G-24508. Where oil is the lubricant, the bearings shall be treated with a preservative compatible with the operating oil.

3.5.1.24.2.2 Lubrication provisions. Except for motors with type 120 bearings, motors shall be relubricable and shall not require disassembly for relubrication. Grease cups, pipes, where applicable, and drains shall be used when grease is a means of lubrication and relubrication of bearings is required. The grease cup shall not be mounted on the motor and the threaded hole used to attach the grease cup shall be provided with a pipe plug or cap. Grease inlet and drain passages shall be of minimum length. For motors critical to ship's mission, (see 6.2), grease passages shall be cleanable without motor disassembly, other than removal of any grease pipes. Grease pipes shall be removable without motor disassembly. Grease pipes, where used, shall be left on the motor; the end outermost from the motor shall be fitted with a pipe plug. Pipe plugs shall be accessible without motor disassembly. The grease inlet shall be located on or above the horizontal centerline of the bearing housing for horizontal motors and at any location convenient to the grease chambers above the bearing for vertical motors. Grease outlets shall be located to afford maximum purging of grease during regreasing operation.

3.5.1.24.2.3 Grease lubricant seals. Except where type 120 bearings are used, the bearing housing shall provide for a close clearance, metallic, nonrubbing seal on both sides of the bearings to prevent the leakage of oil or grease along the shaft. This is in addition to bearing shields or slingers, if required.

3.5.1.24.3 Housing construction. Bearing housing shall permit ready removal of the end shield without removing the bearings. Motors with frame size less than 286 shall have removable inner bearing caps. Motors with frame size 286 and larger shall have removable inner and outer bearing caps. Bearing caps shall be secured with fasteners in such a manner that the fasteners shall be removable without dismantling the motor. Motors with type 120 bearings need not have inner bearing caps.

3.5.1.24.3.1 Removal of bearing. Construction shall permit removal of the ball bearing by pulling on the inner ring of the bearing with one of the tools contained in a "complete" Naval shipboard set of tools specified in GGG-P-781.

3.5.1.24.3.2 Bearing preload washer or springs. The use of bearing preload washers, springs, or both shall be permitted provided they are secured in the housing. The spring or washer shall be applied in such a manner as to provide for temperature differential compensation specified in 3.5.2.1.5.2.

3.5.1.24.4 Warning plate. Where type 120 bearings are used, a plate bearing the words "WARNING: DO NOT LUBRICATE" shall be permanently attached to the motor. The plate shall meet the requirements of 3.5.1.34.

3.5.1.24.5 Sleeve bearings and oil lubricated ball bearings. When use of sleeve bearings is specified (see 6.2), motors having rotors weighing less than 200 pounds may use either split or solid bushing type sleeve bearings. Split cylindrical sleeve bearings shall be used for rotor weights in excess of 200 pounds. Sleeve bearing construction shall be such that unit loads do not exceed 150 pounds per square inch (lb/in^2) and the length to diameter ratio does not exceed one. Sleeve bearings shall be either babbitt faced, bronze backed or solid bronze.

3.5.1.24.5.1 Lubrication of sleeve bearings and oil lubricated ball bearings. Sleeve bearings shall be lubricated by a self contained gear, disc, viscous pump, or forced feed lubrication system as required. Lubricant for sleeve bearings and oil lubricated ball bearings shall be in accordance with MIL-L-17331.

3.5.1.24.5.2 Oil discs. The number of oil discs shall be such that no disc is required to distribute lubricant for an axial distance greater than 3 inches on either side.

3.5.1.24.5.3 Bearing housing. The housing shall provide for a close clearance metallic seal on both sides of the bearings to prevent the leakage of oil along the shaft under all conditions of pitch, roll, or shock. This is in addition to the deflection flanges or slingers required on the shaft. Provision shall be made to ensure against the suction of oil vapor into the motor. Provision shall also be made for observation of the disc scrapers or pumps. These openings shall be oiltight and have a cover secured by a positive lock and gasket. Surface area and oil sump volume shall be adequate to transfer the heat generated in the bearing. Forced water or air cooling may be used. Bearing seats shall be line bored to produce good bearing alignment. The bearing bore centerline shall deviate by not more than 20 percent of the bearing clearance.

3.5.1.24.5.4 Filling. An opening or standpipe for filling, preventing overfilling, and indicating the oil level shall be provided in the reservoir. It shall be fitted with an oiltight plug or cap to prevent the escape of oil due to the motion of the ship. Positive venting shall be provided to assure pressure equalization in the motor. The diameter of the filling opening shall be not less than 1/4 inch for machines built in frames of motors corresponding to 3 hp, continuous rating of 1,800 r/min, and not less than 3/8 inch for larger machines.

3.5.1.24.5.5 Threads. Straight threads shall be used on all plugs and fittings.

3.5.1.24.5.6 End play (sleeve bearings only). To ensure floating of the shaft in horizontal sleeve bearing motors, there shall be at least 1/64 inch end play in either direction.

3.5.1.25 Rotor and stator core.

3.5.1.25.1 Securing core to shaft. Provisions shall be made to prevent rotation of the core on the shaft and axial displacement of the core along the shaft. Keys, knurling of the shaft, or keys in conjunction with press or shrink fits shall be provided to prevent rotation of the core around the shaft. Press or shrink fits without keys to secure the core on the shaft to prevent axial or rotational movement of the core shall be as approved (see 6.8). Tack welding in conjunction with these methods is permissible to prevent axial displacement of the core along the shaft.

3.5.1.25.2 Securing stator core to frame. Means shall be provided to prevent rotation of the core in the frame and axial displacement of the core along the frame.

3.5.1.26 Terminal boxes and terminal box covers. Terminal boxes and covers shall be provided and securely bolted or welded to the frame. Use of pipe nipples where they are necessary or where motors are to be used in inaccessible locations shall be as approved (see 6.8). Terminal boxes shall be provided with conduit openings as specified (see table III; for submarine applications see 3.5.2.5.4). For multispeed motors with multiple independent windings, one conduit opening of the size indicated in table III shall be provided for each hp rating. For motors rated over 250 hp, the conduit openings shall be sized to suit the number and diameter of ship cables specified (see 6.2).

TABLE III. National pipe thread (NPT) assignments for motor terminal boxes - nylon tubes. 1/

Maximum full-load amps	NPT	Tube size	HP
18	3/4	2	1, 2, 3, 5, and 7-1/2
25	1	3	10, 15, 10, 25, and 30
110	1-1/2	5	40, 50, 60, and 75
185	2	6	100 and 125
250	2-1/2	7	150
320	3	8	200
400	3-1/2	9	--

1/ NPT sizes are based on the maximum expected three-conductor cable size. If cable size permits, the hole size may be reduced to the next lower size by use of a reducing bushing which will be inserted by the installing activity. If steel tubes are used, the installing activity shall provide the proper size reducing bushing to fit.

3.5.1.27 Connections and terminals.

3.5.1.27.1 Securing connections. Connections (mechanical and electrical) shall be provided with locking devices in accordance with MIL-E-917. Connections and leads shall be secured to prevent their coming in contact with moving parts or being chafed by contact with stationary parts. Excess solder shall be removed from soldered connections.

3.5.1.27.2 Field connections. In general and where practicable, field connections shall be made on the front end. In split-frame motors, the field connections which will be broken for disassembly shall be readily accessible.

3.5.1.27.3 Securing terminal leads. The leads shall be secured by a lead clamp or by anchoring them to the motor windings so that no strain is put on the end connections. Where a lead clamp is provided, it shall be attached to the frame and not to the end shields.

3.5.1.27.4 Cable connectors. The end of each motor lead shall be fitted with a connector for joining the motor lead to the supply circuit cable or wire. Ship service cables and their terminal lugs shall not be supplied by the motor manufacturer.

3.5.1.27.5 Flexible leads. Terminal leads shall be made of flexible, stranded insulated wire. Means to prevent abrasion of the lead insulation by metallic edges of the motor frame, terminal box, piping, or cable clamp shall be provided.

3.5.1.28 Lead wire identification. Lead wires shall be permanently marked in accordance with MIL-E-917.

3.5.1.29 Painting. Painting shall be in accordance with MIL-E-917.

3.5.1.30 Lifting means. Means shall be provided for lifting motors weighing 150 pounds and over.

3.5.1.31 Temperature limitations. Motor temperature limitations shall be as specified in 3.6.11.

3.5.1.32 Conventional insulation. Conventional insulation, where applicable (see 3.5.2.1 and 3.5.2.2), shall be in accordance with MIL-E-917.

3.5.1.32.1 Insulation class. Insulation class shall be F, H, or N in accordance with MIL-E-917 (see 6.2). Where ambient temperatures of 40°C or 50°C are specified, the insulation shall be class F.

3.5.1.32.2 Slot insulation and varnishing. Slot cell shall be folded under the slot wedge if flat wedge is used, or inserted inside the slot wedge if formed (curved) wedge is used. The wedge shall extend the full length of the slot and extend past the iron a minimum of 1/4 inch. The wedge shall be positioned so as to completely cover the slot cell. For motors in frame sizes 215 or smaller, the flat or curved wedges may be inserted inside the slot cell, and in such cases, the following conditions shall apply:

(a) The slot wedge shall extend the full length of the slot cell and completely cover the windings and close the slot necks.
(b) The wound stator shall be given a minimum of two varnish dips and bakes.

3.5.1.33 Sealed insulation system. The sealed insulation system shall be applied to random wound and form wound motors by manufacturers qualified by NAVSEA in accordance with MIL-STD-2037 (see 4.3.1). For applicability of sealed insulation to particular motor services see 3.5.2.1 and 3.5.2.2. In addition, motors with sealed insulation systems shall meet the following requirements:

(a) Insulation. Insulation shall be class F. The insulating materials used in motors with a sealed insulation system need not meet the minimum material requirements of 3.5.2.1.1.
(b) Terminal box. The terminal box shall be watertight.
(c) Motors furnished with sealed insulation systems shall be constructed so that they can be repaired (rewound) using sealed insulating materials and processes or rewound using conventional rewinding materials and methods.
(d) Insulation resistance, corrected to 25°C, shall be not less than 1000 megohms, dry, and 100 megohms, submerged (see 4.6.20).

3.5.1.34 Identification. Motors shall have identification plates (and information plates where required) which shall be attached to the part of the machinery or equipment which will not ordinarily be replaced during its normal service life. These plates shall be located where they can be read at all times without danger to personnel. Identification plates and information plates shall be made of brass, nickel-copper-alloy, or corrosion-resistant steel in accordance with MIL-P-15024 and MIL-P-15024/5.

3.5.1.34.1 Identification plate markings. Unless otherwise specified (see 6.2), the minimum information to be on identification plates for motors shall include the following items:

(a) Manufacturer's information as follows:

(1) Name.
(2) Identification symbols.
(3) Serial number.
(4) Manufacturer's drawing number, including revision symbol.
(5) Date of manufacture.

(b) Salient design characteristics (this information shall agree with information shown in the classification block of manufacturer's drawing):

(1) Hp (or torque rating).
(2) Design.
(3) Voltage.
(4) Measured full-load current.
(5) Type of motor.
(6) Full-load speed.
(7) Number of phases.
(8) Frequency.
(9) Ambient temperature.

(c) Duty - Where motors rated for intermittent duty, short-time, or varying duty are capable of operating continuously at some decreased rating, that continuous rating shall also be shown on the identification plate. If there is no continuous rating, it shall be so stated.
(d) Class of insulation.
(e) Frame size.
(f) Enclosure type.
(g) Efficiency (minimum).
(h) Navy service.
(i) Contract or order number.

3.5.1.34.2 Frame and rotor. The manufacturer's serial number shall be stamped or otherwise permanently marked in the solid metal of the frame underneath (covered by) the main identification plate. The part number, or other information sufficient to completely identify one rotor, shall be stamped or otherwise permanently marked on the shaft or rotor core. Marking of armatures and field coils shall identify the manufacturer and the style and type of motor.

3.5.1.34.3 Sealed insulation system information plates. Motors with sealed insulation shall have the following information plates:

(a) The plate shall list the name of the activity performing the sealed insulation system and date code consisting of four digits, the first two representing the month, the second two the year of manufacture. The plate shall also contain the statement: "Stator windings insulated to provide a sealed insulation system. Caution: When stripping, oven temperature not to exceed 370°C., measured on core "(see figure 5).
(b) High reliability plate. An octagonal plate shall be attached near the regular identification plate stating at the top using two lines: "DO NOT OVERHAUL", in the center using two lines: "HIGH RELIABILITY", and at the bottom using two lines: "SEE MOTOR DRAWING" (see figure 5).

3.5.1.35 Interchangeability. Bearing caps, bearing cap fasteners, end bells, end bell fasteners, air baffles, parts that affect lubrication, and repair parts that are physically interchangeable shall be either functionally interchangeable or shall be permanently marked "DE" (drive end) or "ODE" (opposite drive end), as appropriate. Permanent marking shall be clearly legible and shall be accomplished by metal stamping or a process that will produce not less than an equivalent level of clarity and permanence. The above parts that are physically reversible shall be functionally reversible.

3.5.1.36 Direction of rotation. Unless otherwise specified (see 6.2), motors shall be inherently reversible (constructed for operation in either direction). Inherently nonreversible motors and motors driving nonreversible auxiliaries shall be equipped with permanently mounted identification plates as specified (see 3.5.1.34) to indicate the direction of rotation when viewed from the end of the motor opposite the normal drive shaft (see figure 5).

3.5.1.37 Provision for measuring speed (explosionproof and explosion-proof, fan-cooled motors excluded). In motors having a single shaft extension, provision shall be made for the measurement of speed with a hand type tachometer. This shall be accomplished on the opposite drive end either by extending the shaft flush with (or slightly beyond) the outer face of the bearing housing, or by providing a hole and a plug in the outer end of the bearing housing. When a hole and plug are provided, the hole shall be threaded and not smaller than 9/16-inch diameter, and the plug shall not be able to interfere with the end of the shaft. A lathe center or other suitable hole shall be provided in the end of the shaft for the insertion of the tachometer tip. For fan-cooled motors a hole not smaller than 9/16-inch diameter shall be provided in the fan guard for access to the end of the shaft. The hole shall be securely covered and shall be in accordance with MIL-STD-108.

3.5.1.38 Standardization. Squirrel cage induction motors shall be in accordance with the standardization requirements shown on figures 1 through 4. Applicable motor standardization requirements, contained in auxiliary equipment specifications, take precedence over figures 1 through 4. For submarine service, low noise applications on surface ships, or applications where the use of standard motors is not practical, nonstandard motors may be proposed for acceptance to the contracting activity. Nonstandard motors shall be as specified on figures 1 through 4, with the exception that the requirements of table A of figures 1 through 4 may be used as a guide.

3.5.2 Requirements applicable to individual services.

3.5.2.1 Service A motors. In addition to the general requirements of 3.5.1 through 3.5.1.38, service A motors shall meet the requirements of MIL-E-917, 3.5.2.1.1 through 3.5.2.1.13, 3.6, and the requirements of MIL-S-901 for grade A shock. Service A motors shall be furnished with a sealed insulation system.

3.5.2 1.1 Materials. The minimum material requirements for service A motors shall be as specified in table IV except nonmagnetic materials for nonmagnetic motors shall be as specified in 3.5.2.4.2.

TABLE IV. Minimum material requirements for service A motors.

Item	Limitation	Material	Specifications or remarks
Motor	All sizes		Materials containing silicone shall not be used except in brushless motors
Balance rings	All sizes	Brass Bronze Corrosion resistant steel Other inherently noncorrodible material	ASTM B 21 ASTM B 30 or B 505 ASTM A 321
Ball bearings	All sizes	----------	General application FF-B-171, noise quiet application MIL-B-17931
Ball bearings caps	All sizes	Steel 1/ Malleable iron Nodular graphitic iron 3/ Aluminum	---------- ASTM A 47 MIL-C-24707/5 Commercial treated for corrosion resistance
Brushes	All sizes		MIL-B-3743
End shields	All sizes	Steel 1/ Malleable iron Nodular graphitic iron 3/	---------- ASTM A 47 MIL-C-24707/5
Eyebolts, lifting	Where used	Steel	ASTM A 489, Zinc coated per ASTM A 153 OR ASTM B 633, thickness class Fe/Zn 12, with a type II finish
Fans - external and internal	All sizes ---------- ----------	Steel 1/ Aluminum Malleable iron Nodular graphitic iron 3/	ASTM B 26 ASTM A 47 MIL-C-24707/5
Fans - external	External fan for fan-cooled motors	Plastic, molded thermosetting	MIL-M-14

See footnotes at end of table.

TABLE IV. Minimum material requirements for service A motors - Continued.

Item	Limitation	Material	Specifications or remarks
Flanges-armature rotor	Where used	Steel 1/	----------
Frames	All sizes ---------- ----------	Steel 1/ Malleable iron Nodular graphitic iron 3/	---------- ASTM A 47 MIL-C-24707/5
Grease cups and pipes	All sizes	Steel 1/	Treated for corrosion
Grease		Synthetic hydrocarbon	DOD-G-24508
Hand-hole or access covers	All sizes ----------	Transparent plastic	MIL-E-917
Insulation - ground and phase, lead and connection, collector ring, spacers and separators, washers, bushings, tubes, wedges and lead clamp.	Class F, H, or N	All types and classes	MIL-E-917 and sealed insulation system
Lead wire	Class F, H, or N	All types and classes	MIL-E-917
O-rings	All sizes	Fluorocarbon rubber	MIL-R-83248
Oil, lubricating	Maximum oil sump temperature 82°C		MIL-L-17331 Navy symbol 2190TEP
Oil, discs	All sizes	Steel 1/	----------
Part covers for totally enclosed type machines where the cover acts as a shield only, and not as a support for another part such as an auxiliary or brake.	----------	Malleable iron Aluminum Plastic molded thermosetting	ASTM A 47 ASTM B 26 MIL-M-14

See footnotes at end of table.

TABLE IV. Minimum material requirements for service A motors - Continued.

Item	Limitation	Material	Specifications or remarks
Quills and spiders	Where used	Steel 1/	----------
Scraper	All sizes	Brass	Commercial
Shafts	Close-coupled pumps All other motors	Steel	Corrosion-resistant material. Tensile strength not less than 75,000 lb/in^2 and elongation not less than 18 percent in 2 inches.
Shaft seals	All sizes	Brass Bronze Corrosion resistant steel Other inherently noncorrodible material	ASTM B 21 ASTM B 30 or B 505 ASTM A 321
Sleeve bearings	All sizes	Bronze Babbitt antifriction metal	ASTM B 30 or B 505 ASTM B 23, Alloy Number 2
Terminal boxes terminal box covers	All sizes	Steel 1/ Malleable iron Nodular graphitic-3 iron	ASTM A 47 MIL-C-24707/5
Wire, magnetic	Types M2, K2, H2	Copper, round 2/	J-W-1177
Varnish insulating	All classes		MIL-I-24092
Wire, end turn banding	All sizes	Steel and non-magnetic alloy	Commercial
Wedges	All sizes	Steel Brass Thermoset fiberglass Nodular graphitic-3 iron	Commercial Commercial Commercial MIL-C-24707/5

1/ Unless otherwise specified steel parts shall be cast, fabricated, wrought or forged. Cast steel shall be in accordance with MIL-C-24707 and MIL-C-24707/1, grades A1Q of ASTM A 757 or WCA of ASTM A 216. For grade WCA of ASTM A 216, the Charpy impact test conditions shall be 20 foot-pounds and minus 20°F.

2/ Alternate wire sizes - sizes other than those in J-W-1177 may be used provided the motor design is such as to permit rewinding with a size and shape wire specified in J-W-1177, having an equivalent or higher temperature rating.
3/ Modular graphitic iron shall be furnished in either of the following two grades: 1) 60-45-15, 2) 60-40-18.

3.5.2.1.2 Solder for winding connections. Solder, where required for electrical connections, shall be silver-base brazing alloy or copper-base brazing alloy in accordance with QQ-B-654 or AWS A5.8, respectively.

3.5.2.1.3 Windings.

3.5.2.1.3.1 Coilhead dimension and forming. Forming fixtures shall not be used for the winding or rewinding of wound components to meet the winding end turn envelope dimensions.

3.5.2.1.3.2 Rotor windings. Coils shall be securely retained in the slot by wedges. Banding shall be by glass insulated tape (see 3.5.1.16) or by steel banding wire. Insulation used under the wire shall be in accordance with MIL-E-917.

3.5.2.1.4 Core material. Core material, laminations, shall be provided with C5 inorganic interlaminar insulation in accordance with ASTM A 677 or ASTM A 683 and shall withstand burn out temperatures of 372°C for 16 hours.

3.5.2.1.5 Ball bearings. Designations for ball bearing type, class and size shall be as defined in MIL-B-17931. Ball bearings, their dimensions, mounting, and application, shall be as specified in table V and FF-B-171 as follows:

(a) Type 111, classes 1, 2, and 7 or type 120 (see 3.5.1.24.4).
(b) For bearings for submarine applications see 3.5.2.5.5.
(c) For surface ship noise quiet applications see 3.5.2.6.1.
(d) For 3600 r/min motors, grease lubricated bearings shall not exceed size 312.
(e) For 3600 r/min synchronous speed motors, bearings shall be loose (C3) internal fit as defined by ABMA 20 except for submarine applications or where axial end play is restricted.
(f) Other types proposed for special application requirements shall be as approved (see 6.8).

TABLE V. Bearing shaft, shaft shoulder, housing, and housing shoulder diameters.

Bearing size	Shaft diameter		Shaft shoulder diameter	Housing diameter		Housing shoulder diameter
	Minimum	Maximum	Minimum	Minimum	Maximum	Maximum
203	0.6692	0.6695	0.770	1.5748	1.5754	1.339
204	.7875	.7878	.940	1.8504	1.8510	1.614
205	.9844	.9847	1.140	2.0472	2.0479	1.811
206	1.1812	1.1815	1.340	2.4409	2.4416	2.205

TABLE V. Bearing shaft, shaft shoulder, housing, and housing shoulder diameters - Continued.

Bearing size	Shaft diameter		Shaft shoulder diameter	Housing diameter		Housing shoulder diameter
	Minimum	Maximum	Minimum	Minimum	Maximum	Maximum
207	1.3781	1.3785	1.530	2.8346	2.8353	2.598
208	1.5749	1.5753	1.730	3.1496	3.1503	2.913
209	1.7718	1.7722	1.930	3.3465	3.3474	3.110
210	1.9686	1.9690	2.130	3.5433	3.5442	3.276
211	2.1655	2.1660	2.410	3.9370	3.9379	3.580
212	2.3623	2.3628	2.717	4.3307	4.3316	3.976
213	2.5592	2.5597	2.913	4.7244	4.7253	4.370
214	2.7560	2.7565	3.110	4.9213	4.9233	4.567
215	2.9529	2.9534	3.307	5.1181	5.1191	4.764
216	3.1497	3.1502	3.622	5.5118	5.5128	5.039
217	3.3466	3.3472	3.819	5.9055	5.9065	5.433
218	3.5434	3.5440	4.016	6.2992	6.3002	5.827
219	3.7403	3.7409	4.213	6.6929	6.6939	6.221
220	3.9371	3.9377	4.409	7.0866	7.0876	6.614
221	4.1340	4.1346	4.685	7.4803	7.4815	7.008
222	4.3308	4.3314	4.875	7.8740	7.8752	7.402
303	0.6692	0.6695	0.906	1.8504	1.8510	1.614
304	0.7875	0.7878	1.024	2.0472	2.0479	1.811
305	0.9844	0.9847	1.140	2.4409	2.4416	2.280
306	1.1812	1.1815	1.340	2.8346	2.8353	2.620
307	1.3781	1.3785	1.590	3.1496	3.1503	2.940
308	1.5749	1.5753	1.813	3.5433	3.5442	3.310
309	1.7718	1.7722	2.000	3.9370	3.9379	3.560
310	1.9686	1.9690	2.270	4.3307	4.3316	4.000
311	2.1655	2.1660	2.468	4.7244	4.7253	4.380
312	2.3623	2.3628	2.688	5.1181	5.1191	4.750
313	2.5592	2.5597	2.968	5.5118	5.5128	5.190
314	2.7560	2.7565	3.156	5.9055	5.9065	5.560
315	3.9529	2.9534	3.380	6.2992	6.3002	5.940
316	3.1497	3.1502	3.550	6.6929	6.6939	6.250
317	3.3466	3.3472	3.840	7.0866	7.0876	6.620
318	3.5434	3.5440	4.060	7.4803	7.4815	7.000
319	3.7403	3.7409	4.290	7.8740	7.8752	7.380
320	3.9371	3.9377	4.488	8.4646	8.4658	7.940
321	4.1340	4.1346	4.685	8.8583	8.8595	8.307
322	4.3308	4.3314	4.875	9.4488	9.4500	8.898
324	4.7245	4.7251	5.276	10.2362	10.2374	9.685
326	5.1182	5.1189	5.827	11.0236	11.0248	10.315

3.5.2.1.5.1 Size and series. Unless otherwise specified (see 6.2), the bearings shall be of the size and series as shown in table B of figures 1 through 4, as applicable. Bearings at opposite ends of the motor shall be a different size. Grease lubricated ball bearings shall be selected so as to not exceed the nd_m value of 350,000, where n is rotating speed in r/min and d_m is bearing mean diameter in millimeters. If this nd_m value is exceeded, oil lubrication shall be provided.

3.5.2.1.5.2 Bearing mounting. Bearings shall be fully mounted in the end shields, not in a cartridge. Each bearing shall be secured on the shaft by a locknut and a lockwasher or by a locknut utilizing a nylon lock. For frames 215 and smaller, a beveled snap ring, type III, class 2 of MIL-R-21248, is acceptable in place of the locknut. Mounting of bearings methods are as follows:

(a) Fixed-free method. The fixed bearing shall be constrained axially in the housing by suitable housing and end cap shoulders. For gear motors, the fixed bearing shall be on the gear end. The free end bearing housing shall provide a clearance for thermally induced, axial shaft growth of not less than 0.020 inches for frames 182 through 326, 0.035 inches for frames 365 through 445 and 0.060 inches for frames 505 and larger.

(b) Opposed shoulder method. The shaft end play shall compensate for any relative movement that may occur between the shaft and the housing due to temperature differential between these parts. The end play shall be not less than 0.020 inches for frames 182 through 326 and 0.030 inches for frames 365 and larger. The end play shall be not greater than 0.045 inches for all frames (see 4.6.7).

3.5.2.1.6 Sleeve bearings. The lubricating disc shall clear all obstructions. Oil shall be removed from the disc by means of a brass scraper. The disc shall be attached to and rotate with the shaft, and shall deliver oil from the sump to the upper portion of the bearing for lubrication.

3.5.2.1.6.1 Oil disc. The disc shall be of uniform cross-section with a channel on the inside diameter to contain the oil while rotating. A brass scraper shall be mounted that shall remove oil from the channel of the disc for bearing lubrication.

3.5.2.1.6.2 Clearances. Oil clearances shall be as specified in table VI.

TABLE VI. Oil clearances.

Basic diameter of journal (inches)	Maximum diametrical oil clearance including shaft and bearing tolerances (inch)
1.000	0.004
2.000	.005
3.000	.007
4.000	.009
5.000	.010
6.000	.012
7.000	.014
8.000	.016
9.000	.018
10.000	.020

3.5.2.1.7 Brush holder support. The brush holder support shall be secured to prevent loosening of the support under shock or vibration (see 3.5.1.19.1 through 3.5.1.19.4).

3.5.2.1.8 Method of attaching fans to shaft. Where fans are not an integral part of the shaft, one of the following methods shall be used in attaching fans to the shaft:

(a) A key, shaft shoulder, and a nut with keyed lock washer.
(b) A key, shaft shoulders, and rings or tubing.
(c) A long key secured in a closed-end key seat with locked set screw secured on the key.
(d) A Woodruff key with a locked set screw secured on the key. The set screw shall not produce unbalance.
(e) A split fan with clamping bolts and key.

3.5.2.1.9 Thread cutting screws. Thread cutting (self-tapping) screws shall not be used to secure any part of the motor.

3.5.2.1.10 Securing terminal leads. The method of securing terminal leads shall be such that stress from outside the motor is not transmitted to electrical connections inside the motor. Unclamped, friction rubber bushings shall not be used to secure terminal leads. Sealing compounds for anchoring leads shall not be used (see 3.5.1.27.3).

3.5.2.1.11 Cable connectors. Connectors shall be of the solderless type in accordance with MIL-T-16366 (see 3.5.1.27.4).

3.5.2.1.12 Temporary air filters. When specified (see 6.2), motors shall operate when air intakes are covered by a filtering media (see 6.2) temporarily attached to the motor housing.

3.5.2.1.13 Dynamic balance. Unless otherwise specified (see 6.2), the degree of balance shall be precision balance as specified in table VII.

TABLE VII. Mechanical balance levels.

Motor speed (r/min)	Maximum allowable total amplitude (peak to peak)		
	Standard balance (inch)	Precision balance (inch)	Super-precision balance (inch)
3000-4000	0.001	0.0005	0.0002
1500-2999	.0015	.00075	.0003
1000-1499	.002	.001	.0004
999 and below	.003	.0015	------

3.5.2.2 Service C motors. Service C motors shall be marine type commercial motors. In addition to the general requirements of 3.5.1 through 3.5.1.38, service C motors shall meet the requirements of 3.5.2.2.1 through 3.5.2.2.4, 3.6, and the requirements of MIL-S-901 for grade B shock. When specified (see 6.2), service C motors for operation in severe environmental service condition such as exposure to occasional salt spray, splashing, salt laden atmosphere, or submergence shall be provided with a sealed insulation system.

3.5.2.2.1 Protection against corrosion. Service C motors shall be protected against corrosion in accordance with MIL-E-917.

3.5.2.2.2 Magnet wire. The magnet wire shall be round and of such size as to permit rewinding with round integral sized copper wire in accordance with J-W-1177.

3.5.2.2.3 Ball bearings. Ball bearings shall be replaceable with the types specified in 3.5.2.1.5. The bearings shall be mounted such that the axial movement of the shaft shall be not more than 0.045 inch, including bearing end play (see 4.6.7).

3.5.2.2.4 Dynamic balance. Unless otherwise specified (see 6.2), the degree of balance shall be standard balance as specified in table VII.

3.5.2.3 Pump motors. When specified (see 6.2), pump motors shall meet service A (see 3.5.2.1) or service C (see 3.5.2.2) requirements as applicable and shall be as follows:

(a) For dripproof protected pump motors, when an air intake at the pump end of the motor is provided, the air flow direction shall be at right angles to the shaft.
(b) Except for motors with submersible or watertight enclosures, pump motors shall have a slinger with guard on each motor shaft extension immediately outside the end shield to prevent entrance of water into the bearing housing. The slinger shall have an external diameter of not less than 1.5 times the shaft diameter and an axial clearance between the end shield and slinger not greater than 30 mils. The guard need not be furnished if the slinger end shield or the pump configuration will ensure that no

injury to personnel may result and no entrance of water into the bearing housing can take place. Balancing rings may also serve the function of a slinger if so constructed.

(c) The maximum value of full-load slip for 2-pole, centrifugal pump motors, 100 hp and above, shall not exceed 1.25 percent at the conclusion of continuous full-load heat run.

(d) Pump motors and their bearings shall be relubricable.

3.5.2.4 Nonmagnetic motors. When specified (see 6.2), nonmagnetic motors shall meet the service A requirements (see 3.5.2.1) and shall be as specified in 3.5.2.4.1 and 3.5.2.4.2.

3.5.2.4.1 Construction. Motors shall be as follows:

(a) Have not less than four poles.

(b) Have no protuberances of magnetic material, such as feet or supports.

3.5.2.4.2 Materials. Materials shall be as follows:

(a) Parts shall be of nonmagnetic material having a maximum relative permeability of less than 2 after fabrication.

(b) The use of ferromagnetic material shall be considered for the following parts only:

(1) Parts in the electrical magnetic circuits.

(2) Parts for which substitution of nonmagnetic materials could not be provided without impairing either the strength or satisfactory operation of the motor.

3.5.2.5 Motors for submarine service. When specified (see 6.2), motors for submarine service shall meet service A requirements (see 3.5.2.1) and be as specified in 3.5.2.5.1 through 3.5.2.5.13.

3.5.2.5.1 Enclosures. The enclosures shall be as specified in 3.5.1.8 or shall be special as specified (see 6.2) except that dripproof protected enclosures shall meet the requirements of MIL-STD-108 at 45 degrees from the vertical in lieu of 15 degrees.

3.5.2.5.2 Mounting. Horizontal motors shall be constructed for either deck mounting or overhead suspension. Dual ended, ventilated (air inlets in both end shields and air outlets in frame), dripproof protected, horizontal motors are acceptable provided a shield is constructed to meet the necessary dripproofness requirements when the motor is suspended from an overhead structure. This shield shall be provided when required (see 6.2). Tests on dual ended, dripproof protected, horizontal motors shall be conducted with the shield installed on the motor.

3.5.2.5.3 Feet. Unless otherwise specified (see 6.2), the feet shall be detachable and secured by means of bolts if by this arrangement the motor can be passed through a specified diameter round hatch. The bottom of the feet shall be machined to a finish of 100 to 125 microinches root mean square (rms). The bottom of the feet shall be blued in lieu of painting. Deviation from coplanarity of the feet shall not exceed the following:

Frame	By feeler gauge (inch)
182 - 326	0.002
365 - 445	.003
Above 445	.004

3.5.2.5.4 Terminal boxes. Except for symmetrical motors, means shall be provided for mounting the terminal box on either side of the frame. Internal leads shall be of sufficient length to allow connections to the terminal box on either side of the frame. On horizontal motors, the end shields shall be interchangeable, the frame shall be able to be turned end for end, and the rotor shall be reversible in the assembly. On vertical motors, mounting holes shall be symmetrical so that stator can be rotated 180 degrees on the mounting foundation.

3.5.2.5.5 Ball bearings. The requirements of 3.5.2.1.5 are applicable with the exception that bearings, their fit ups and other application requirements shall be in accordance with MIL-B-17931 and its application appendix.

3.5.2.5.6 Shafts. Keyways which extend up to the bearing seat shall be end milled. Keyways shall not extend under the bearing more than absolutely necessary and under no circumstances under the ball track.

3.5.2.5.7 Frames and end shields. The diameter bolt circle for the clearance holes of the end bracket shall have a tolerance not greater than 25 percent of the tolerance of the clearance holes. The angular position of these clearance holes shall have the same tolerance as the tapped holes in the frame.

3.5.2.5.8 Covers, plates, and hoods. The use of flat covers, plates, and hoods should be avoided. Enclosures shall be stiffened by the use of ribs, formed shaping, and similar measures. Natural frequencies of all major parts shall be greater than 1.4 times the maximum frequency of exciting forces most likely to force them into vibration, such as mechanical unbalance, magnetic effects, and fan blade effects.

3.5.2.5.9 Caution plate. A plate bearing the caution "LOW NOISE MOTOR - HANDLE WITH CARE" shall be attached to motor frame and shall be as specified in 3.5.1.34 (see figure 5).

3.5.2.5.10 Dynamic balance. Unless otherwise specified (see 6.2), the degree of balance shall be super-precision as specified in table VII.

3.5.2.5.11 Lubrication provisions. Except for motors with doubled sealed bearings, motors shall be relubricable and shall not require disassembly for relubrication. Grease cups, pipes, and drains shall be used when grease is a means of lubrication and relubrication of bearings is required. The grease cup shall not be mounted on the motor and the threaded hole used to attach the grease cup shall be provided with a pipe plug or cap. Grease inlet and drain passages shall be of minimum length and shall be cleanable without motor disassembly other than removal of any grease pipes. Grease pipes shall be removable without motor disassembly. Grease pipes, where used, shall be left on the motor; the end outermost from the motor shall be fitted with a pipe plug or cap. Pipe plugs or caps shall be accessible without motor disassembly. The grease inlet shall be

located on or above the horizontal centerline of the bearing housing for horizontal motors and at any location convenient to the grease chambers above the bearing for vertical motors. Grease outlets shall be located to afford maximum purging of grease during regreasing operation.

3.5.2.5.12 Interchangeability. Bearing caps, bearing cap fasteners, end bells, end bell fasteners, air baffles, removable fans and parts that affect lubrication that are physically interchangeable shall be functionally interchangeable. The above parts that are physically reversible shall be functionally reversible.

3.5.2.5.13 Special bearing preload. When special preload requirements are specified (see 6.2 and 30.3 of appendix B), the following shall be applicable:

(a) Selective fitting of bearing preload washers and springs shall be prohibited. Preload washers and springs shall meet the following (see 4.6.21):

(1) The preload washer or spring, after being fully compressed, shall be self-restoring to its original free height.
(2) The preload washer or spring, when compressed to the nominal design compression, shall produce a force within the range determined to be acceptable for the application.

(b) Parts not normally replaced that affect the dimensional allowance in the bearing housing for the preload washer or spring may be machined after initial assembly to achieve the appropriate allowance. It is acceptable for additional material to be designed into a part to provide an allowance for the above machining. After machining, the part shall be in accordance with the requirements of the affected part drawing.

3.5.2.6 Motors for low noise applications (surface ships only). Unless otherwise specified (see 6.2), motors for low noise applications (see 6.6.21) on surface ships shall meet service A requirements (see 3.5.2.1) and shall be as specified in 3.5.2.6.1 and 3.5.2.6.3.

3.5.2.6.1 Ball bearings. The requirements of 3.5.2.1.5 are applicable with the exception that ball bearings shall be in accordance with either MIL-B-17931 or FF-B-171, provided the FF-B-171 bearings are not preselected on the basis of special low noise requirements of fits and tolerances.

3.5.2.6.2 Shafts. Keyways which extend up to the bearing seat shall be end milled. Keyways shall not extend under the bearing more than absolutely necessary and under no circumstances under the ball track.

3.5.2.6.3 Dynamic balance. Unless otherwise specified (see 6.2), the degree of balance shall be super-precision in accordance with table VII.

3.6 Performance. Service A and C motors shall meet the requirements of 3.6.1 through 3.6.14.

3.6.1 Resistance. Average terminal to terminal winding resistance, corrected to 25°C, shall not differ from the value measured during first article testing by more than the percentage specified in table IX. The resistance balance (see 6.6.22) shall be as follows:

(a) For motors with average terminal to terminal winding resistance less than 0.1 ohms, corrected to 25°C, the resistance balance shall be not greater than plus or minus 2.5 percent.
(b) For motors with an average terminal to terminal winding resistance greater than or equal to 0.1 ohms, corrected to 25°C, the resistance balance shall be not greater than plus or minus 1.5 percent.

3.6.2 Lubrication. The lubrication system shall provide adequate lubrication of bearings for the specified mounting position (see 3.5.1.20). No suction of lubricant into the electrical windings shall occur. Conformance to 3.5.1.24.2.1 and 3.5.1.24.5.1 shall be demonstrated (see 4.6.4).

3.6.3 Noise.

3.6.3.1 Airborne noise. Unless otherwise specified (see 6.2), airborne noise of motors shall not exceed the limits specified in table VIII (see 4.6.5.1). Mufflers shall not be used with motors rated less than 200 hp. When specified (see 6.2), motors rated 200 hp and larger may use mufflers.

TABLE VIII. Airborne noise limits (sound pressure levels in decibels (dB) referenced to 20 micropascals (μPa)).

HP 3/	Enclosure	Synchronous speed (r/min)	Octave band center frequency (Hz)								
			31.5	63	125	250	500	1k	2k	4k	8k
1 through 5	All	All	68	68	67	57	56	53	48	48	44
7.5 through 25	All	1800 and less	66	66	62	61	61	58	52	47	44
7.5 through 25	All	1/ 3600	68	68	67	72	70	69	68	66	63
30 through 150	All	1800 and less	70	70	70	69	68	65	65	61	61
30 through 150	All	1/ 3600	73	73	73	73	73	68	68	65	63
Above 2/ 150	All	All	79	76	76	76	75	73	72	66	63

1/ Limits are established for the direction of motor rotation required by the driven auxiliary. No limits are defined for opposite rotation.
2/ Motors rated 200 hp and above may use noise kits when approved (see 6.8).
3/ For each speed rating, horsepower (hp), for the purposes of table VIII, is defined as the smallest value of rated hp applicable to a motor.

3.6.3.2 Structureborne noise.

3.6.3.2.1 Low noise surface ship applications. Unless otherwise specified (see 6.2), the structureborne noise for low noise surface ship applications (see 6.6.21) shall not exceed the limits specified in MIL-STD-740-2 for type II equipment at all frequencies except between 100 Hz and 160 Hz. For frequencies between 100 Hz and 160 Hz, the structureborne noise shall not exceed the limits specified in MIL-STD-740-2 for type II equipment by more than 5 decibels (dB) (see 4.6.5.2).

3.6.3.2.2 Submarine applications. Unless otherwise specified (see 6.2), structureborne noise of motors for submarines shall not exceed the limits specified in MIL-STD-740-2 for type III equipment (see 4.6.5.2).

3.6.4 Weight. Unless otherwise specified (see 6.2), motors shall conform to weight limitations as specified on figures 1 through 4 (see 4.6.9).

3.6.5 No-load input (induction motors only). The no-load amperes and watts (see 4.6.10) shall not differ from the values measured during first article testing by more than the percentages specified in table IX.

TABLE IX. Tolerance for no-load input and stator resistance.

HP	No-load input		Stator resistance at 25°C (percent)
	Amps (percent)	Watts (percent)	
All	± 10	+ 15	± 5

3.6.6 Pull-up torque, breakdown torque, locked-rotor torque, locked-rotor current, locked-rotor impedance, and slip (induction motors only). Motors shall meet the requirements for pull-up torque (see 6.6.13), breakdown torque (see 6.6.14), locked-rotor torque (see 6.6.15), locked-rotor current (see 6.6.16), locked-rotor impedance, and slip specified in 3.6.6.1 through 3.6.6.2.3 (see 4.6.11).

3.6.6.1 Single speed motors. Values specified herein apply only to squirrel cage induction motors (see 3.5.1.11).

3.6.6.1.1 Pull-up torque. The pull-up torque of designs A, B, and C continuous duty motors with rated voltage and frequency applied shall be not less than rated full-load torque. With rated voltage and frequency applied, the pull-up torque of design B7 motors shall be not less than 70 percent of full-load torque. With rated voltage and frequency applied, the pull-up torque of design FF motors shall be not less than 115 percent of full-load torque.

3.6.6.1.2 Breakdown torque. With rated voltage and frequency applied, breakdown torque of the motors shall be in accordance with the values specified in table X.

3.6.6.1.2.1 Design FF. With rated voltage and frequency applied, the breakdown torque of design FF motors shall be not more than 225 percent of full-load torque.

TABLE X. Breakdown torque.

HP	Synchronous speeds (r/min)	Breakdown torque Percent of full-load torque (min)	
		Design B and B7	Design C
1/2	720	200	--
	1200	275	--
3/4	900	220	--
	720 and lower	200	--
	1800	300	--
1	1200	265	--
	900	215	--
	720 and lower	200	--
	3600	250	--
1-1/2	1800	280	--
	1200	250	--
	900	210	--
	720 and lower	200	--
	3600	240	--
	1800	270	--
2	1200	240	--
	900	210	--
	720 and lower	200	--
	3600	230	--
	1800	250	--
3	1200	230	225
	900	205	200
	720 and lower	200	--
	3600	215	--
	1800	225	200
5	1200	215	200
	900	205	200
	720 and lower	200	--
	3600	200	--
	1800	215	190
7-1/2	1200	205	190
	900	200	190
	720 and lower	200	--

TABLE X. Breakdown torque - Continued.

HP	Synchronous speeds (r/min)	Breakdown torque Percent of full-load torque (min)	
		Design B and B7	Design C
10	3600	200	--
	1800 to 900	200	190
	720 and lower	200	--
15 to 25	All speeds	200	190
30 to 200	All speeds	200	190
250 and larger	All speeds	175	--

3.6.6.1.3 Locked-rotor torque.

3.6.6.1.3.1 Designs A and B. With rated voltage and frequency applied, the locked-rotor torque of design A and B motors shall be not less than the values specified in table XI.

3.6.6.1.3.2 Design C. With rated voltage and frequency applied, the locked-rotor torque of design C motors shall be not less than the values specified in table XII.

3.6.6.1.3.3 Design D. With rated voltage and frequency applied, the locked-rotor torque of design D, 4-, 6-, and 8-pole motors shall be not less than 275 percent of full-load torque.

3.6.6.1.3.4 Design F. With rated voltage and frequency applied, the locked-rotor torque of design F, 4- and 6-pole motors, rated 30 hp and larger, shall be not less than 125 percent of full-load torque.

TABLE XI. Locked rotor torque, designs A and B.

Motor hp	Synchronous speeds (r/min)						
	3600	1800	1200	900	720	600	514
1	175	250	165	130	130	115	110
1-1/2	170	235	160	130	125	115	110
2	160	215	155	130	125	115	110
3	150	185	150	130	125	115	110
5	140	175	150	125	120	115	110
7-1/2	135	165	150	125	120	115	110
10	130	160	140	125	120	115	110
15	130	150	135	125	120	115	110

TABLE XI. Locked rotor torque, designs A and B - Continued.

Motor hp	Synchronous speeds (r/min)						
	3600	1800	1200	900	720	600	514
20	130	150	135	125	120	115	110
25	130	150	135	125	120	115	110
30	125	140	135	125	120	115	110
40	120	140	135	125	120	115	110
50	120	140	135	125	120	115	110
60	105	140	135	125	120	115	110
75	105	125	125	125	120	115	110
100	100	110	125	120	115	115	110
125	100	110	125	120	115	115	-
150	100	100	120	120	-	-	-
200	70	80	100	100	-	-	-
250	70	80	100	100	-	-	-
Over 250	70	80	-	-	-	-	-

TABLE XII. Locked-rotor torque, design C.

HP	Synchronous speeds (r/min)		
	1800	1200	900
1	---	---	---
1-1/2	---	---	---
2	---	---	---
3	---	250	225
5	250	250	225
7-1/2	250	225	200
10	250	225	200
15	225	200	200
20 through 200	200	200	200

3.6.6.1.3.5 Design FF. With rated voltage and frequency applied, the locked-rotor torque of design FF motors shall be not less than 115 percent or more than 155 percent of full-load torque.

3.6.6.1.3.6 Design B7. With rated voltage and frequency applied, the locked-rotor torque of design B7 motors shall be not less than 70 percent of full-load torque.

3.6.6.1.4 Locked-rotor current. The locked-rotor current for 440-Vac motors with standard horsepower ratings shall be in accordance with the values specified in table XIII. For other than 440-Vac motors, the locked rotor current shall be proportional to the ratio of 440 volts divided by the applicable rated voltage. Motors shall withstand locked-rotor current at rated voltage for 20 seconds. For 440-Vac motors furnished in other than standard hp ratings, the maximum locked-rotor current shall be in accordance with the following equations:

(a) DPP enclosures:

Below 20 hp - I_{lr} = (7.69 x hp) + 7.8

Above 20 hp - I_{lr} = (7.61 x hp) - 1.7

(b) All other enclosures:

Below 20 hp - I_{lr} = (8.46 x hp) + 8.6

Above 20 hp - I_{lr} = (8.37 x hp) - 1.9

3.6.6.1.4.1 Design A. The locked-rotor current of design A motors shall meet the requirements of 3.6.6.1.4 except the locked-rotor current shall be not greater than the values specified in table XIII by more than 25 percent.

3.6.6.1.4.2 Design B7. The locked-rotor current of design B7 motors shall meet the requirements of 3.6.6.1.4 except the locked-rotor current shall be not greater than the values specified in table XIII by more than 5 percent.

3.6.6.1.4.3 Design FF. The locked-rotor current of design FF motors shall meet the requirements of 3.6.6.1.4 except the locked-rotor current shall be not greater than 67 percent of the values specified in table XIII.

3.6.6.1.5 Slip. Unless otherwise specified (see 6.2), design A, B, B7, C, and F motors shall have a slip at rated load of less than 5 percent, except for design A and B and B7 motors with 10 or more poles which shall a slip at rated load not greater than 6 percent. Design D motors shall have a slip at rated load between 5 and 13 percent of rated speed. (For 2-pole, TEFC pump motors 100 hp and greater see 3.5.2.3).

3.6.6.2 Multispeed motors. Unless otherwise specified (see 6.2), multispeed motors in which any of the speeds are obtained by reconnecting the windings or by separate windings shall be as specified in 3.6.6.2.1 through 3.6.6.2.3.

3.6.6.2.1 Two-speed motors. Locked-rotor current, torque, and slip requirements shall be the values specified in table XIV.

TABLE XIII. Locked-rotor current, amperes, maximum.

Designs B, C, and D 1/ 2/		
HP	Dripproof protected	All other enclosures
1	15.7	17.3
1.5	20.9	23.0
2	26.1	28.7
3	33.4	36.7
5	48	52.8
7.5	66.4	73.0
10	84.7	93.2
15	121	133
20	152	167

TABLE XIII. Locked-rotor current, amperes, maximum - Continued.

Designs B, C, and D 1/ 2/		
HP	Dripproof protected	All other enclosures
25	191	210
30	227	250
40	303	333
50	379	417
60	455	500
75	567	624
100	758	834
125	949	1,044
150	1,135	1,249
200	1,516	1,668
250	1,909	2,100
300	2,282	2,510
350	2,662	2,929
400	3,043	3,348
450	3,423	3,766
500	3,804	4,185

1/ Design C - 3 hp through 200 hp only, 1800, 1200, 900 r/min.
2/ Design D - Through 150 hp only, 1800, 1200, 900 r/min.

3.6.6.2.2 Two-speed design B7 motors. Breakdown torque requirements for both speeds of two-speed design B7 motors shall be as specified in table XIV. Locked-rotor current, locked-rotor torque, and pull-up torque for both speeds of two-speed design B7 motors shall be as specified in the following:

(a) Locked-rotor current shall be not greater than the values specified in table XIV by more than 5 percent.
(b) Locked-rotor and pull-up torque shall be not less than 70 percent of full-load torque.

3.6.6.2.3 Multispeed motors of more than two speeds. Motors with more than two speeds shall, for the highest and lowest speeds, meet the requirements of 3.6.6.2.1 or 3.6.6.2.2, as applicable. When required, locked-rotor current and torque requirements for all speeds, between highest and lowest, shall be as specified (see 6.2).

TABLE XIV. Locked-rotor current, locked-rotor torque, pull-up torque, and breakdown torque for multispeed motors, design B.

1- winding 2-speed (2-, 4-, 6-, 8-, 10-, and 12-pole)			
Speed characteristics	Constant torque	Variable torque	Constant hp
Locked-rotor current (maximum)			
High speed Low speed	10 percent over table XIII 10 percent over table XIII	20 percent over table XIII 10 percent over table XIII	10 percent over table XIII 10 percent over table XIII
Locked-rotor torque (percent full-load torque) (minimum)			
High speed Low speed	Table XI Table XI	Table XI 100	120 Table XI
Pull-up torque (percent full-load torque) (minimum)			
High speed Low speed	100 100	100 100	100 100
Breakdown torque (percent full-load torque) (minimum)			
High speed Low speed	Table X Table X	Table X 150	175 Table X
Slip (percent) (maximum) 1/			
High speed Low speed	5 5	5 5	5 5
2- winding 2-speed (2-, 4-, 6-, 8-, 10-, and 12-pole)			
Speed characteristics	Constant torque	Variable torque	Constant hp
Locked-rotor current (maximum)			
High speed Low speed	10 percent over table XIII 10 percent over table XIII	10 percent over table XIII 10 percent over table XIII	10 percent over table XIII 10 percent over table XIII

See footnote at end of table.

TABLE XIV. Locked-rotor current, locked-rotor torque, pull-up torque, and breakdown torque for multispeed motors, design B - Continued.

Locked-rotor torque (percent full-load torque) (minimum)			
High speed Low speed	Table XI Table XI	Table XI Table XI	Table XI Table XI
Pull-up torque (percent full-load torque) (minimum)			
High speed Low speed	100 100	100 100	100 100
Breakdown torque (percent full-load torque (minimum)			
High speed Low speed	Table X Table X	90 percent of table X Table X	90 percent of table X Table X
Slip (percent) (maximum) 1/			
High speed Low speed	5 5	5 5	5 5

1/ For 2-, 4-, 6-, and 8-pole only.

3.6.7 Synchronous motors. Synchronous motors shall make two starts in succession without damage to any part. Torques with rated voltage applied at rated frequency shall be not less than the percentages of full-load torque specified in table XV.

3.6.8 Load performance (synchronous motors). The load performance shall be in accordance with that established by the first article test (see 4.6.13.2).

TABLE XV. Normal torques - synchronous motors.

Speed (r/min)	HP	Power factor	Locked-rotor	Pull-in 1/ 2/	Pull-out 2/
500 to 1800	200 and below	1.0	100	100	150
	150 and below	0.8	100	100	175
	250 to 1000	1.0	60	60	150
	200 to 1000	0.8	60	60	175
	1250 and larger	1.0	40	60	150
		0.8	40	60	175
450 and below	All ratings	1.0	40	30	150
		0.8	40	30	200

1/ Based on normal WK2 of load.
2/ With rated exciting current applied.

3.6.9 Phase characteristic (synchronous motors). The load and no-load phase characteristic shall be in accordance with that established by the first article test (see 4.6.13).

3.6.10 Inclined operation. The mechanical balance of the motor shall not change, no pounding or grinding of the bearings shall occur, and the lubrication system shall meet the requirements of 3.6.2 (see 4.6.14).

3.6.11 Temperature rise. The requirements of 3.6.11.1 through 3.6.11.4 shall apply, as applicable (see 4.6.16).

3.6.11.1 Continuous duty. Motors rated for continuous duty (see 3.5.1.6) shall carry rated load continuously at the ambient temperature specified (see 3.5.1.3) without exceeding the allowable temperature rises in table XVI.

3.6.11.2 Intermittent duty. Motors rated for intermittent duty shall carry rated load for the time duration which will permit operation of the motor indefinitely at the ambient temperature and the cycle of load, no-load, and rest specified (see 3.5.1.6) without exceeding the allowable temperature rises in table XVI. Where intermittent operation is involved and no definite operating cycle can be given, a short-time duty motor of sufficient rating to meet the estimated load and duty cycle requirements shall be required.

3.6.11.3 Varying duty. Motors rated for varying duty shall carry rated load for the time duration which will permit indefinite operation of the motor at the ambient temperature and the cycle of varying loads specified (see 3.5.1.6) without exceeding allowable temperature rises in table XVI.

3.6.11.4 Short-time duty. Motors rated for short-time duty shall carry rated load which, starting at the ambient temperature, can be carried constantly for the period specified (see 3.5.1.6) without exceeding allowable temperature rises in table XVI.

TABLE XVI. Maximum temperature rises (°C) and measurement method[1/].

Maximum ambient temperature		40°C	50°C	65°C	70°C	80°C
Insulation class		F	F	F H N	F H N	H N
Item	Motor part					
1	Windings other than those in item 4:					
	(a) Dripproof protected, fan cooled and air over enclosures. Method 2[3/]	80	70	55 80 105	50 75 100	65 90
	(b) Others. Method 2[3/]	85	75	60 85 110	55 80 105	70 95

See footnotes at end of table.

TABLE XVI. Maximum temperature rises (°C) and measurement method[1/] - Continued.

Maximum ambient temperature		40°C	50°C	65°C	70°C	80°C
Insulation class		F	F	F H N	F H N	H N
Item	Motor part					
2	Cores and mechanical parts in contact with or adjacent to the insulation:					
	(a) Motors in 1(a). Method 1[2/]	70	60	45 70 95	40 65 90	55 80
	(b) Motors in 1(b). Method 1[2/]	75	65	50 75 100	45 70 95	60 85
3	Collector rings. Method 1[2/]	85	75	60 75 100	55 70 95	60 85
4	Bare copper winding and single layer field windings with exposed uninsulated surfaces:					
	(a) Motor in 1(a). Method 1[2/]	80	70	55 80 105	50 75 100	65 90
	(b) Motors in 1(b). Method 1[2/]	85	75	60 85 110	55 80 105	70 95
5	Bearing, ball[5/]. Method 1 or 3[2,4/]	50	40	35	30	20
	Bearing, sleeve.[5/] Method 3[4/]	50	40	- - - - -	- - - -	- -
	Bearing, oil sump. Method 1 or 3[2,4/]	40	30	- - - - -	- - - -	- -

1/ Squirrel-cage and mechanical parts (such as brush holders, brushes and pole tips) may attain such temperatures as will not injure the motor in any respect.
2/ As determined by temperature measurement method 1 of MIL-E-917.
3/ As determined by temperature measurement method 2 of MIL-E-917.
4/ As determined by temperature measurement method 3 of MIL-E-917.
5/ Bearing temperatures measured on bearing outer ring or babbitt.

3.6.12 Dielectric strength. Motors shall withstand dielectric test voltages specified in table XVII (see 4.6.17).

TABLE XVII. Dielectric test voltages.

Part	Test voltage	Minimum duration
Secondary windings of wound rotors:		
Nonreversing	1,000 plus twice normal induced voltage on open circuit.	1 minute
Reversing, while running at approximately normal speed by reversing the primary connections.	1,000 plus four times normal induced voltage on open circuit.	1 minute
Field windings of synchronous motors:		
To be started with the field short circuited	Ten times the excitation voltage, but not less than 2,500 nor more than 5,000 volts.	1 minute
To be started with the field open circuited and sectionalized	1.5 times the maximum r/min voltage which can occur between the terminals of any section but in no case less than 2500 volts or 10 times the rated excitation voltage per section, whichever is the larger.	1 minute
All others:		
Motors rated more than 600 volts	2,000 plus 2.25 times rated voltage.	1 minute
Motors rated 600 volts or less	1,000 plus twice rated voltage or 1,200 plus 2.4 times rated voltage	1 minute 1 second

3.6.13 Electrical balance. With balanced voltage applied, amperes in any phase at rated load shall not differ from the arithmetic average of the maximum and minimum phase amperes by more than 10 percent for motors rated 1-1/2 hp and under; by more than 7-1/2 percent for motors rated 2 and 3 hp; and by more than 5 percent for motors over 3 hp (see 4.6.18).

3.6.13.1 For submarine applications. The maximum deviation of any phase current from the average of all phase currents shall be not greater than 3 percent (see 4.6.18).

3.6.14 Efficiency. Efficiency testing applies to design A, B, and B7 continuous duty motors, only. Design A, B, and B7 continuous duty motors shall meet the requirements of 3.6.14.1 through 3.6.14.4 (see 6.3).

3.6.14.1 Single speed motors. Single speed design A and B7 motors shall have a minimum full-load efficiency as specified in table XVIII. Single speed design B motors shall have full-load efficiencies reduced by not more than 1 percentage point from that specified in table XVIII.

3.6.14.2 Multispeed motors. Multispeed design A and B7 motors shall have full-load efficiencies reduced by not more than 3 percentage points from that specified in table XVIII for the highest speed only. Multispeed design B motors shall have full load efficiencies reduced by not more than 4 percentage points from that specified in table XVIII for the highest speed only. Efficiencies for all other speeds need not be as specified in table XVIII.

3.6.14.3 Motors with shaft seals. Motors with shaft seals shall meet the efficiency requirements of 3.6.14.1 through 3.6.14.4 either with or without seals.

3.6.14.4 Non-standard hp ratings. Design A, B, and B7 motors furnished in hp ratings other than those specified in table XVIII shall have full-load efficiencies as specified in 3.6.14.1 through 3.6.14.3 for the next lower hp rating.

TABLE XVIII. Minimum motor efficiency.

Efficiency (percent)				
Enclosure	DPP		All other	
Sync. speed Rated hp	≥ 1200 r/min	≤ 900 r/min	≥ 1200 r/min	≤ 900 r/min
≥ 200	97.0	95.0	97.0	95.0
150	96.5	94.5	97.0	95.0
125	96.0	94.0	97.0	95.0
100	95.5	93.5	96.5	94.5
75	95.0	93.0	96.0	94.0
60	94.0	92.0	95.5	93.5
50	94.0	92.0	95.0	93.0
40	93.0	91.0	95.0	93.0
30	92.0	90.0	94.0	92.0
25	92.0	90.0	94.0	92.0
20	92.0	90.0	93.0	91.0
15	91.0	89.0	93.0	91.0
10	90.0	88.0	92.0	90.0
7.5	90.0	88.0	91.0	89.0
5	89.0	87.0	89.0	87.0
3	88.0	86.0	88.0	86.0
2	87.0	85.0	87.0	85.0
1.5	86.0	84.0	86.0	84.0
1	86.0	84.0	86.0	84.0

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Inspections.

4.2.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.3).
(b) Periodic inspection (see 4.4).
(c) Quality conformance inspection (see 4.5).

4.2.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed under the test conditions specified below; ambient conditions shall be within these ranges but need not otherwise be controlled:

(a) Temperature - 25 ± 15°C.
(b) Power input - rated voltage and frequency (see 3.5.1.2).
(c) Attitude - normal operating position except as directed herein.

4.2.3 Noncompliance. Any motor with one or more defect shall be rejected. In addition, if any motor fails to pass an inspection, the manufacturer shall notify the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of the product which can be corrected and which were manufactured with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the cognizant activity has been taken. In the event of failure after reinspection, the manufacturer shall notify the cognizant inspection activity of the failure.

4.3 Periodic inspection. Samples for periodic inspection shall be randomly selected as specified in table XIX. Periodic inspection shall consist of the inspections specified in table XX (see 6.3). Sampling for periodic inspection shall be based on the number of motors of identical design and rating offered in the previous 12 months. Sampling shall also be based on the number of motors of identical design and rating that were sampled in the previous 12 months. If a motor has been submitted for first article inspection in the same 12 months as additional motors of an identical design and rating offered for delivery, the motor shall be considered in figuring succeeding quantities for periodic sampling.

4.4 First article inspection. Prior to the offering of any identical production unit for acceptance by the Government, one motor shall have successfuly undergone first article inspection as described herein. First article inspection shall consist of the inspections specified in table XX (see 6.3). A complete first article inspection shall be required after any change in design, material, or process which affects the performance characteristics of the motor.

4.4.1 Sealed insulation system suitability inspection. Suitability shall be determined through qualification as described in 4.6.19.1. Once a sealed insulation system has been qualified as specified in 4.6.19.1, requalification is required in accordance with MIL-STD-2037.

4.5 Quality conformance inspection. Quality conformance inspection as specified in table XXI shall be performed on all motors offered for delivery on a contract or order (see 6.3).

TABLE XIX. Sampling for periodic inspection.

Number of Motors (Offered last 12 months)	Sample Size
1-12	1
13-25	2
26-50	3
51-90	4
91-150	5
151-280	6

TABLE XX. First article inspection.

Inspection	Requirement	Test method
Material (if specified)		
Service A	3.5.2.1.1	4.6.1
Service C	3.5.2.2	4.6.1
Assembly	Appendix A	4.6.2
Resistance (cold)	3.6.1	4.6.3

TABLE XX. First article inspection - Continued.

Inspection	Requirement	Test method
Lubrication	3.6.2	4.6.4
Noise		
Airborne	3.6.3.1	4.6.5.1
Structureborne	3.6.3.2	4.6.5.2
Mechanical balance		
Service A	3.5.2.1.13	4.6.6
Service C	3.5.2.2.4	4.6.6
End play		
Sleeve bearing motors	3.5.1.24.5.6	4.6.7.1
Ball bearing motors		
Service A	3.5.2.1.5	4.6.7.2
Service C	3.5.2.2.3	4.6.7.2
Effectiveness of enclosure: 1/		
All enclosures	3.5.1.8	4.6.8
Weight	3.6.4	4.6.9
No-load input (induction motors)	3.6.5	4.6.10
Pull up torque, breakdown torque, locked-rotor torque, and current (induction motors)	3.6.6	4.6.11
Load test (induction motors only)	3.5.1.12	4.6.12
Phase characteristic (synchronous motors)		
No-load test	3.6.9	4.6.13.1
Load test	3.6.8	4.6.13.2
Inclined operation (sleeve bearing and oil lubricated ball bearing motors only)	3.6.10	4.6.14
Shock 1/		
Service A	3.5.2.1	4.6.15
Service C	3.5.2.2	4.6.15
Heat run	3.6.11	4.6.16
Dielectric strength	3.6.12	4.6.17
Electrical balance	3.6.13	4.6.18
Sealed insulation system suitability 1/	3.5.1.33	4.6.19.1
Efficiency	3.6.14	4.6.20
Preload device (submarine motors with special pre-load requirements only)	3.5.2.5.13	4.6.21
Sealed insulation system-electrical	3.5.1.33	4.6.19.2
Inspection of packaging	5.0	4.7

See footnote at top of next page.

1/ These are one-time tests and need not be repeated once satisfactorily demonstrated unless either material or processes change.

TABLE XXI. Quality conformance inspection.

Inspection	Requirement	Test method
Group A		
Material (if specified)		
Service A	3.5.2.1.1	4.6.1
Service C	3.5.2.2	4.6.1
Assembly	Appendix A	4.6.2
Resistance (cold)	3.6.1	4.6.3
Lubrication	3.6.2	4.6.4
Preload device (submarine motors with special preload requirements only)	3.5.2.5.13	4.6.21
Group B		
Structureborne noise	3.6.3.2	4.6.5.2
Mechanical balance		
Service A	3.5.2.1.13	4.6.6
Service C	3.5.2.2.4	4.6.6
End play		
Sleeve bearing motors	3.5.1.24.5.6	4.6.7.1
Ball bearing motors	3.5.2.1.5 and 3.5.2.2.3	4.6.7.2
No-load input (induction motors)	3.6.5	4.6.10
Phase characteristic (synchronous motors)		
No-load test	3.6.9	4.6.13.1
Dielectric strength	3.6.12	4.6.17
Sealed insulation system - electrical	3.5.1.33	4.6.19.2

4.6 Test methods.

4.6.1 Materials. The Government may require material tests whenever it considers it necessary to ascertain that the quality of a material used is at least equal to the material specified herein and covered by the referenced specifications, or as shown on the manufacturer's drawing.

4.6.2 Assembly.

4.6.2.1 Service A motors. The inspections for service A motors shall be as specified in appendix A herein.

4.6.2.2 Service C motors. Each motor shall be visually examined to determine that construction and workmanship conform to the requirements specified herein. The fit of parts shall be examined to determine the interchangeability of parts which may require replacement during the service life of the motor.

4.6.3 Resistance (cold). With the motor not operating and at the ambient temperature, each terminal to terminal winding resistance (cold) and the ambient temperature shall be measured. In the case of wound rotor induction motors, the resistances between collector rings and the temperature of the rotor windings shall also be measured.

4.6.4 Lubrication. The effectiveness of the lubricating system with the motor in its normal position shall be observed during the progress of the other tests, or by special test, as applicable (see 6.3). Oil rings of sleeve bearing motors shall turn freely and there shall be no foaming of the oil. Lubricants similar to those required for service operation shall be used. It shall be demonstrated that the motor lubrication is satisfactory, that the specified limitations of the bearing temperatures have not been exceeded, and that there is no suction of lubricant into the electrical windings under any operating condition.

4.6.5 Noise.

4.6.5.1 Airborne noise. Airborne noise shall be measured using the instrumentation and procedures of MIL-STD-740-1 with the exception that noise levels at the measurement positions shall be averaged. Motors shall be tested while operating at no load with rated voltage and frequency applied (see 6.3).

4.6.5.2 Structureborne noise. Unless otherwise specified, motors with structureborne noise requirements shall be tested at no-load with rated voltage and frequency in accordance with MIL-STD-740-2 with the exception that quality conformance testing shall be conducted at the transducer location which produced the maximum response during first article testing (see 6.3).

4.6.6 Mechanical balance. The mechanical balance of the completely assembled motor and any special attachments (such as brakes or overspeed switches) shall be measured. Motors shall be tested at no-load, except motors having a varying speed (but not a definite no-load speed) shall be tested at their highest rated speed. The method of test shall be as follows:

(a) The motor shall be mounted on an elastic mounting so proportioned that the up and down natural frequency shall be at least as low as one-quarter of the maximum operating speed of the motor. To accomplish this, the elastic mounting shall be deflected downwards at least by the following amounts due to the weight of the motor. The deformation of the mounting shall be not more than one-half the original height of the elastic element.

R/min	Compression (inch)
900	1
1,800	1/4
3,600	1/16
7,200	1/64

(b) Prior to assembly, the rotor shall be balanced in a balancing machine with or without bearings. If balanced with bearings, the inside bearing caps shall be supported on the shaft during balancing. Balancing shall be accomplished in two planes for both static and dynamic correction.
(c) A vibration indicator shall be used.
(d) With the motor running at rated input voltage and frequency and the axis of the shaft in its normal position, the amplitude of vibration of the bearing housing in the direction giving the maximum amplitude shall be measured and recorded. The motor shall be balanced with one-half standard key in keyway (that is, a key of full length flush with the top of the keyway, where applicable).

4.6.7 End play.

4.6.7.1 Sleeve bearing motors. The end play of horizontal sleeve bearing motors shall be measured while at standstill by alternately pressing and releasing the rotor shaft at each end.

4.6.7.2 Ball bearing motors. The end play of ball bearing motors shall be determined by clamping an indicator to the motor frame and measuring axial shaft movement while applying an axial force to the shaft. The force shall not exceed 150% of the weight of the rotor assembly. The shaft shall be moved through its free travel and readings shall be taken. For heavy rotors, the motor may be lowered onto its shaft in a vertical position and the weight of the motor released slowly onto the shaft and displacement measured. Enough weight shall be released to support the motor without distorting the end shields. The process shall be repeated to confirm measurements.

4.6.8 Effectiveness of enclosure. Enclosed motors shall be tested in accordance with MIL-E-2036 and MIL-STD-108 except as follows:

(a) The drip test for a dripproof protected enclosure is not required.

4.6.9 Weight. The weight of motor and rotor shall be measured and shall conform to 3.6.4.

4.6.10 No-load input (induction motors only). Measurements of line volts and amperes, watt inputs, and rotational speed shall be taken. The motor shall be run for a minimum of 1 hour to allow bearing losses to become constant before any readings are taken. Where the rotor of the motor is supported by the bearings of the driven auxiliary, this test may be conducted with the motor driving the auxiliary with the auxiliary unloaded.

4.6.11 Pull-up, breakdown, and locked-rotor torque and current (induction motors).

4.6.11.1 Test with motor operating at rated voltage. For motors rated at 60 horsepower or less, pull-up and breakdown torque and locked-rotor current and torque shall be measured with the motor operating at rated voltage. For motors rated in excess of 60 horsepower, testing should be performed at rated voltage with the exception that locked-rotor torque and current may be measured with the

motor operating at less than rated voltage as specified in 4.6.11.2 if testing at rated voltage would exceed the kVA limits of the test facility. The collector rings of wound rotor induction motors shall be short circuited during the test. Readings of voltage, current, watts, and torque shall be taken. For locked-rotor torque and current test, the locked-rotor condition shall be maintained for 20 seconds at rated voltage unless locked-rotor torque and current values are obtained by 4.6.11.2. When locked-rotor torque and current values are obtained from tests at less than rated voltage, the locked-rotor capacity shall be demonstrated by 4.6.11.2. Tests shall be initiated with motor at room ambient temperature.

4.6.11.2 Test with motor operating at less than rated voltage. Locked-rotor torque and current values shall be obtained with motor operating at the maximum kilovoltamperes (kVA) available at rated frequency. If the locked-rotor current varies with rotor position, the rotor shall be locked in the position where the locked-rotor current is equal to the mean of the maximum and minimum values. Readings of input voltage, current, watts, and torque values. The test shall be repeated at voltages producing approximately half and one-quarter of the locked-rotor current measured at maximum kVA. Input voltage, current, watts, and torque shall be measured. The proportion of current shall be adjusted such that the minimum locked-rotor current shall be not less than the full load motor current at rated load. The locked-rotor current, corrected to rated voltage, shall be determined by the following equations:

For enclosed rotor slots:

$$I_{lr} = I_1 \times (V_r/V_1)^{\beta}$$

where:

$$\beta = 0.7\alpha + 0.35$$

and

$$\alpha = \log(I_3/I_1)/\log(V_3/V_1)$$

For semi-enclosed and open rotor slots:

$$I_{lr} = 1.04 \times I_3 \times (V_r/V_3)^{\sigma}$$

where:

$$\sigma = 1.05\sigma_2 - 0.35(\sigma_1 - 1) \quad \text{for} \quad \sigma_2 > \sigma_1$$

or

$$\sigma = 0.7\sigma_2 + 0.35 \quad \text{for} \quad \sigma_2 \leq \sigma_1$$

and

$$\sigma_1 = \log(I_2/I_1)/\log(V_2/V_1)$$

$$\sigma_2 = \log(I_3/I_2)/\log(V_3/V_2)$$

The locked-rotor torque, corrected to rated voltage, shall be the minimum of the three values determined by the following equation:

$$T_{lr} = T_m \times (V_r/V_m)^{\beta}$$

where:

$$\beta = \log(T_m/T_n)/\log(V_m/V_n)$$

and

$$m = 3,\ n = 2;\quad m = 3,\ n = 1;\quad m = 2,\ n = 1$$

To conform to the requirement to lock the rotor for 20 seconds at rated voltage, the rotor shall be locked at reduced voltage, V3, for a time in seconds determined by the following equation:

$$t_{LR} = 20 \times (V_r \times I_{1r})/(V_3 \times I_3)$$

The values for the above equations are:

I_{1r} = locked-rotor current at rated voltage.
I_3 = locked-rotor current measured at maximum KVA of test facility.
I_2 = measured locked-rotor current intermediate to I3 and I1.
I_1 = lowest value of measured locked-rotor current, not less than rated current.
V_r = rated voltage.
V_3 = measured locked-rotor voltage at maximum kVA of test facility.
V_2 = measured locked-rotor voltage associated with I2.
V_1 = measured locked-rotor voltage associated with I1.
T_{1r} = locked-rotor torque at rated voltage.
T_3 = measured locked-rotor torque at maximum kVA of test facility.
T_2 = measured locked-rotor torque associated with locked-rotor voltage V2.
T_1 = measured locked-rotor torque associated with locked-rotor voltage V1.
t_{LR} = period of time, in seconds, with rotor locked at voltage, V3.

4.6.12 Load test (induction motors only). With the motor operating at rated voltage and frequency, simultaneous measurements of each line to line voltage, frequency, amperes in each phase, rotational speed, and input watts shall be taken at 0, 1/4, 1/2, 3/4, 4/4 and 5/4 of rated hp. The hp load may be determined by current or watt input or by torque. The motor shall be at approximately its normal operating temperature during these tests.

4.6.13 Phase characteristic (synchronous motors only).

4.6.13.1 No-load test. The no-load test consists of taking a series of measurements of armature amperes, field amperes, and field voltage as the field current is varied from zero to a value that produces 150 percent of rated armature amperes. A measurement of amperes in all phases shall be taken with zero field. Sufficient measurements to plot a "vee curve", that is, armature amperes against field amperes, shall be taken. The watts input at the minimum value of stator amperes shall check the sum of the stator copper, core, friction, and windage losses. This test shall be conducted at rated voltage and rated frequency.

4.6.13.2 Load characteristics test. The load characteristics test shall be similar to the no-load test except that measurements need not be obtained for zero field. Unless otherwise specified (see 6.2), this test shall be conducted under rated load conditions.

4.6.14 Inclined operation (sleeve bearing and oil lubricated ball bearing motors only). Under each of the positions of inclination specified in 4.6.14.1 and 4.6.14.2, the motor shall be run for a period of not less than 30 minutes for surface ship motors and 1 hour for submarine motors. This test may be made on the combined motor and driven auxiliary. The motor or combined motor-driven auxiliary shall be run at not less than its maximum service speed, and the driven auxiliary need not be loaded. During the progress of these tests it shall be ascertained that the mechanical balance is as good as it was in the normal horizontal position, that there is no pounding or grinding at the bearings, and that the lubrication is satisfactory. If the motor is provided with oil-ring lubrication, it shall be ascertained that the rings do not rub or strike against the sides or ends of the oil well, that they do not "dance" or show pronounced irregularity of movement, and that the shaft does not sling oil into the motor. For submarine motors, the bearing or lubricating oil temperature at the completion of test shall be measured. Additionally, the suitability of the motor for operation when a ship is rolling 45 degrees for surface ships and 60 degrees for submarine motors to either side shall be determined by inspection of design.

4.6.14.1 Horizontal motors. The inclination test positions for horizontal motors shall be as follows:

(a) Surface ship motors:

(1) Shaft inclined 15 degrees, front end low.
(2) Shaft inclined 15 degrees, rear end low.
(3) Shaft horizontal, motor base tilted 15 degrees to the right.
(4) Shaft horizontal, motor base tilted 15 degrees to the left.

(b) Submarine motors inclination test shall be the same as in (a) except that inclinations shall be 45 degrees.

4.6.14.2 Vertical motors. Vertical motors shall be tested by inclining them to an angle of 15 degrees for surface ship motors and 45 degrees for submarine motors from their normal position, in any direction (that direction which imposes the most severe condition, if there is any dissymmetry) and for a period of 30 minutes for surface ship motors and 1 hour for submarine motors. This test may be made on the combined unit used for the special operating test. Vertical motor-driven auxiliaries shall be tested by inclining them to an angle of 15 degrees for surface ship units and 45 degrees for submarine units from their normal position, in each of four different directions; namely, forward, backward, to the right, and to the left. Observations shall be made as specified in 4.6.14 for horizontal motors and combined motor-driven auxiliaries.

4.6.15 High-impact shock test. Tests for lightweight motors shall be nine blows delivered while the motor is operating under no load at nominal speed (see 6.3). An additional nine blows shall be delivered with the motor stationary; separate motors may be submitted for each series of nine blows if desired by the contractor. Tests specified in MIL-S-901 under group I and group III in the horizontal and inclined orientation for medium weight motors shall be conducted with the motor running under no load at nominal speed. Tests under group II shall be with the motor stationary. For inclined orientation, medium weight motors

shall be mounted with the motor shaft axis inclined and shaft extension up. Separate motors may be submitted for each series of three blows if desired by the contractor. Tests shall be as specified in MIL-S-901 and with other features of the test as follows:

(a) Required type of shock test. Type A, B, or C as specified (see 6.2).
(b) Weight designation of the shock test (as required by the motor). Motors weighing 250 pounds or less shall be tested on the lightweight shock testing machine. Motors weighing in excess of 250 pounds and up to 6,000 pounds shall be tested on a medium weight shock testing machine. Motors weighing over 6,000 pounds shall be tested on a floating shock test platform. When a motor shaft supports a part of a driven auxiliary, such as a pump impeller or a clutch-type coupling, the motor shall be shock tested with the shaft loaded with the part or with an equivalent weight for that part.
(c) Required class of equipment. Unless otherwise specified (see 6.2), class I.
(d) Required grade of equipment. Grade A for service A motors or grade B for service C motors (see 6.2).
(e) Method of mounting on shock-testing machine. Mounting adapters shall be as shown on the applicable figures of MIL-S-901.

4.6.15.1 Post-shock analysis. Following completion of the shock test, the following examinations shall be performed on the motor in the order given below:

(a) Visual inspection (external). Service A and C motors shall be visually inspected without disassembly for breakage, distortion, deformation, and dislocation of any parts.
(b) Heat run. Service A motors shall be operated at full load (at rated speed) with rated input voltage and frequency applied for not less than 4 hours. Bearing and oil temperature rises shall be determined as specified in 4.6.16. During this test, any unusual motor noises (e.g. squeals, grinding or pounding) shall be noted.
(c) Dielectric strength. For service A and C motors, a dielectric strength test as specified in 4.6.17 shall be performed immediately following the heat run. However, the applied voltage shall be 65 percent of the values in table XVII.
(d) Internal inspection. Service A motors shall be disassembled and inspected thoroughly for damage (such as breakage, distortion, deformation, or dislocation of parts). The extent of disassembly shall be sufficient to observe the condition of all parts including, be not limited to, the structure, bearings and winding. The causes of any increase in motor airborne noise shall be determined.

4.6.15.2 Failure to perform principal functions. Any of the following shall be cause for rejection of the motor:

1. Service A motors.

(a) Breakage of any parts, including mounting bolts.
(b) Appreciable distortion or dislocation of any parts such as mounting feet, poles, coils, brushes, and bearings.
(c) Values of speed differing by more than 1 percent of the preshock test values, and no-load input watts increasing by more than 5 percent. If no-load watts decrease by more than 10 percent, this does not constitute a failure, but rationale shall be provided explaining this reduction.
(d) A mechanical imbalance of more than two times the applicable value specified in table VII.
(e) Either a bearing or oil temperature rise or both in excess of that permitted in table XVI.
(f) Any unusual motor noises (e.g. squeals, grinding or pounding) when operating. The cause of such noise shall be determined.
(g) Insulation failures during the dielectric strength test of 4.6.15.1(c).

2. Service C motors.

(a) The motor comes adrift during exposure to HI shock. Motor parts come adrift with the exception of parts that remain within the motor.
(b) Insulation failures during the dielectric strength test of 4.6.15.1(c).

4.6.15.3 Disposal of shock-tested motors. Motors which have failed to pass the high-impact shock test shall not be acceptable, either as a whole or in any of the parts. However, motors which have passed the high-impact shock test shall be considered acceptable as an item in the contract, provided the post-shock tests are passed and the mechanical corrective measures below are accomplished. Minor deformations shall be those which do not cause unqualified rejection of the design under the high-impact shock test but are in excess of the dimensional tolerances specified on the applicable motor drawing.

(a) Mounting flanges connecting directly to the driven auxiliary shall be replaced in the event of minor deformation.
(b) Minor deformations affecting alignments (including alignments with the auxiliary) shall be corrected.
(c) All ball bearings shall be replaced.
(d) Service C motors shall be restored to operational condition and shall be inspected as specified in 4.6.15.1(b) and (d).

4.6.15.4 Shock extension. Motor shock test acceptance may be extended upon approval (see 6.3, 6.8 and appendix D), based on the following:

(a) If the acceptance of the tested motor is based on a type A (combined motor and auxiliary) test, acceptance may be extended to the same motor when applied to a different auxiliary if the accepted and proposed motor-auxiliaries employ a flexible coupling and the auxiliaries are of the same basic type; for example, pumps or fans.

(b) Shock acceptance of a motor based on a type A test is not extendable to a different motor.
(c) Shock acceptance of a motor based on a type B (motor only) test may be extendable to another motor based on the following:

(1) The core length and shaft extension of the accepted motor shall be not less than that of the motor proposed for extension.
(2) The shaft extensions of the accepted and proposed motors shall have similar configurations. The shaft height, "d" dimension (see figures 1 through 4), shall be identical.
(3) The motor configurations shall be similar.

4.6.15.5 Waiver. Where the motor will be shock tested as part of an overall package, shock test of the motor alone is not required.

4.6.16 Heat-run test. The heat-run test for motors shall utilize embedded thermocouples in accordance with the following and methods 1 and 2 of MIL-E-917 for the first article test. Periodic tests may be in accordance with method 2 of MIL-E-917. The heat-run test for continuous duty motors shall be in accordance with the following:

(a) Rated motor load - 100 percent.
(b) Voltage and frequency - rated.
(c) Time - until motor temperatures are constant.

Motor load may be obtained by maintaining the current or watt input corresponding to rated motor hp output.

4.6.16.1 Details of temperature tests. Normal load heat runs on continuous duty motors shall be continued until constant temperatures have been attained in all parts of the motor. For motors having several continuous ratings, the heat run shall be conducted using the rating giving the highest temperature rises. In cases where the highest temperature rises cannot be determined prior to the test, the motor shall be tested separately for each rating. Temperature measurements by thermocouple shall be used during the progress of the heat run to determine when the constant operating temperature has been reached. It shall be considered that constant temperatures have been reached when at least three consecutive readings taken at 15-minute intervals show no increase in the temperature in any part of the motor, when adjusted for changes in ambient temperature. The winding temperature rise shall then be determined in accordance with the procedures for method 2 of MIL-E-917. The bearings' temperature rise shall be determined in accordance with the procedures of methods 1 or 3.

4.6.16.2 Duration of temperature test. The duration of the temperature test of a motor with a short-time or overload requirement shall be the time specified for that rating. Intermittent and varying duty motors shall be tested at the specified duty cycle. In lieu thereof, the motors may be tested as short-time duty motors of sufficient rating to meet the actual load requirements.

4.6.16.3 Use of temporary air filters. When temporary air filters are to be used, the tests of 4.6.16.1 shall be repeated with the filter media specified (see 3.5.2.1.12) attached to the air intakes. Three thicknesses of filter media shall be used to simulate a loaded or dirty filter. Temperature limits of table XVI shall apply.

4.6.16.4 Heat run measurements. The following measurements shall be made for each heat run test:

(a) Motor input voltage and current, watts and revolutions per minute.
(b) Motor output power (may be calculated using current, torque, or watt inputs).
(c) Temperatures measured concurrently as follows:.

1. Motor parts as required in table XVI.
2. Room ambient.

4.6.16.5 Measurement of temperature rise. The temperature rise of each motor component part shall be determined immediately at the conclusion of the heat run. Temperature rise (see table XVI) shall be determined in accordance with method 1 (thermometer), method 2 (resistance), and method 3 (embedded detector) of MIL-E-917. In determining temperature rise, no correction shall be made for barometric pressure, humidity, or for any differences in heat transfer characteristics between the test ambient temperature and the maximum design ambient temperature.

4.6.17 Dielectric tests. The dielectric test shall be conducted after all other tests have been completed. The frequency of the testing voltage shall be not less than 60 Hz and shall approximate a sine wave. If the insulation resistance of the windings is known to be lower than specified, due to dirt or moisture or damage to windings, this shall be remedied before the application of the dielectric test voltage. The dielectric test shall be conducted on the completely assembled machine and not upon individual parts. An exception is made in case of repair parts which require dielectric test; for example, repair coils and repair rotating elements with insulated windings. In the case of motors using capacitors, the dielectric test on the motor may be conducted with the capacitor disconnected. The capacitor shall be given a separate dielectric test according to the rating of the capacitor used.

4.6.17.1 Measurement of test voltage. The measurement of the voltage used in dielectric tests shall be made by the voltmeter method whereby the instrument derives its voltage from the high-volt circuit either directly or by means of a voltmeter coil placed in the testing transformer, or through an auxiliary ratio transformer. In any case, if the capacitance of the machine to be tested is such as to cause wave distortion, the testing voltage shall be checked by a crest-voltage meter. If the crest-voltage meter is calibrated in crest volts, its reading shall be reduced to the corresponding rms sinusoidal value by multiplying by 0.707.

4.6.17.2 Points of application. Test voltage shall be successively applied between each electric circuit and all other electric circuits and metal parts grounded. Test voltage shall be applied in such a manner as to preclude the possibility of pitting the bearings in case of insulation failure. Voltage need not be applied between stationary and rotating windings.

4.6.18 Electrical balance. Line currents measured during the heat run test of 4.6.16 shall be used to demonstrate conformance to the electrical balance requirement of 3.6.13.

4.6.19 Sealed insulation system.

4.6.19.1 Sealed insulation system suitability. Prior to motor delivery, suitability of the sealed insulation system shall be demonstrated by the manufacturer through qualification in accordance with MIL-STD-2037. Upon demonstration of compliance with MIL-STD-2037, NAVSEA will issue a letter certifying the manufacturer as qualified. This letter shall be evidence of suitability for motors with a sealed insulation system (see 6.3).

4.6.19.2 Sealed insulation system - electrical. Sealed insulation systems shall be tested as follows:

(a) Insulation resistance (submergence). Each wound assembly including lead connections shall be submerged for 24 hours in fresh water with a minimum conductivity of 500 microsiemens/cm and a maximum surface tension of 31 dynes/cm at 25°C. Wound assemblies with commutators or slip rings should be submerged to a point where the water level is as close as possible to the uninsulated areas.

(1) The conductivity of the fresh water may be increased by adding bicarbonate of soda to the water (salts are not used due to corrosive effects). The surface tension may be adjusted by addition of a wetting agent such as Triton X-100 (manufactured by Rohm and Haas, Philadelphia, PA) or equivalent.

(2) The dry insulation resistance should be verified to be not less than 1000 megohms prior to submergence. While submerged, as a minimum, the insulation resistance shall be measured after 1 minute, 10 minutes, 1 hour, and 24 hours. Insulation resistance shall also be measured immediately after removal from submergence, and one hour after removal from submergence. Values of insulation resistance shall be corrected to 25°C and shall be in accordance with 3.5.1.33. Insulation resistance shall be measured using a 500 Vdc potential between the windings and ground.

(b) Insulation resistance (dry). Apply a test potential of 500 Vdc between the windings and ground until a stable reading is obtained, but not less than 1 minute. Measure the insulation resistance and the average winding temperature. If the winding is at ambient temperature, a measurement of the ambient temperature

may be substituted for that of the winding temperature. A megohm bridge or meter shall be used with a range of 0.1 to 1,000,000 megohms. Insulation resistance measurements shall be corrected to 25°C and shall be as specified in 3.5.1.33.

(c) Surge comparison. A commercial surge comparison tester with a minimum operating voltage range of 0 to 5000 volts shall be used. The comparison tester shall be connected to the stator windings in and the test voltage shall be adjusted to 5000 volts in accordance with the facilities procedure approved in accordance with MIL-STD-2037. The test shall be repeated after each rearrangement of the test lead connections to the stator so that all possible combinations of the phases are tested (compared).

4.6.20 Efficiency. The efficiency test shall be conducted as specified in appendix C (see 6.3).

4.6.21 Preload device (for submarine motors with special preload requirements see 6.2). The uncompressed length of the preload device shall be measured before and after being fully compressed. The force required to compress the preload device shall be measured for the nominal design value of compression associated with the preload device's intended application.

4.7 Inspection of packaging. Samples packages and the inspection of the packaging (preservation, packing and marking) for shipment, stowage and storage shall be in accordance with the requirements of section 5 and the documents specified herein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging or preparation for delivery requirements of referenced documents listed in section 2, see 6.7.)

5.1 General.

5.1.1 Navy fire-retardant requirements.

(a) Lumber and plywood. Unless otherwise specified see 6.2), all lumber and plywood including laminating material used in shipping container construction member, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Levels A and B - Type II - weather resistant.
- Category 1 - general use.

Level C - Type I - non-weather resistant.
- Category 1 - general use.

(b) Fiberboard. Fiberboard used in the construction of unit containers shall conform to the class-domestic/fire retardant or class-weather resistant/fire retardant material requirements of ASTM D 4727, as specified (see 6.2).

5.2 Preservation, packing and marking. Motors shall be preserved level A or C and packed level A, B or C as specified (see 6.2) and marked in accordance with MIL-E-16298 and shall include bar codes and applicable packaging acquisition options therein as specified (see 6.2).

5.3 Special requirements (submarine motors).

(a) The method of mounting each motor within its shipping container or handling device shall insure the integrity of the requirements of MIL-STD-740.
(b) In addition to the marking specified in 5.2, marking of shipping containers and handling devices for motors shall be in accordance with MIL-STD-740.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. AC, 60-Hz, integral-hp motors conforming to this specification are intended for use with driven auxiliaries on board Naval ships.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Service (see 1.2).
(c) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(d) If first article inspection is required (see 3.1).
(e) Duplex bearing life calculation, if other than as specified (see 3.2).
(f) Voltage/Frequency (see 3.5.1.2).
(g) Ambient operating temperature (see 3.5.1.3).
(h) Duty (see 3.5.1.6). If other than continuous duty, specify the following duty cycle as applicable:

(1) Number of starts.
(2) Number of plug stops.
(3) Number of dc dynamic braking stops.
(4) Number of plug reversals.
(5) Connected inertia at shaft speed.
(6) Starting torque.
(7) Acceleration torque and time limits.
(8) Periods of running.
(9) Condition of loads during running, including no load conditions.

(10) For submersible motors, the period of operation in air.
(11) Time frame for one complete duty cycle, (1) through (10).
(12) The maximum periods and sequence of times the duty cycle (1) through (10) will be imposed in a 24-hour period.

(i) Whether thermal protection is required and if the number of sensors is other than specified (see 3.5.1.7).
(j) Submersible enclosures, depth of submergence for shaft seals (see 3.5.1.8).
(k) Speed (see 3.5.1.9).
(l) HP (see 3.5.1.10).
(m) Type and design (see 3.5.1.11).
(n) Mounting (see 3.5.1.20).
(o) If rotation of end shields is required (see 3.5.1.21).
(p) If shaft extension differs from figures 1-4 (see 3.5.1.23).
(q) Bearing type, if other than ball (see 3.5.1.24.1)
(r) When sleeve bearings are required (see 3.5.1.24.5).
(s) Size of conduit openings for motors rated above 250 hp (see 3.5.1.26).
(t) Class of conventional insulation (see 3.5.1.32.1)
(u) If nonreversible motors are required (see 3.5.1.36).
(v) Whether identification plate marking is other than as specified (see 3.5.1.34.1).
(w) If bearing size and series is other than as specified (see 3.5.2.1.5.1).
(x) If temporary air filter is required and filtering media (see 3.5.2.1.12).
(y) Degree of balance, if other than as specified (see 3.5.2.1.13, 3.5.2.2.4, and 3.5.2.6.3).
(z) If sealed insulation system is required for service C motors (see 3.5.2.2).
(aa) If pump motor is specified (see 3.5.2.3), specify the following:

(1) Service (see 3.5.2.3).

(bb) Nonmagnetic motors (see 3.5.2.4).
(cc) If motor for submarine service is specified (see 3.5.2.5) specify the following:

(1) If enclosure is other than specified (see 3.5.2.5.1).
(2) If drip shield is required (see 3.5.2.5.2).
(3) If feet are other than specified (see 3.5.2.5.3).

(dd) When dynamic balance is other than as specified (see 3.5.2.5.10).
(ee) If submarine motor has a special bearing preload (see 3.5.2.5.13, 30.3 of appendix B).
(ff) If motor for low noise application is specified (see 3.5.2.6).
(gg) When airborne noise is other than as specified (see 3.6.3.1).
(hh) If noise muffler is required (see 3.6.3.1).
(ii) Structureborne noise limits, if other than specified (see 3.6.3.2.1 and 3.6.3.2.2).
(jj) Weight limitations, if other than specified (see 3.6.4).
(kk) Whether slip is other than specified (see 3.6.6.1.5).

(ll) Multispeed motor requirements, if other than specified (see 3.6.6.2).
(mm) Locked-rotor current and torque requirements for intermediate speeds of multispeed motors (see 3.6.6.2.3).
(nn) If load test is to be conducted under conditions other than as specified (see 4.6.13.2).
(oo) Shock test:

(1) Type of shock test (see 4.6.15(a)).
(2) Class of equipment, if other than specified (see 4.6.15(c)).
(3) Grade of equipment (see 4.6.15(d)).

(pp) Fire-retardant material requirements (see 5.1.1).
(qq) Level of preservation, packing and marking and options required (see 5.2).
(rr) If motor is critical to ship's mission (see 3.5.1.24.2.2).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.5, appendix B, and figures 5 and 6	DI-DRPR-80651	Engineering drawings	
4.6.19.1 and appendix E	DI-MISC-80678	Certification/data report	10.3.2 does not apply
4.6.15	DI-ENVR-80708	Shock test report	----
4.3, 4.4 and 4.5	DI-QCIC-81110	Inspection and test plan	----
4.3, 4.4, 4.5, 4.6.15.4 and appendix D	DI-NDTI-80809-B	Test/inspection reports	10.3 applies
4.6.5.1	DI-HFAC-80272	Equipment airborne sound measurements test report	----
4.6.5.2	DI-HFAC-80274	Equipment structureborne vibration acceleration measurements test report	----

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.3.1 Data item considerations for the Contracting Officer. When this specification is applied on a contract, considerations in determining the essentiality of the above data requirements are as follows:

1. The Engineering Drawing Reports, as described in appendix B, are essential when determining compliance of a motor with this specification. Engineering drawings are vital to effective motor maintenance and provide critical information necessary in correcting dysfunctional systems. Engineering drawings contain the data used in provisioning motors. Engineering drawings should be included in auxiliary equipment technical manuals. When a motor is procured for the first time or when there is a change in a motor or when technical manuals are required, the Engineering Drawing Report should be obtained.
2. The Certification Data Report, as described in appendix E, will forward verification of a supplier's certification for the sealed insulation system. This report should be obtained for each procurement of motors with a sealed insulation system.
3. The Shock Test Report is essential when determining motor shockproofness. This report should be obtained whenever a shock test is required. Verification of shockproofness is a requirement of first article inspection (see 4.4).
4. The Inspection and Test Plan Report should be obtained whenever a contractor's past performance warrants verification of their test and quality assurance procedures.
5. The Test/Inspection Report, as described in appendix D, establishes a permanent record of the first article, periodic and quality assurance tests and inspections. The report should be furnished to the Government if a contractor's previously furnished motors of the same or similar design exhibited quality deficiencies. In the absence of quality deficiencies, the report should be kept at the manufacturer's facility and should be available to the Government. Reports should be kept for 5 years. The report should also be used to furnish a manufacturer's request for shock test extension.
6. The Airborne and Structureborne Noise Test Reports should be obtained whenever the contractor's past performance or criticality of the motor warrants verification of noise test results.
7. The first article inspection is the only source of much of the information contained in the Engineering drawings. Possession of the engineering drawings by the Government is critically important as indicated above. Therefore, the first article inspection is also critically important and should be required (see 4.4).
8. The material test, paragraph 4.6.1, should not be required as part of an inspection unless the contracting officer considers the expectation of material deficiencies to warrant the inspection.

6.4 First article. When a first article inspection is required, the item should be a first article sample. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirements for first article inspection to those bidders offering a product which has previously passed first article inspection. Bidders offering such products, who wish to rely on such test results, must furnish such evidence with the bid.

6.4.1 Sealed insulation certification. Prior to implementation of the proposed sealed insulation suitability tests of the first article inspection, manufacturers should contact the Naval Sea Systems Command, Electrical Engineering Group, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 for instructions on the preparation of the test procedures.

6.5 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.5.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should be specified.

6.6 Definitions. The following definitions apply wherever such terms appear in this specification.

6.6.1 Integral hp motor. An integral hp motor is one built in a frame size 182 or larger as shown in table B of figures 1 through 4 and as shown in the frame size table for ac motors of MIL-P-17840 and MIL-F-18953.

6.6.2 Duty. The following definitions apply to duty:

6.6.2.1 Continuous duty. Continuous duty is a requirement of service that demands operation at a substantially constant load for an indefinite time (see 3.6.12.1).

6.6.2.2 Intermittent duty. Intermittent duty is a requirement of service that demands operation for alternate intervals of load and no-load; load and rest; or load, no-load, and rest (see 3.6.12.2).

6.6.2.3 Varying duty. Varying duty is a requirement of service that demands operation at loads and for intervals of time, both of which may be subject to wide variation (see 3.6.12.3).

6.6.2.4 Short-time duty. Short-time duty is a requirement of service that demands operation at a substantially constant load for a short and specified time (see 3.6.12.4).

6.6.3 Thermal protection (inherent overheating protection). Thermal protection is provided by a protective device embedded in the motor winding which is responsive to motor temperature whose purpose, when applied to a motor, is to protect the motor against excessive overheating due to overload or failure to start.

6.6.4 Enclosures. The following definitions apply to enclosures.

6.6.4.1 Air-over. Motors with enclosures designated with the suffix air-over AO, are intended for exterior cooling by a ventilating means external to the motor.

6.6.4.2 Submersible. Submersible motors are classified by their maximum rated submergence depth. Submersible motors must operate in accordance with specification requirements while submerged and in air as indicated in the duty cycle.

6.6.5 Squirrel-cage induction motor. A squirrel-cage induction motor is one in which the secondary circuit of a squirrel-cage winding is disposed in the secondary core.

6.6.5.1 Design A. Design A motors have characteristics similar to design B motors except that breakdown torques and starting currents are higher. Because of higher starting currents these motors are limited in their applications onboard ships.

6.6.5.2 Design B. Design B motors are standard general purpose motors having low starting current, normal torque and normal slip. These motors are widely used in such Naval shipboard applications as pumps, fans, blowers and machine tools where the characteristics of the design B7 motor are not appropriate for the application.

6.6.5.3 Design B7. Design B7 motors are high efficiency motors normally applied to centrifugal loads where high shaft connected inertia, accelerating under excessive loads, or rapid accelerating times are not a concern. Design B7 motors are similar to design B motors except that their locked-rotor and pull-up torques are permitted to be lower than design B, and the locked-rotor current may be higher than design B.

6.6.5.4 Design C. Design C motors have high breakaway torque, low starting currents and normal slip. These motors are suitable for applications requiring high breakaway torques during starting, such as compressors, conveyors and reciprocating pumps.

6.6.5.5 Design D. Design D motors have a high breakaway torque with high slip. These motors are suitable for high inertia loads such as punch presses, shears or other high inertia auxiliaries where energy is stored in fly wheel under heavy fluctuating load conditions.

6.6.5.6 Design F. Design F motors have low starting torque, low starting current and low breakdown torque.

6.6.5.7 Design FF. Design FF motors have characteristics similar to design F motors except that the starting torque is lower than design F.

6.6.6 Wound-rotor induction motor. A wound-rotor induction motor is an induction motor in which the secondary circuit consists of a polyphase winding or coils whose terminals are either short circuited or closed through suitable circuits.

6.6.6.1 Collector-ring starting motor. Collector-ring starting is used where the starting torque requirements are particularly severe and a resistance (secondary resistance type) starter is provided for starting duty only. The resistance is short-circuited when the load has been brought up to speed and thenceforth the motor has constant-speed characteristics.

6.6.6.2 Collector-ring starting and running motor. Collector-ring starting and running is used where adjustable varying-speed characteristics are desired. A resistance starter (secondary resistance type) is provided for both starting and running duty, the resistors being of the continuous duty type.

6.6.6.3 Induction starting and running. Induction starting and running motor is an ac motor in which a primary winding on one member (usually the stator) is connected to the power source and a polyphase secondary winding on the other member (usually the rotor) carries induced current.

6.6.7 Synchronous motor. A synchronous motor is a motor in which the average speed of normal operation is exactly proportional to the frequency of the system to which it is connected. Synchronous motors usually have direct current field excitation.

6.6.8 Speed. The following definitions apply to speed.

6.6.8.1 Constant-speed motor. A constant-speed motor is one in which the normal speed of operation is constant or constant within tolerances; for example, a synchronous motor or an induction motor with small slip.

6.6.8.2 Multispeed motor. A multispeed motor is one which can be operated at any of two or more definite speeds, each being practically independent of the load.

6.6.8.3 Adjustable speed motor. An adjustable speed motor is one in which the speed can be varied gradually over a considerable range, but when once adjusted remains practically unaffected by the load; for example, a commutator motor with brush-shifting feature. The base speed of an adjustable speed motor is the lowest speed obtained at rated load and rated voltage at normal operating temperatures.

6.6.8.4 Varying speed motor. A varying speed motor is one in which the speed varies with the load, ordinarily decreasing when the load increases, such as a high-slip motor.

6.6.8.5 Adjustable varying speed motor. An adjustable varying speed motor is one in which the speed can be adjusted gradually, but when once adjusted for a given load, will vary in considerable degree with change in load, such as a wound rotor induction motor.

6.6.9 Power factor. The power factor of an ac motor is the ratio of the kilowatt input to the kilovolt ampere input and is usually expressed as a percentage.

6.6.10 Front (of motor). The front or opposite drive end of a motor is the end opposite the coupling.

6.6.11 Back (of motor). The back or drive end of a motor is the end which carries the coupling or driving pulley.

6.6.12 Sealed insulation system. A sealed insulation system is an insulation system which through the use of materials and processes, seals the windings and protects them against contaminants found in severe environmental conditions.

6.6.13 Pull-up torque. The pull-up torque of an ac motor is the minimum torque developed by the motor during the period of acceleration from rest to the speed at which breakdown torque occurs. For motors which do not have a definite breakdown torque, the pull-up torque is the minimum torque developed up to rated speed.

6.6.14 Breakdown torque. The breakdown torque of a motor is the maximum torque which it will develop with rated voltage applied at rated frequency, without an abrupt drop in speed.

6.6.15 Locked-rotor torque. The locked-rotor torque of a motor is the minimum torque which it will develop at rest for all angular positions of the rotor, with rated voltage applied at rated frequency.

6.6.16 Locked-rotor current. The locked-rotor current of a motor is the steady-state current taken from the line with the rotor locked and with rated voltage and frequency applied to the motor.

6.6.17 Full-load torque. The full-load torque of a motor is the torque necessary to produce its rated hp at full-load speed.

6.6.18 Pull-in torque. The pull-in torque of a synchronous motor is the maximum constant torque under which the motor will pull its connected inertia load into synchronism, at rated voltage and frequency, when its fixed excitation is applied.

6.6.19 Pull-out torque. The pull-out torque of a synchronous motor is the maximum sustained torque which the motor will develop at synchronous speed with rated voltage applied at rated frequency and with normal excitation.

6.6.20 Efficiency. The efficiency of a machine is the ratio of the power output to the total power input. It is expressed as a percentage.

6.6.21 Low noise surface ship application. An application where a specific strutureborne noise limit is applicable to the motor. Most surface ship motors do not have a specific structureborne noise requirement and therefore are not classified as low noise surface ship motors.

6.6.22 Resistance balance. The resistance balance is equal to the difference between the maximum and minimum terminal to terminal winding resistance divided by the average terminal to terminal winding resistance.

6.7 Sub-contacted material and parts. The packaging or preperation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.8 NAVSEA approval and direction. Deviations from specified materials, procedures, and requirements and selection of specific alternative materials, features and procedures require NAVSEA approval or direction. Requests should include supporting documentation.

6.9 Subject term (key word) listing.

Driven auxiliaries
Induction
Squirrel-cage
Synchronous
Wound-rotor

6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 6105-N176)

EXAMINATION OF SERVICE A MOTORS

10. SCOPE

10.1 Scope. This appendix covers a list of examinations which shall be performed before, during, and after assembly of service A motors furnished in accordance with this specification. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. REQUIREMENTS

30.1 General. General examination shall be conducted to determine conformance to the following:

(a) Materials are as specified on approved drawings. Material has been ordered and inspected in accordance with the applicable material or component specification.
(b) Welding and brazing has been done in accordance with the approved drawings. There is no evidence of non-fusion, weld cracks, undersized welds, incomplete welds, heavy porosity, weld splatter, or slag.
(c) Soldered connections are solidly bonded. There are no cold soldering, rosin joints, corrosive flux, fractured joints, or excess solder. Satisfactory connections have been made prior to soldering. Bolted connections include approved locking devices and are secured against vibration. Solderless connectors are properly crimped. The connector and crimping tool are properly sized.
(d) Finished castings are as shown on approved drawings and are clean and free of molding sand, cracks, blow holes, split, and deformations. Sufficient material is allowed for machining. Casting defects have not been covered by unauthorized repairs.
(e) Machining is as shown on approved drawings. The surfaces, including mating surfaces, as applicable, are smooth, square, and are free of burrs, sharp edges, chatter marks, and scratches or damage due to handling. Surface finish is as shown on approved drawings, and there are no tool marks except those normally associated with the indicated surface finish. There are no flaws exposed in the material as a result of machining.
(f) No parts are Government surplus or have been previously used or reclaimed.
(g) Items including hardware (nuts, bolts, lockwashers, and so forth) are made of corrosion-resistant material or are given a corrosion-resistant treatment as shown on the approved drawings.

(h) A satisfactory varnishing process has been used. NOTE: The Government may require a coil or winding to be cut apart to examine the extent of the varnish treatment and filling if there is a question as to the effectiveness of varnish treatment used.
(i) Bolts, nuts, set screws, and other fasteners are secured in a manner which will preclude loosening in service. Locking devices are as shown on the approved drawings.
(j) Insulation creepage and clearance distance are in accordance with approved drawings. Creepage distances have not been achieved by cemented or butted joints.

30.2 Examination prior to assembly. Items to be examined prior to assembly shall be as follows:

(a) Shafts. Shafts shall be examined to determine conformance to the following:

(1) Items (a), (b), (e), and (f) of 30.1 above.
(2) Dimensions, tolerances, keyways, fillets, shoulders, threads, and surface finishes are as shown on the approved drawings.
(3) Eccentricity tolerances including out of round for the bearing seats, bearing shoulder, collector ring seats, and the core seats are as shown on the approved drawings.
(4) After welding on appurtenances, shafts have been stress-relieved as shown on the approved drawings.
(5) The shaft has not been built up in any way to correct errors or reclaim material (unless specific case basis approval has been obtained in advance).
(6) Shoulders are square as shown on the approved drawings.

(b) Collector ring assemblies. Collector ring assemblies shall be examined to determine conformance to the following:

(1) Items (a), (b), (d), (e), (f), and (j) of 30.1.
(2) Dimensions and dimensional tolerances are as shown on the approved drawings.
(3) Manufacturing and assembly processes used are as specified on the approved drawings. Specific temperatures and curing cycles are as shown on the approved drawings.
(4) Brush contact surfaces are smooth and are free of sharp edges, burrs, porosity and tool or chatter marks. Slip ring grooves have no burrs.
(5) Terminal studs are fixed to the rings in a positive manner as shown on the approved drawings.
(6) Terminal stud insulation is as shown on the approved drawings.

(c) Fans. Fans shall be examined to determine conformance to the following:

(1) Items (a), (b), (d), (e), (f), (g), and (j) of 30.1.
(2) Dimensions and the number and contour of blades are as shown on the approved drawings.

(3) The fan surfaces which move the air are free from any irregularities, surplus weld material or any other projections which may be a source of excessive airborne noise.
(4) Fans which break down into several parts are indexed in a manner such that they can be assembled in one way only.

(d) End shields, bearing housings, end caps and frames. Examination shall be conducted to determine the following:

(1) Items (a), (b), (d), (e), and (f) of 30.1.
(2) Sufficient metal is available for drilling and tapping.
(3) Drilling, tapping, and bolt centers are as shown on the approved drawings. Holes are clean, free of chips, and are drilled straight. There are no burred threads. Holes are spotfaced and are located so that edge distance is adequate in accordance with the approved drawings.
(4) End shields and frames have been cleaned and have been given a coat of primer and enamel or a coat of rust preventive before storing.
(5) The end shields, except mating surfaces (such as bearing housings and rabbets) are cleaned, primed, and painted on the inside surface prior to assembly. The inside of the frame is primed and painted if it did not receive at least two dips and bakes in the varnish treatment of the stationary electrical components.
(6) Mating surfaces of shields and frames are concentric and square as shown on the approved drawings.
(7) Dimensions, dimensional tolerances, and concentricities are as shown on the approved drawings.
(8) Bearing housings have sufficient metal to permit redrilling and bushing of the housing.

30.3 Examination during assembly. Items to be examined during assembly shall be as follows:

(a) General. General examination shall be conducted to determine conformance to the following:

(1) All items of 30.1.
(2) Parts are interchangeable, and no handfitting or selective matching of parts is necessary.
(3) No shims, spacers, or washers are used in the assembly to correct machining or material discrepancies.
(4) Assembly and disassembly of equipment can be done without the use of special tools. Special tools are defined as those tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the Office of the Defense Contract Management Area Operations (DCMAO)).

(b) Items examined during winding and assembly of rotating elements. Examination shall be conducted to determine conformance to the following:

(1) Keys shown on the approved drawings are used to prevent rotational movement of all rotating parts (such as collector rings, rotors, armatures).
(2) When any parts are pressed on the shaft, the pressure required to press on these parts is within the limits shown on the approved drawings.
(3) When any parts are shrink fitted on the shaft, the interference shrink fits of the parts are as shown on the approved drawings.
(4) Axial movement of parts is prevented by means of press rings, snap rings, press fit, shrink fit, or lock washers and nuts as shown on the approved drawings.
(5) Fans are secured to the shaft as shown on the approved drawings.
(6) For fabricated rotors, the bars are securely retained in the slots, bars are not able to shift in slots and bars are welded or brazed to the end rings with an even distribution of weld metal. Bars and end rings are of uniform cross-sectional area throughout.
(7) Bearings are of the size and type as shown on the approved drawings.
(8) The inner races of the ball bearings are secured to the shaft by means of shaft shoulders, lockwashers and nuts, or by the opposed shoulder method as shown on the approved drawings.
(9) Bearing locknuts and lockwashers, where used, are as shown on the approved drawings.
(10) Bearing and bearing seats are free from dirt, sand, metal particles, corrosion, or other foreign material.
(11) Lamination size and stacking are as shown on the approved drawings.
(12) Slot or ground insulation are as shown on the approved drawings.
(13) Slot or ground insulation extends beyond stacking as shown on the approved drawings.
(14) Wire size and type is as shown on the approved drawings. There are no substitutions.
(15) Wound coils (including preformed) have dimensions and number of turns as shown on the approved drawings.
(16) Undue force is not required to insert slot wedge in place, and insulation is not damaged or pushed out of place by the wedge.
(17) Slot wedges are of material and size as shown on the approved drawings. Length of wedge exceeds length of slot as shown on the approved drawings.
(18) Coils are not loose after the wedge is in place.
(19) The wedge size is proper for the size and shape of the slot, and there is no possibility that the wedge will cock in the slot and slip out.
(20) Coil connections are insulated as shown on the drawings.
(21) Coil support and phase insulation is as shown on the approved drawings. Phase insulation is inserted between the phase coils and is shaped to fit coil configurations.

(22) Coil extensions are insulated and secured as shown on the approved drawings.
(23) Insulation materials are as shown on the approved drawings.
(24) Insulation is cleaned off unless self-fluxing wire is used, and coil wire ends are tinned before making soldered connections.
(25) Lead wires are of the type and size shown on the approved drawings.
(26) Windings are mechanically secured as shown on the approved drawings.
(27) Completed winding assembly, including winding and pole, has been given a minimum of two varnish treatments with an approved clear baking varnish when preformed coils are used and has been given one varnish treatment prior to insertion in the slots or on the poles. When preformed coils are not used, the complete assembly has been given at least three varnish treatments.
(28) Type of varnish, treating and baking time cycle, and baking temperatures are shown on the approved drawings.
(29) The treated windings and coils are clean, smooth, and glossy with good bonding and filling. Varnish seals are complete and show no signs of cracks or breaks. The completed winding has no air bubbles, air pockets, voids, or dry spots on the surface and is not soft or sticky.
(30) There is no sign of excessive varnish buildup on one side of the winding assembly and lack of varnish buildup on other side. The thickness of the varnish on the winding assembly is uniform over the entire surface of the windings.
(31) Lead wires are insulated from ground and secured to prevent them from moving due to centrifugal force. Length and arrangement of wires permit ready repair; there is no aimless wiring resulting in "rats nests." Wiring is as shown on the approved drawings.
(32) No glyptal or nonapproved type of varnish or paint has been put on any of the rotating elements.
(33) Coils or windings have not been nicked or damaged during handling and processing.
(34) Completed rotating elements are dynamically balanced. The type of balance weights and method of securing are as shown on the approved drawings. Rotating elements have been secured to prevent loosening in service. Balance weights are not attached in the air stream to the fan.

(c) Items examined during winding and assembly of stationary elements. Examination during winding and assembly of stationary elements shall be conducted to determine whether items conform to the following:

(1) Items 30.3(b)(10) through (28), (31), and (32).
(2) Complete stator assembly or stator core is keyed to frame or frame spider as shown on the approved drawings.

(3) Force required to press complete stator assembly or stator core into the frame or frame spider is within the limits shown on the approved drawings.
(4) Axial movement of the stator within the frame is precluded by means of snap rings, welds, or other means as shown on the approved drawings.
(5) Lead wires are insulated from ground and secured within the frame with a clamp or fastening device.
(6) Lead wires pass through the frame, enter the terminal box, and are secured in such a manner to prevent chafing or abrasion as shown on the approved drawings.
(7) Terminal lugs of the type and size shown on the approved drawings are provided on the leads. Terminal lugs are properly crimped, and there are no cut wire strands.
(8) Terminal boxes are of the type and size required and are secured as shown on the approved drawings.
(9) Leads are properly marked as shown on the approved drawings (for example, T1, T2, T3).
(10) Coil end extensions dimensions are as shown on the approved drawings.

30.4 Examination during final assembly. Examination during final assembly shall be conducted to determine whether items conform to the following:

(a) All items of 30.1.
(b) Coil ends do not protrude to a point where they may contact the end brackets or the rotating elements.
(c) End shields properly match frames, bearing housings, and end caps. Holes align, there is no excess clearance, and no undue force is required to assemble parts.
(d) Bearing outer races are secured in their housings as shown on the approved drawings.
(e) There is no evidence of grease leakage past the close clearance nonrubbing seals into the motor or along the shaft.
(f) Spring washers, if used, to provide preloading of the bearing shall be selected and secured in the housing as shown on the approved drawings.
(g) Seals of prelubricated bearings are not damaged, and there is no evidence of grease leakage out of the bearing.
(h) Brush holder studs are secured as shown on the approved drawings.
(i) Brush rigging insulation is as shown on the approved drawings.
(j) Brush holders and springs are of the type and size shown on the approved drawings.
(k) Brush holders are secured as shown on the approved drawings.
(l) Brushes are of the manufacturer's grade designation shown on the approved drawings.
(m) Brushes have been properly seated over a minimum of 90 percent of contact area of brush, and carbon dust has been removed from the machine.
(n) Brush shunts are adequately attached to the brush material by embedding or riveting.

(o) Brush size is as shown on the approved drawing and fits properly in the holder without sanding or filing and brushes move freely in the brush holders in the direction parallel to the length of the brush.
(p) Brush tension is adjustable and is set as shown on the approved drawings. Spring tension can be readily measured by spring scale.
(q) Brushes are properly aligned parallel to the shaft and do not extend beyond the edge of the slip rings.
(r) Brush lug terminals are properly secured by screws which are not used for securing the brush holders to the rigging.
(s) Brush leads are furnished with lugs which are adequately secured.
(t) Water slingers are secured to the shaft as shown on approved drawings.
(u) Air gaps have been adjusted to design value and are uniform within the limits shown on the approved drawings.
(v) Bearings have been lubricated with grease as specified on the approved drawings.
(w) Except where prelubricated bearings are used, grease piped cups and drains are as shown on approved drawings.
(x) Air baffles are securely attached and do not interfere with rotating elements.
(y) Lifting means are provided as shown on the approved drawings.
(z) Equipment enclosure is as shown on the approved drawing.
(aa) Drain plugs are provided as shown on the approved drawings.
(bb) The motor, other than identification plates or shaft extensions, is painted as shown on the approved drawings.
(cc) Identification and instruction plates are legible and are complete as shown on the approved drawings.
(dd) Mounting feet are flat, square, and are as shown on the approved drawings.
(ee) The overall dimensions, mounting dimensions, distance from shaft center line to bottom of feet, and location of terminal boxes are as shown on the approved drawings.
(ff) For close-coupled motors, the shaft runouts, mounting flange concentricity and squareness are as shown on the approved drawings.
(gg) Shaft seals are the proper type and are secured as shown on the approved drawings.
(hh) Where high tensile bolts or screws such as socket head types are used, provision is made to prevent replacement with a lower tensile strength bolt or screw. There are no slotted head bolts or screws used to secure end brackets to the frame. Thread-cutting screws (self tapping) are not used to secure any part of the motor.
(ii) Where oil lubrication is used, the lubrication system is complete as shown on the approved drawing and there is no leakage of oil into or out of the motor.
(jj) Motor, particularly bearing housings, is clean and free of dirt, metal chips or other foreign materials.
(kk) Stationary lead wires do not contact rotating parts.

30.5 Handling precautions subsequent to final assembly. Subsequent to final assembly, the motor vendor shall assure that sufficient handling precautions are taken to maintain the motor integrity and general cleanliness prior to and throughout packaging for shipment.

40. PROCEDURES

40.1 Flow chart. Flow charts may be required.

40.2 Examinations. Examinations shall not be waived or reduced and shall comply with the following:

(a) Prior to assembly, motor items shall be examined to determine conformance to 30.2.
(b) During assembly, motor items shall be examined to determine conformance to 30.3.
(c) During final assembly, the motor shall be examined to determine conformance to 30.4.

ENGINEERING DRAWINGS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included on the drawings when specified in the contract or order. This appendix is mandatory only when data item description DI-DRPR-80651 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DRAWING CONTENTS

30.1 Drawings for service A motors. Drawings for service A motors shall be multidetailed wherever possible, and figure 5 may be used as a guide for format and arrangement. In addition, drawings shall contain the following information:

(a) An assembly end and side view showing all parts of the motor identified with piece number in the list of materials and direction of mounting. The assembly side view shall show a longitudinal section of the motor above the centerline. The assembly end view shall show a transverse quarter section above the centerline. These assembly views shall clearly show the following information:

(1) Bearing housing construction, bearing fits and tolerances, preload devices and provision for shaft expansion. The means of securing the preload device in the bearing housing. Bearing fits and tolerances may be shown as a note on the drawing or on other assembly views.
(2) Sectional view of collector rings (where used), brush rigging and brushes, design and materials of all brush rigging and brush holder stud installation, and methods of supporting brush rigging, brush holder studs, and brushes against excessive deflection due to high impact shock. If necessary for clarity, a separate detail shall be included on the drawing. Brush information shall include manufacturer's grade, Government grade and Government form number.
(3) Method of retaining collector rings and insulation, sleeves, rings, and rotor core to shaft. Where a press fit is used to secure the rings or cores to the shaft, the interference fit and minimum pressure to force the core or rings on the shaft shall be shown. Where a shrink fit is used to secure the ring or cores to the shaft, the interference fit and minimum pressure to remove the rings or cores from the shaft shall be shown.
(4) Dripshields, baffles and screen guards and the method used to attach them to the end shields or frames.
(5) Method of attaching terminal box to frame.

(6) Method of bringing cables out of frame into terminal box and the method for protecting these cables against chafing at sharp metallic corners.
(7) Method of clamping motor leads in the terminal box to prevent strain on internal connections and method of protecting lead insulation against abrasion by the clamp.
(8) Method of attaching fan to shaft and detail of fan showing constructions and number of blades.
(9) Overall dimensions including mounting, shaft extensions and key.
(10) Method of securing stator core to frame to prevent axial and rotational movement, and the minimum pressure to force the core in the frame shall be shown if a press fit is used in conjunction with other means. Where a shrink fit is used, the pressure required to force the stator core out of the frame shall be shown
(11) Lifting means where required (see 3.5.1.30).
(12) Direction of air flow.
(13) Total axial movement of the shaft to include bearing end play.
(14) For submarine motors, the center of gravity and radii of gyration about the three principal axes shall be shown in the end and side views as appropriate.
(15) The nominal dimension and tolerance for the rabbet diameter for the frame and end shields shall be shown.
(16) Details required by this specification and not covered in the foregoing enumeration.

(b) A detail working drawing of the shaft including bearing mounting dimensions.
(c) A schematic wiring diagram of the motor windings.
(d) Drawing of wiring arrangement and stator connection diagram. A connection table of motor leads for two or more speed or dual voltage motors.
(e) Guaranteed performance including locked-rotor current, torque and power factor; pull-up torque, breakdown torque, and efficiency and power factor at 2/4, 3/4, and 4/4 load and calculated value of safe locked rotor time.
(f) Stator inside and outside diameters, and core length.
(g) Rotor outside diameter, number of bars, and bar material. Indicate reference line and dimension for locating rotor axially on shaft in connection with replacement of shaft or rotor.
(h) Size of end ring and end ring material.
(i) Winding data of stator, including:

(1) Number of poles.
(2) Type of connection.
(3) Number of slots.
(4) Number of coils.
(5) Winding pitch in slots.
(6) Turns in series per coil (TPC), for fractional turn windings, the sequence of TPC for a pole-phase group shall be shown.
(7) Conductor circular mils or size and form (round or rectangular).
(8) Conductor insulation and Government specification.

(9) Measured resistance between terminals in ohms adjusted to 25°C.
(10) Weight of copper in pounds.

(j) Insulation materials and their dimensions and applicable specification of the following:

(1) Slot cell
(2) Spacer.
(3) Top wedge.
(4) "U" wedge (where used).
(5) Insulation between phases.
(6) Insulation on coil extensions.
(7) Insulation on coil leads and connections.
(8) Government specification and grade of varnish.
(9) Lead wire size and current carrying capacity, and lead wire markers.

(k) Slot sections showing dimensions of sections and details of slot wedges, slot armor, coil spacers, and slot tubes.
(l) Sketches showing in detail how field coils, where used, are assembled, insulated and supported on the pole pieces, and method of preventing excessive relative motion between the various conductors and windings when subjected to high-impact shock.
(m) Where seals are used, a sketch showing construction of seal and method used to secure seal in its housing and shaft to prevent axial or rotational movement.
(n) Test data. Data from the first article inspection, verified and attested to by the Government Quality Assurance Representative, shall be used to comply with the following test data requirements. For multispeed motors, the test data shall be included for each definite speed:

(1) Table of heat run data containing the following:

a. The hp load, amperes and loading duration.
b. Temperature measurements, by thermocouple, of the ambient air and the motor parts listed in table XVI. Measurements, in degrees centigrade shall be shown for operation one hour before shutdown (in case of short-time duty motors this column need not be completed) final while running (prior to shutdown), and after shutdown.
c. The hot and cold winding resistance in ohms and rise by resistance in degrees centigrade.
d. Cold and hot ambient temperatures in degrees centigrade associated with the cold and hot resistance, respectively.

(2) Performance at rated voltage and frequency including the following at 5/4, 4/4, 3/4, 2/4, and 0 load.

a. Actual load, amperes, watts, r/min, efficiency, power factor, and torque. For motors with seals, if efficiency at rated load can not be met with seals, then the efficiencies with and without seals shall be shown.

(3) Amperes, volts, r/min, and torque in pound-feet at locked rotor, pull-up and breakdown. When locked-rotor current or torque are determined based on measurements at less than rated voltage, the current, torque, volts and watts shall be shown for each value of test voltage.
(4) Air-gap in inches for sleeve bearing motors only.
(5) Weight of the complete motor and weight and moment of inertia, WR^2, of the rotor. Weight should be indicated in pounds, WR^2 in pound-$feet^2$.
(6) Airborne noise and structureborne noise test data.
(7) For motors with special bearing preload requirements (see 3.5.2.5.13), the uncompressed height of the preload device before and after full compression and the force produced by the preload device when compressed to the nominal design compression shall be shown on the drawing.

(o) Detail of the identification plate and identification plate data (and other information plate detail and data where required). Where an identification plate drawing has been submitted to NAVSEA, it will not be necessary to show a detail of the identification plate on the motor drawing. However, it will be necessary to identify the plate in the list of material and show the manufacturer's drawing number of the identification plate drawing.
(p) A note identifying bearings by manufacturer, Government type, class, size, and series.
(q) A note identifying the type and class of the applicable Government standard bearing puller (see GGG-P-781).
(r) Additional insulation data:

(1) The following additional insulation data shall be included on each command drawing or on a separate insulation drawing. If the data are shown on a separate insulation drawing covering insulation practice for a number of motors, the insulation drawing can deferred to on each applicable motor drawing subject to the following:

a. A manual is being supplied for the driven equipment and a copy of both the motor and insulation drawings are included in the manual.
b. When a manual is not being supplied for the driven equipment, reference to the insulation drawing on the motor drawing will be permitted provided the insulation drawing is furnished with the motor drawing.

(2) These additional data, together with the information required by (j), (k), (l), and (n), inclusive, shall completely describe all insulation used, indicating the materials, dimensions, forms, sequence of winding and insulation

operations, numbers of layers and amount of overlapping of tape applications, treatment schedules prebake period and temperature, number of dips and class of varnish used, varnish manufacturer's identification number or symbol, temperature and duration of baking temperatures, vacuum and pressure employed during impregnation (where used) as applicable for each type of wound assembly (main field coils, stator coils, and wound rotor assembly) including:

a. Conductor strand and turn insulation.
b. Coil insulation including slot and end turn insulation of each armature coil, ground insulation, coil turn separators, coil end turn banding insulation, and support pads between coils and armature, rotor or pole piece supports.
c. Other sketches shall show such details as dimensions, the direction and overlap of the various tape windings on strands. Conductors, turns and coils, the distance that coil slot insulation and slot wedge extend beyond the iron, and the original and final shape of the wound conductors and coils, including flare. A sketch shall be shown indicating the location of pins or the form for winding mush or random wound coils.
d. Each sketch shall be identified as to the design of motor and the type of winding.

(s) Classification block directly above title block including manufacturer's type and class, frame size, duty enclosure, speed class, synchronous and full-load r/min, hp, volts, Hz, phases, type of rotor design, class of insulation, type of mounting, service classification, ambient temperature, and measured full-load amperes. In addition, the following identification shall be placed below the classification block:

(1) For submarine motors - "SPECIAL QUIET MOTOR DESIGN, MIL-STD-740".
(2) For nonmagnetic motor - "NONMAGNETIC (NM)".

(t) Government specification, size, and quantity applicable to motor terminal lugs.
(u) Phantom view of grease cups flagged and listed by size in the parts list with the following comment in the remarks column: "Repair part only".
(v) On drawings covering equipment shock-test, which have been found satisfactory, there shall be indicated the following:

(1) For motors accepted by other than shock test extension, the file number and date of the shock-test report and the serial number and date of the command or agency letter of acceptance.
(2) For motors accepted by shock test extension, the file number and date of the shock test report from which acceptance was extended, the serial number and date of the Government

acceptance letter for the motor from which shock test acceptance was extended and the serial number and date of the Government letter authorizing the shock test extension.

(w) Structureborne noise acceptance criteria and identification of the driven auxiliary including manufacturer and model number (or equivalent).

(x) On class H or N insulated motors, the file number and date of the command, or agency concerned letter accepting the insulation suitability test.

(y) In the parts list, identify onboard repair parts by an asterisk and add the following note under the parts list: "Piece numbers identified by an asterisk are normally supplied as onboard repair parts. For onboard repair parts actually furnished refer to the contract or order".

(z) On nonmagnetic motors, the unit weight of all items constructed from magnetic materials.

(aa) On motors with sealed insulation system, the file number and date of the suitability test report.

(bb) In the specifications and exceptions block, include the number of the specification, the revision and effective date, the amendment and effective date, as applicable, and additional data pertaining to special requirements of the acquisition specifications.

NOTE: Figure 5 is indicative of the general arrangement and information desired by the command or agency concerned for a service A motor drawing for a two-speed, integral hp, ac motor. The command or agency concerned recognizes that the information required on other designs of motors, such as single speed, will not be the same as shown hereon. In such cases it will be permissible to add or subtract the necessary column and information so as to fit the particular motor.

(cc) For mechanical fasteners in rotating assemblies, the following shall be shown:

(1) Torque range for tightening.

(2) Fastener that may by used in balance correction shall be identified in the parts list with the designator, Balance.

(3) For fasteners used in balance correction, the maximum stack height of washers, including the lockwasher, if present, that may be installed under the head of the fastener, shall be shown. The dimension shall be identified as, Maximum Washer Stack Height.

(dd) The method of balance correction shall be provided.

(ee) The serial number and date of the Government acceptance letter of the motor drawing shall be shown.

(ff) If used, the grade of nodular graphitic iron shall be shown in the parts list.

(gg) For motors with a sealed insulation system, the following note should be shown on the drawing: This is a high reliability motor. Repair class C overhaul, is allowable if it is in response to a conditional requirement. Winding repair shall be in accordance with NSTM Chapter 300.

(hh) For submarine symmetrical motors, a note should be added to the drawing indicating that the motor is symmetrical. The procedure for interchanging the end shields, reversing the rotor assembly and rotating the frame shall be provided.
(ii) For motors rated for other than continuous duty, the duty cycle or the Government document describing the duty cycle shall be shown.
(jj) The following details of the bearing preload device shall be shown in the parts list, in the sectional views or in a note:

(1) The material, the outer and inner diameters and the free height shall be shown. In addition, for coiled springs, the number of coils, the coil diameter and the wire diameter shall be shown.
(2) For submarine motors with special bearing preload requirements (see 3.5.2.5.13), in addition to the information in (jj).1, above, the nominal working length and force and the plus and minus tolerance for the nominal working length and force shall be shown. The following information shall also be provided: the dimensions and tolerances of the cavity for the preload device, the surface that is machined to bring the cavity length within tolerance and the method for determining how much metal to remove from that surface to achieve the correct cavity length.

30.2 Drawings for service C motors. Drawings for service C motors shall be multidetailed wherever possible. Figure 5 may be used as a guide for format and arrangement to the extent necessary to conform with the applicable data requirements. Drawings for service C motors shall contain the following information:

(a) An outline drawing showing all dimensions, clearance holes, tapped holes, holes for mounting and position of mounting.
(b) Stator data including inside diameter, core length and winding data. Winding data to include:

(1) Number of poles.
(2) Type of connection.
(3) Number of slots.
(4) Number of coils.
(5) Winding pitch in slots.
(6) Turns in series per coil (TPC), for fractional turn windings, the sequence of TPC for a pole-phase group shall be shown.
(7) Conductor circular mils or size and form (round or rectangular).
(8) Conductor insulation and Government specification.
(9) Measured resistance between terminals in ohms adjusted to 25°C.
(10) Weight of copper in pounds.

(c) Rotor data including o.d., number of bars, bar material and end ring size and material.
(d) Insulation materials and their dimensions and applicable specification of the following:

(1) Slot cell.
(2) Spacer.
(3) Top wedge.
(4) "U" wedge (where used).
(5) Insulation between phases.
(6) Insulation on coil extensions.
(7) Insulation on coil leads and connections.
(8) Government specification and grade of varnish.
(9) Lead wire size, type and current carrying capacity.

(e) A detailed working drawing of the shaft.
(f) Schematic wiring diagram of motor windings and stator connection diagram.
(g) Guaranteed performance including locked-rotor current, torque and power factor; pull-up torque, breakdown torque, and efficiency and power factor at 2/4, 3/4, and 4/4 load.
(h) Weight of complete motor in pounds.
(i) Classification block directly above title block including manufacturer's type and class, frame size, duty enclosure, speed class, synchronous and full-load r/min, hp, volts, Hz, phases, type of rotor design, class of insulation, type of mounting, service classification, ambient temperature, and measured full-load amperes. In addition, the following identification shall be placed below the classification block:

(1) For submarine motors - "SPECIAL QUIET MOTOR DESIGN, MIL-STD-740".
(2) For nonmagnetic motor - "NONMAGNETIC (NM)".

(j) Parts list for repair parts and tools (only) with manufaturer's part numbers.
(k) Phantom view of grease cup, where used, with a note indicating that it is a repair part item only.
(l) A connection table of motor leads for two or more speed or dual voltage motors or both. Terminal markings shall be shown on connection and wiring diagrams.

30.3 Drawings for motors with special preload requirements. A drawing shall be provided containing calculations demonstrating that the preload device functions as intended, as defined by the drawing details of 30.1(jj), above, given the preload device tolerances and the tolerances on the parts that restrain them. As a minimum, the calculations shall include a tolerance stackup analysis calculating the minimum and maximum values for working length and the minimum and maximum spring force at those lengths.

TEST PROCEDURES FOR MOTOR EFFICIENCY

10. SCOPE

10.1 Scope. This appendix covers the efficiency testing procedures, conditions and calculations for polyphase induction motors that are constructed to meet high efficiency requirements. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

20.1 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
112-1991 - IEEE Standard Test Procedure for Polyphase Induction Motors And Generators.

(Application for copies shall be addressed to the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents may also be available in or through libraries or other informational services.)

30. REQUIREMENTS

30.1 Except as specified herein, motor efficiency tests shall be performed in accordance with IEEE 112, Method B (Input-Output with Loss Segregation).

30.2 In the event of conflict between this appendix and IEEE 112, this appendix takes precedence.

40. PROCEDURES

40.1 Test sample. The motor(s) shall be selected from normal production.

40.2 Test equipment. Test equipment shall be as specified in 40.2.1 through 40.2.5.

40.2.1 Digital meters. Digital meters shall be read above 15 percent of their scale range.

40.2.2 Analog meters. Analog meters shall be read above 50 percent of their scale range.

40.2.3 Accuracy. The accuracy of voltmeters and ammeters shall be at least 0.25 percent of full scale. The accuracy of wattmeters and torque meters shall be at least 0.1 percent of full scale.

40.2.4 Temperature measuring equipment. Temperature measuring equipment for the efficiency test shall be the same equipment used during the heat run test.

40.3 Measurements.

40.3.1 Power. The total power read on a wattmeter shall be reduced by the amount of losses in the voltage circuits of the wattmeter whenever this loss is a measurable portion of the total power read.

40.3.2 Slip. The accuracy of slip measurements shall be within plus or minus 5 percent of slip speed.

40.3.3 Temperature. Winding temperature shall be determined by the resistance method or by thermocouple (see 40.4.2).

40.4 Test procedures. Test samples shall be tested as specified in 40.4.1 through 40.4.3.

40.4.1 General. Data for efficiency calculations shall be obtained from six load points, approximately equally spaced, between 25 percent and 150 percent of motor rated torque. This data shall not be obtained until temperature stabilization is attained.

40.4.2 Temperature stabilization. The efficiency test shall be conducted after the heat run test. The motor shall be operated at 100 percent of rated load until the winding temperature rise has stabilized as determined in the heat run test. Verification of achieving rated temperature rise shall be by either a rise by resistance test or by thermocouple. If verification is by thermocouple, the thermocouples shall be the same ones used in the heat run and the thermocouple installation shall be unmodified from that of the heat run test. Temperature shall be stabilized when either the rise by resistance or the rises by all thermocouples are within 3°C of the values attained during the heat run test.

40.4.3 Core loss and friction and windage loss. The core loss and friction and windage loss tests shall be conducted immediately after the temperature test and at no load.

40.5 Efficiency calculation. When calculating efficiency, the stator winding resistance shall be corrected to a centigrade temperature equal to the rise by resistance at 100 percent load, as determined in the heat run test, plus 25°C. The 25°C represents a standarized ambient temperature.

TEST REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix identify's specific content requirements pertinent to the submittal of test reports. For each test report that may be required (see 6.3.1), a Contract Data Requirements Lists (CDRL) is attached. The CDRL is partially completed to indicate the deliverables necessary to satisfy the requirements of a specific report and to indicate the appropriate timing for submittal of the report. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TEST REPORT CONTENT REQUIREMENTS

30.1 First article inspection report. The report shall contain results of the first article tests/inspections of table XX as follows:

(a) When specified, the material test (see 4.6.1) shall be performed to verify compliance of contractor selected material(s) with the minimum requirements of this specification. Test data shall be provided that compares each material characteristic identified for the minimum material requirement(s) of this specification with those of the selected material.
(b) The results of the assembly inspection (see 4.6.2) shall be forwarded. Each item of the inspection shall be addressed.
(c) The resistance between each pair of motor leads and the ambient temperature shall be furnished (see 4.6.3).
(d) Observed results of the lubrication system shall be shown (see 4.6.4).
(e) The measured airborne noise levels shall be shown for each specified octave band (see 4.6.5.1).
(f) The measured structureborne noise levels shall be shown for each specified octave band (see 4.6.5.2).
(g) The maximum amplitude of vibration and the motor speed at which the vibration was measured shall be shown (see 4.6.6).
(h) The bearing end play shall be shown (see 4.6.7).
(i) Results of the enclosure effectiveness test addressing all acceptance criteria shall be shown (see 4.6.8).
(j) No-load input data shall consist of the amount of operating time prior to the measurements, input watts, speed and line volts and amperes for each phase (see 4.6.10).
(k) Locked rotor data shall consist of current, watts, voltage and torque at locked rotor, pull-up and breakdown. The KVA limits of the test facility shall be shown. For testing at reduced voltage, all measured and calculated data shall be shown (see 4.6.11).
(l) Load test data shall consist of percent rated load, speed, watts, amps, efficiency and power factor at 0, 25, 50, 75, 100 and 125 percent of rated load (see 4.6.12).

(m) The phase characteristic test for synchronous motors shall contain measurements of field and armature current sufficient to plot a "vee" curve (see 4.6.13).

(n) For each of the test positions of inclination the maximum mechanical imbalance during operation and the speed shall be shown. The mechanical imbalance when mounted in it's normal position (horizontal or vertical) shall be shown. A qualitative statement addressing the adequacy of the lubrication and other issues, identified in the inclined operation test requirement, shall be included (see 4.6.14).

(o) The heat-run test data shall consist of the line voltage and current, watts, torque and speed immediately before shut-down, elapsed time at the test load, the cold resistance, the cold ambient temperature, the hot resistance, the hot ambient temperature and the temperature rise. The temperature rise of each bearing, as measured on the outer ring, shall also be shown (see 4.6.16).

(p) The dielectric test shall consist of the test voltage and the elapsed time of application. The report shall also indicate whether the motor withstood the proof voltage (see 4.6.17).

(q) The electrical balance data shall consist of each line current as measured immediately before shut-down of the heat run and the associated percent current balance (see 4.6.18).

(r) The sealed insulation system electrical test data shall consist of the test water's conductivity and surface tension and values of insulation resistance, corrected to 25°C, after 1 minute, 10 minutes, 1 hour and 24 hours of submergence. The insulation resistance, dry, corrected to 25°C, shall also be shown. A qualitative indication shall be included addressing the outcome of the surge test (see 4.6.19.2).

(s) The efficiency test data shall consist of line current and volts, watts, speed, torque and efficiency (see 4.6.20).

(t) The preload device test data shall consist of the uncompressed length of the preload device before and after full compression. The nominal design value of compression and the force measured to achieve that compression shall also be shown (see 4.6.21).

(u) The inspection of packaging test data shall consist of a qualitative evaluation of the sample packages.

30.2 Periodic inspection report. The report shall contain results of the periodic tests/inspections as specified in table XX as follows:

(a) The test/inspection data shall be as specified in 30.1, above, with the exception that the data requirement of 30.1(i) is not required.

30.3 Quality conformance inspection report. The report shall contain results of the periodic tests/inspections as specified in table XXI as follows:

(a) The test/inspection data shall be as specified above for 30.1(a) through (d), 30.1(f) through (h), 30.1(j). 30.1(m). 30.1(p), 30.1(r) and 30.1(t).

30.4 Shock test extension report. The report shall contain the following:

(a) The drawing of the motor from which shock test acceptance is being extended.
(b) The drawing of the motor to which shock test acceptance is being extended.
(c) A copy of the shock test and motor post shock inspection associated with the motor from which shock test acceptance is being extended.
(d) If extension is requested based on a type A shock test, adequate detail of both auxiliaries should be included to allow the determination of their similarity.

CERTIFICATION DATA/REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included in the certification/data report when specified in the contract or order. This appendix is mandatory only when data item description DI-MISC-80678 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. CERTIFICATION REPORT CONTENT REQUIREMENTS

30.1 Certification for sealed insulation systems. The contractor's facility shall be qualified for implementation of a sealed insulation system prior to furnishing motors to the Government. A copy of the NAVSEA letter qualifying the contractor's facility for implementation of a sealed insulation system shall be forwarded to the Government, as specified in 4.6.19.1 of this specification, as evidence of qualification.

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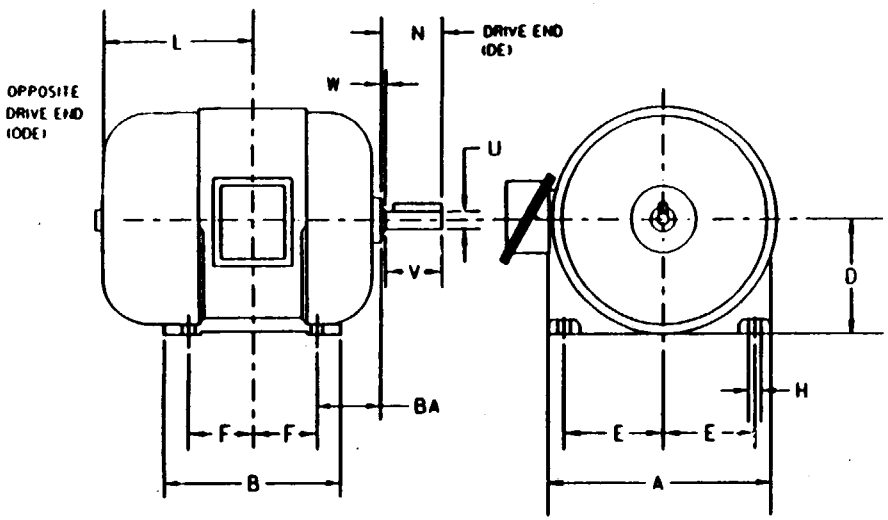


CONVENTIONAL MOTOR FRAME

TOLERANCES:

D DIMENSIONS		
FRAMES 182TN-326TN (S)	+0",	-1/32"
FRAMES 365TN(S)-507TN(S)	+0",	-1/16"
"2E" DIMENSION	+1/64",	-1/64"
"2F" DIMENSION	+1/64",	-1/64"
U DIMENSION		
SHAFT DIAMETERS 1" THRU 1-1/2" INC.	+0.0000",	-0.0005"
SHAFT DIAMETERS 1-5/8" THRU 3-3/8" INC.	+0.000",	-0.001"
KEYWAYS		
WIDTH		
DEPTH	+0.002"	-0.000"

SHAFT DIAMETER	KEY DIMENSION	BOTTOM OF KEYSEAT TO OPPOSITE SIDE OF SHAFT
1-1/8"	1/4" X 1/4"	.986" - .971"
1-3/8"	5/16" X 5/16"	1.201" - 1.186"
1-5/8"	3/8" X 3/8"	1.416" - 1.401"
1-7/8"	1/2" X 1/2"	1.591" - 1.576"
2-1/8"	1/2" X 1/2"	1.845" - 1.830"
2-3/8"	5/8" X 5/8"	2.021" - 2.006"
2-5/8"	5/8" X 5/8"	2.275" - 2.260"
2-7/8"	3/4" X 3/4"	2.450" - 2.435"
3-3/8"	7/8" X 7/8"	2.880" - 2.865"

TABLE B-STANDARD MOUNTING DIMENSIONS, BEARING SIZES AND MAXIMUM WEIGHTS FOR A. C. T FRAME MOTORS

FRAME NUMBER	KEY WAY NOMINAL WIDTH	KEY WAY NOMINAL DEPTH	A (MAX.)	B (MAX.)	D	E	F	BA 5/ (NOM.)	H	N-W	U	V (MIN.)	L MAXIMUM DPP	L MAXIMUM FC	MAXIMUM WEIGHT (POUNDS) DPP	MAXIMUM WEIGHT (POUNDS) FC	BEARING SIZE, MINIMUM 3/ ODE	BEARING SIZE, MINIMUM 3/ DE	FRAME NUMBER
182TN	1/4	1/8	9	6-1/2	4-1/2	3-3/4	2-1/4	2-3/4	17/32	2-3/4	1-1/8	2-1/2	6-1/4	7-3/4	80	90	205	206	182TN
184TN	1/4	1/8	9	7-1/2	4-1/2	3-3/4	2-3/4	2-3/4	17/32	2-3/4	1-1/8	2-1/2	6-3/4	8-1/4	95	115	205	206	184TN
213TN	5/16	5/32	10-1/2	7-1/2	5-1/4	4-1/4	2-3/4	3-1/2	21/32	3-3/8	1-3/8	3-1/8	7-1/4	9-1/2	135	145	206	207	213TN
215TN	5/16	5/32	10-1/2	9	5-1/4	4-1/4	3-1/2	3-1/2	21/32	3-3/8	1-3/8	3-1/8	7-3/4	10	160	175	206	207	215TN
254TN	3/8	3/16	12-1/2	10-3/4	6-1/4	5	4-1/8	4-1/4	25/32	4	1-5/8	3-3/4	9	11-3/4	240	260	207	209	254TN
256TN	3/8	3/16	12-1/2	12-1/2	6-1/4	5	5	4-1/4	25/32	4	1-5/8	3-3/4	9-3/4	12-3/4	300	320	207	209	256TN
286TN	1/2	1/4	14	14	7	5-1/2	5-1/2	4-3/4	25/32	4-5/8	1-7/8	4-3/8	10-3/4	14	440	460	207	310	286TN
286TNS	3/8	3/16	14	14	7	5-1/2	5-1/2	4-3/4	25/32	3-1/4	1-5/8	3	10-3/4	14	440	460	207	209	286TNS
326TN	1/2	1/4	16	15-1/2	8	6-1/4	6	5-1/4	15/16	5-1/4	2-1/8	5	11-3/4	15-1/4	625	705	209	311	326TN
326TNS	1/2	1/4	16	15-1/2	8	6-1/4	6	5-1/4	15/16	3-3/4	1-7/8	3-1/2	11-3/4	15-1/4	625	705	209	310	326TNS
365TN	5/8	5/16	18	16-1/2	9	7	6-1/8	5-7/8	1-1/16	5-7/8	2-3/8	5-5/8	12-1/2	16-1/2	775	1150	310	313	365TN
365TNS	1/2	1/4	18	16-1/2	9	7	6-1/8	5-7/8	1-1/16	3-3/4	1-7/8	3-1/2	12-1/2	16-1/2	775	1150	310	311	365TNS
405TN	3/4	3/8	20	17-3/4	10	8	6-7/8	6-5/8	1-1/16	7-1/4	2-7/8	7	14	18-1/2	1140	1350	311	315	405TN
405TNS	1/2	1/4	20	17-3/4	10	8	6-7/8	6-5/8	1-1/16	4-1/4	2-1/8	4	14	18-1/2	1140	1350	311	311	405TNS
445TN	7/8	7/16	22	20-1/2	11	9	8-1/4	7-1/2	1-3/16	8-1/2	3-3/8	8-1/4	16-1/4	21	1550	2100	311	318	445TN
445TNS 1/	5/8	5/16	22	20-1/2	11	9	8-1/4	7-1/2	1-3/16	4-3/4	2-3/8	4-1/2	16-1/4	21	1550	2100	311	313	445TNS
445TN2 2/	1/2	1/4	22	20-1/2	11	9	8-1/4	7-1/2	1-3/16	4-1/4	2-1/8	4	16-1/4	21	1550	2100	311	311	445TN2
505TNS 1/	5/8	5/16	25	23	12-1/2	10	9	8-1/2	1-5/16	4-1/4	2-1/8	4	18-1/2	22-1/2	2050	2400	311	314	505TNS
505TN2 2/	1/2	1/4	25	23	12-1/2	10	9	8-1/2	1-5/16	4-1/4	2-5/8	4	18-1/2	22-1/2	2050	2400	311	311	505TN2
507TNS 1/	5/8	5/16	25	27	12-1/2	10	11	8-1/2	1-5/16	4-1/4	2-5/8	4	21	25	2550	3025	311	314	507TNS
507TN2 2/	1/2	1/4	25	27	12-1/2	10	11	8-1/2	1-5/16	4-1/4	2-1/8	4	21	25	2550	3025	311	311	507TN2

1/ 1800 R/MIN AND LESS
2/ 3600 R/MIN
3/ MAXIMUM BEARING SIZE , 312, FOR 3600 R/MIN
4/ SEE NOTE 7
5/ "BA" MAY INCREASE BY 5% AND 60% FOR MOTORS WITH FACE SEALS FOR WT AND SUBMERSIBLE ENCLOSURES, RESPECTIVELY

FIGURE 1. STANDARDS FOR INTEGRAL HORSEPOWER ALTERNATING CURRENT GENERAL PURPOSE "T" FRAME MOTORS.

NOTES (FOR TABLE "B")
1. DPP-DRIPPROOF PROTECTED.
2. FC-FAN COOLED, APPLIES TO TEFC, SPTFC, EXPFC.
3. OPPOSITE DRIVE END (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON ODE OR DE.

TABLE A - FRAME SIZE ASSIGNMENTS FOR DESIGN A, B AND C
CONSTANT SPEED, "T" FRAME MOTORS.

Hp	3600 R/MIN		1800 R/MIN		1200 R/MIN		900 R/MIN	
	DPP	FC	DPP	FC	DPP	FC	DPP	FC
1 1/	182TN	182TN	182TN	182TN	182TN	182TN	182TN	184TN
1-1/2	182TN	182TN	182TN	182TN	182TN	184TN	184TN	213TN
2	182TN	182TN	182TN	182TN	184TN	213TN	213TN	215TN
3	182TN	184TN	182TN	184TN	213TN	215TN	215TN	254TN
5	182TN	213TN	184TN	213TN	215TN	254TN	254TN	256TN
7-1/2	184TN	215TN	213TN	215TN	254TN	256TN	256TN	256TN
10	213TN	254TN	215TN	254TN	256TN	256TN	286TN	286TN
15	215TN	256TN	254TN	256TN	286TN	286TN	286TN	326TN
20	254TN	286TN	256TN	286TN	286TN	326TN	326TN	326TN
25	256TN	286TN	286TN	286TN	326TN	326TN	326TN	365TN
30	286TN	326TN	286TN	326TN	326TN	365TN	365TN	365TN
40	286TN	326TN	326TN	326TN	365TN	365TN	365TN	405TN
50	326TN	365TNS	326TN	365TN	365TN	405TN	405TN	405TN
60	326TN	365TNS	365TN	365TN	405TN	405TN	405TN	445TN
75	365TNS	405TNS	365TN	405TN	405TN	445TN	445TN	445TN
100	365TNS	445TN2	405TN	445TN	445TN	445TN	445TN	-----
125	405TNS	445TN2	405TN	445TN	445TN	445TN	-----	-----
150	445TN2	445TN2	445TN	445TN	-----	-----	-----	-----
200	445TN2	-----	445TN	-----	-----	-----	-----	-----
250	445TN2	-----	-----	-----	-----	-----	-----	-----

1/ INCLUDES 1/2 AND 3/4 HP.

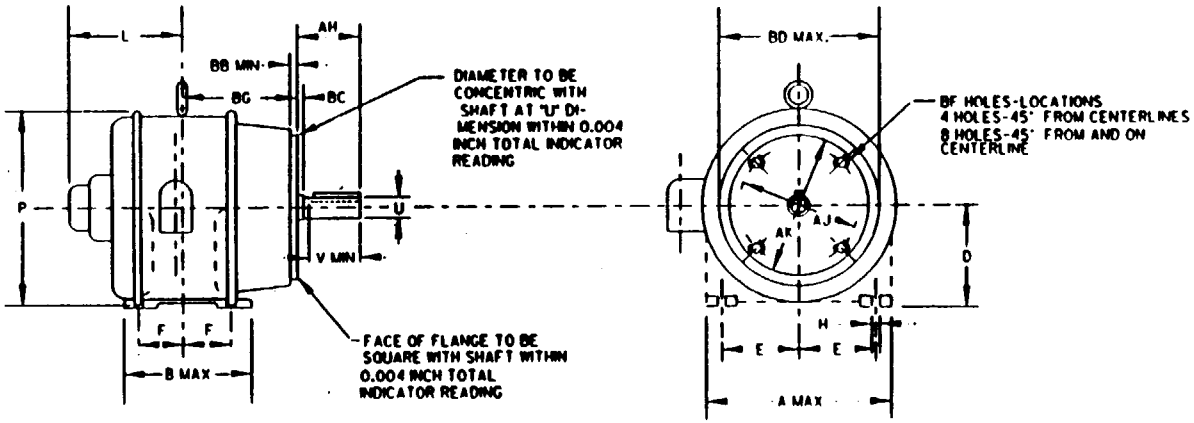
HORSEPOWER, SYNCHRONOUS SPEED, FRAME SIZE AND DEGREE OF ENCLOSURE SHALL BE IN ACCORDANCE WITH TABLE "A" AND WHERE A CHOICE EXISTS, WILL BE SPECIFIED IN THE CONTRACT OR ORDER.

EXCEPT FOR MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES, MOTOR WEIGHTS SHALL NOT EXCEED THE MAXIMUM LIMITS OF TABLE "B". MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES SHALL NOT EXCEED THE MAXIMUM WEIGHT LIMITS OF TABLE "B", FOR (FC) ENCLOSURES, BY MORE THAN 4 PERCENT.

NOTES (FOR TABLE "A")

1. DPP - DRIPPROOF PROTECTED.
2. FC - FAN COOLED, APPLIES TO TEFC, SPTFC, EXPFC.
3. MOTORS WITH ENCLOSURES OTHER THAN DPP AND THE AIR-OVER AND SUBMERSIBLE TYPES, SHALL HAVE THE SAME FRAME SIZE AS THE FAN COOLED (FC) TYPES. MOTORS WITH AIR-OVER OR SUBMERSIBLE ENCLOSURES SHALL HAVE FRAME SIZES NOT LARGER THAN THE (FC) TYPES.
4. SHORT SHAFT EXTENSIONS (TNS) MAY BE FURNISHED FOR COUPLED SERVICE AS SHOWN IN TABLE B.
5. FRAME SIZE MAY BE INCREASED BY ONE (1) FRAME SIZE FOR 3600 R/MIN MOTORS WHERE A NON-MAGNETIC ONE PIECE SHAFT IS REQUIRED.
6. SHORT SHAFT EXTENSIONS (TNS) SHALL BE FURNISHED ON 3600 R/MIN MOTORS 365 FRAME AND 405 FRAME. THE TN2 SHAFT EXTENSION SHALL BE FURNISHED ON 3600 R/MIN MOTORS 445 FRAME AND LARGER.
7. OPPOSITE DRIVE END (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON THE ODE OR DE.
8. MOTORS WITH A DEGREE OF ENCLOSURE OF TOTALLY ENCLOSED (TE) MAY USE A FRAME SIZE APPLICABLE TO THE NEXT LARGER HP RATING INDICATED IN TABLE A FOR FC ENCLOSURES OF THE SAME SPEED RATING.

FIGURE 1. STANDARDS FOR INTEGRAL HORSEPOWER ALTERNATING CURRENT GENERAL PURPOSE "T" FRAME MOTORS. - CONTINUED



TYPE C - FACE-MOUNTED INTEGRAL-HORSEPOWER MOTOR FRAME

TOLERANCES

D DIMENSIONS		
FRAMES 182TNC-326TNC	+0"	-1/32"
FRAMES 365TNC-505TN2C	+0"	-1/16"
"2E" DIMENSION	+1/64"	-1/64"
"2F" DIMENSION	+1/64"	-1/64"
U DIMENSION		
SHAFT DIAMETERS 1"-1-1/2" INC.	+0.0000"	-0.0005"
SHAFT DIAMETERS 1-5/8"-3-3/8" INC.	+0.000"	-0.001"
KEYWAYS		
WIDTH	+0.002"	-0.000"
DEPTH		

SHAFT DIAMETER	KEY DIMENSION	BOTTOM OF KEYSEAT TO OPPOSITE SIDE OF SHAFT
1-1/8"	1/4" X 1/4"	.986" - .971"
1-3/8"	5/16" X 5/16"	1.201" - 1.186"
1-5/8"	3/8" X 3/8"	1.416" - 1.401"
1-7/8"	1/2" X 1/2"	1.591" - 1.576"
2-1/8"	1/2" X 1/2"	1.845" - 1.830"
2-3/8"	5/8" X 5/8"	2.021" - 2.006"
2-5/8"	5/8" X 5/8"	2.275" - 2.260"
2-7/8"	3/4" X 3/4"	2.450" - 2.435"
3-3/8"	7/8" X 7/8"	2.880" - 2.865"

NOTE: FOR VERTICAL MOTORS WITHOUT FEET ALL THE DIMENSIONS OF TABLE B APPLY EXCEPT A, B, H, E, F AND D.

TABLE B - STANDARD MTG. DIMENSIONS, BEARING SIZES AND WEIGHTS FOR TYPE C FACE - MOUNTED HORIZONTAL AND VERTICAL ALTERNATING CURRENT "T" FRAME MOTORS.

FRAME NUMBER	A (MAX.)	B (MAX.)	H	E	F	D	P 1/ (MAX.)	U	V (MIN.)	AH	AJ	AK	BB	BC	BD 1/ (MAX.)	BG	NO.	BF HOLE TAP SIZE	BF HOLE MIN. DEPTH	KEY WAY NOMINAL WIDTH	KEY WAY NOMINAL DEPTH	L MAXIMUM DPP	L MAXIMUM FC	MAX. WT. (POUNDS) DPP	MAX. WT. (POUNDS) FC	BEARING SIZE MIN. 4/ 5/ ODE	BEARING SIZE MIN. 4/ 5/ DE	FRAME NUMBER
182TNC	9	6-1/2	17/32	3-3/4	2-1/4	4-1/2	9	1-1/8	2-1/2	2-5/8	7-1/4	8-1/2	1/4	1/8	9	5-7/8	4	1/2-13	3/4	1/4	1/8	6-1/4	9	90	100	205	206	182TNC
184TNC	9	7-1/2	17/32	3-3/4	2-3/4	4-1/2	9	1-1/8	2-1/2	2-5/8	7-1/4	8-1/2	1/4	1/8	9	6-3/8	4	1/2-13	3/4	1/4	1/8	6-3/4	9-1/2	105	125	205	206	184TNC
213TNC	10-1/2	7-1/2	21/32	4-1/4	2-3/4	5-1/4	10-1/2	1-3/8	3-1/8	3-1/8	7-1/4	8-1/2	1/4	1/4	9	7-1/4	4	5/8-11	3/4	5/16	5/32	7-1/4	10-1/4	145	160	206	207	213TNC
215TNC	10-1/2	9	21/32	4-1/4	3-1/2	5-1/4	10-1/2	1-3/8	3-1/8	3-1/8	7-1/4	8-1/2	1/4	1/4	9	8	4	5/8-11	3/4	5/16	5/32	7-3/4	11	175	190	206	207	215TNC
254TNC	12-1/2	10-3/4	25/32	5	4-1/8	6-1/4	12-1/2	1-5/8	3-3/4	3-3/4	7-1/4	8-1/2	1/4	1/4	10	9-1/8	4	3/4-10	3/4	3/8	3/16	9-1/4	13	265	280	207	209	254TNC
256TNC	12-1/2	12-1/2	25/32	5	5	6-1/4	12-1/2	1-5/8	3-3/4	3-3/4	7-1/4	8-1/2	1/4	1/4	10	10	4	3/4-10	3/4	3/8	3/16	10	14	335	350	207	209	256TNC
286TNC	14	14	25/32	5-1/2	5-1/2	7	14	1-7/8	4-3/8	4-3/8	9	10-1/2	1/4	1/4	13	10-1/2	4	3/4-10	1	1/2	1/4	12-1/4	15-1/2	475	490	207	309	286TNC
286TNSC	14	14	25/32	5-1/2	5-1/2	7	14	1-5/8	3	3	9	10-1/2	1/4	1/4	13	10-1/2	4	3/4-10	1	3/8	3/16	12-1/4	15-1/2	475	490	207	209	286TNSC
326TNC	16	15-1/2	15/16	6-1/4	6	8	16	2-1/8	5	5	9	10-1/2	1/4	1/4	13-1/4	11-1/2	4	7/8-9	1	1/2	1/4	13-1/4	17	700	800	309	311	326TNC
326TNSC	16	15-1/2	15/16	6-1/4	6	8	16	1-7/8	3-1/2	3-1/2	9	10-1/2	1/4	1/4	13-1/4	11-1/2	4	7/8-9	1	1/2	1/4	13-1/4	17	700	800	309	309	326TNSC
365TNC	18	16-1/4	1-1/16	7	6-1/8	9	18	2-3/8	5-5/8	5-5/8	14	16	1/4	1/4	18	12-1/4	8	3/4-10	1	5/8	5/16	14-3/4	18	870	1290	310	313	365TNC
365TNSC	18	16-1/4	1-1/16	7	6-1/8	9	18	1-7/8	3-1/2	3-1/2	14	16	1/4	1/4	18	12-1/4	8	3/4-10	1	1/2	1/4	14-3/4	18	870	1290	310	310	365TNSC
405TNC	20	17-3/4	1-1/16	8	6-7/8	10	20	2-7/8	7	7	14	16	1/4	1/4	18	13-3/4	8	3/4-10	1	3/4	3/8	16-1/2	19-1/4	1250	1530	312	315	405TNC
405TNSC	20	17-3/4	1-1/16	8	6-7/8	10	20	2-1/8	4	4	14	16	1/4	1/4	18	13-3/4	8	3/4-10	1	1/2	1/4	16-1/2	19-1/4	1250	1530	311	311	405TNSC
445TNC	22	20-1/2	1-3/16	9	8-1/4	11	22	3-3/8	8-1/4	8-1/4	16	18	1/4	1/4	20	16	8	7/8-9	1	7/8	7/16	18-1/2	21-1/2	1750	2375	313	317	445TNC
445TNSC 2/	22	20-1/2	1-3/16	9	8-1/4	11	22	2-3/8	4-1/2	4-1/2	16	18	1/4	1/4	20	16	8	7/8-9	1	5/8	5/16	18-1/2	21-1/2	1750	2375	313	313	445TNSC
445TN2C 3/	22	20-1/2	1-3/16	9	8-1/4	11	22	2-1/8	4	4	16	18	1/4	1/4	20	16	8	7/8-9	1	1/2	1/4	18-1/2	21-1/2	1750	2375	311	311	445TN2C
505TNC 2/	24-1/2	21-1/2	1-3/16	10	9	12-1/2	24-3/4	1-3/8	2-11/16	2-13/16	20	22	1/4	1/4	24	18-1/2	8	5/8-11	1	5/8	5/16	20-1/2	23	2300	2800	311	314	505TNC
505TN2C 3/	24-1/2	21-1/2	1-3/16	10	9	12-1/2	24-3/4	1-3/8	2-11/16	2-13/16	20	22	1/4	1/4	24	18-1/2	8	5/8-11	1	1/2	1/4	20-1/2	23	2300	2800	311	311	505TN2C

1/ THIS DIMENSION SHALL NOT CAUSE INTERFERENCE IN THE PLANE OF THE FEET.
2/ 1800 R/MIN AND LESS
3/ 3600 R/MIN
4/ MAXIMUM BEARING SIZE , 312, FOR 3600 R/MIN
5/ SEE NOTE 7

NOTES (FOR TABLE "B")

1. DPP-DRIPPROOF PROTECTED.
2. FC-FAN COOLED. APPLIES TO TEFC, SPTFC, EXPFC.
3. OPPOSITE DRIVE END (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON THE ODE OR DE.

FIGURE 2. STANDARDS FOR INTEGRAL HORSEPOWER ALTERNATING CURRENT TYPE C FACE-MOUNTED HORIZONTAL AND VERTICAL "T" FRAME MOTORS

TABLE A - FRAME SIZE ASSIGNMENTS FOR C FACE DESIGN A, B AND C CONSTANT SPEED, 'T' FRAME MOTORS.

Hp	3600 R/MIN		1800 R/MIN		1200 R/MIN		900 R/MIN	
	DPP	FC	DPP	FC	DPP	FC	DPP	FC
1 1/	182TN	182TN	182TN	182TN	182TN	182TN	182TN	184TN
1-1/2	182TN	182TN	182TN	182TN	182TN	184TN	184TN	213TN
2	182TN	182TN	182TN	182TN	184TN	213TN	213TN	215TN
3	182TN	184TN	182TN	184TN	213TN	215TN	215TN	254TN
5	182TN	213TN	184TN	213TN	215TN	254TN	254TN	256TN
7-1/2	184TN	215TN	213TN	215TN	254TN	256TN	256TN	256TN
10	213TN	254TN	215TN	254TN	256TN	256TN	286TN	286TN
15	215TN	256TN	254TN	256TN	286TN	286TN	286TN	326TN
20	254TN	286TN	256TN	286TN	286TN	326TN	326TN	326TN
25	256TN	286TN	286TN	286TN	326TN	326TN	326TN	365TN
30	286TN	326TN	286TN	326TN	326TN	365TN	365TN	365TN
40	286TN	326TN	326TN	326TN	365TN	365TN	365TN	405TN
50	326TN	365TNS	326TN	365TN	365TN	405TN	405TN	405TN
60	326TN	365TNS	365TN	365TN	405TN	405TN	405TN	445TN
75	365TNS	405TNS	365TN	405TN	405TN	445TN	445TN	445TN
100	365TNS	445TN2	405TN	445TN	445TN	445TN	445TN	-----
125	405TNS	445TN2	405TN	445TN	445TN	445TN	-----	-----
150	445TN2	445TN2	445TN	445TN	-----	-----	-----	-----
200	445TN2	-----	445TN	-----	-----	-----	-----	-----
250	445TN2	-----	-----	-----	-----	-----	-----	-----

1/ INCLUDES 1/2 AND 3/4 HP.

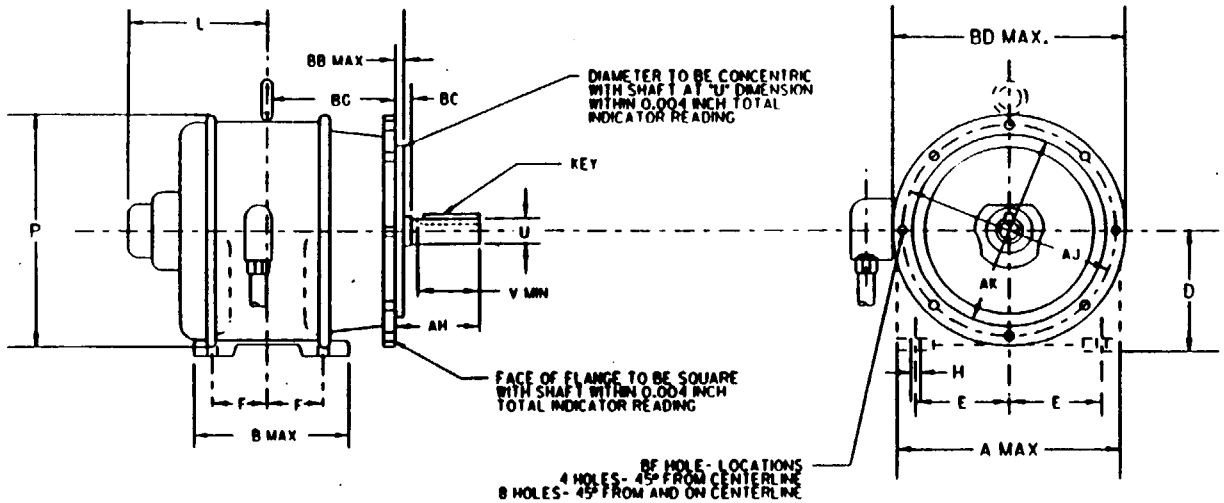
HORSEPOWER, SYNCHRONOUS SPEED, FRAME SIZE AND DEGREE OF ENCLOSURE SHALL BE IN ACCORDANCE WITH TABLE 'A' AND WHERE A CHOICE EXISTS, WILL BE SPECIFIED IN THE CONTRACT OR ORDER.

EXCEPT FOR MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES, MOTOR WEIGHTS SHALL NOT EXCEED THE MAXIMUM LIMITS OF TABLE "B". MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES SHALL NOT EXCEED THE MAXIMUM WEIGHT LIMITS OF TABLE "B", FOR (FC) ENCLOSURES, BY MORE THAN 4 PERCENT.

NOTES (FOR TABLE 'A')

1. DPP-DRIPPROOF PROTECTED.
2. FC-FAN COOLED, APPLIES TO TEFC, SPTFC, EXPFC.
3. MOTORS WITH ENCLOSURES OTHER THAN DPP AND THE AIR-OVER AND SUBMERSIBLE TYPES, SHALL HAVE THE SAME FRAME SIZE AS THE FAN COOLED (FC) TYPES. MOTORS WITH AIR-OVER OR SUBMERSIBLE ENCLOSURES SHALL HAVE FRAME SIZES NOT LARGER THAN THE (FC) TYPES.
4. SHORT SHAFT EXTENSIONS (TNS) MAY BE FURNISHED FOR COUPLED SERVICE AS SHOWN IN TABLE B.
5. FRAME SIZE MAY BE INCREASED BY ONE (1) FRAME SIZE FOR 3600 R/MIN MOTORS WHERE A NON-MAGNETIC ONE PIECE SHAFT IS REQUIRED.
6. SHORT SHAFT EXTENSIONS (TNS) SHALL BE FURNISHED ON 3600 R/MIN MOTORS 365 FRAME AND 405 FRAME. THE TN2 SHAFT EXTENSION SHALL BE FURNISHED ON 3600 R/MIN MOTORS 445 FRAME AND LARGER.
7. OPPOSITE DRIVE END (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON THE ODE OR DE.
8. MOTORS WITH A DEGREE OF ENCLOSURE OF TOTALLY ENCLOSED (TE) MAY USE A FRAME SIZE APPLICABLE TO THE NEXT LARGER HP RATING INDICATED IN TABLE A FOR FC ENCLOSURES OF THE SAME SPEED RATING.

FIGURE 2. STANDARDS FOR INTEGRAL HORSEPOWER ALTERNATING CURRENT TYPE C FACE MOUNTED HORIZONTAL AND VERTICAL 'T' FRAME MOTORS. -CONTINUED



TYPE D - FACE-MOUNTED INTEGRAL - HORSEPOWER MOTOR FRAMES

TOLERANCES

"D" DIMENSIONS		
FRAMES 182TND-326TND	+0",	-1/32"
FRAMES 365TND-505TN2D	+0",	-1/16"
"2E" DIMENSION	+1/64",	-1/64"
"2F" DIMENSION	+1/64",	-1/64"
"U" DIMENSIONS		
SHAFT DIAMETERS 1" - 1 1/2" INC.	+0.0000",	-0.0005"
SHAFT DIAMETERS 1-5/8" - 3-3/8" INC.	+0.000",	-0.001"
KEYWAYS		
WIDTH	+0.002",	-0.000"

THE SHAFT RUNOUT SHALL NOT EXCEED THE FOLLOWING

FRAME SIZE	SHAFT RUNOUT (TIR)
182TND-286TNSD	0.002 INCH MAX.
326TND-505TN2D	0.003 INCH MAX.

"AK" DIMENSION

11" AND SMALLER	+0.000",	-0.002"
14" AND LARGER	+0.000",	-0.003"

SHAFT DIAMETER	KEY DIMENSION	BOTTOM OF KEYSEAT TO OPPOSITE SIDE OF SHAFT
1-1/8"	1/4" x 1/4"	.986" - .971"
1-3/8"	5/16" x 5/16"	1.201" - 1.186"
1-5/8"	3/8" x 3/8"	1.416" - 1.401"
1-7/8"	1/2" x 1/2"	1.591" - 1.576"
2-1/8"	1/2" x 1/2"	1.845" - 1.830"
2-3/8"	5/8" x 5/8"	2.021" - 2.006"
2-5/8"	5/8" x 5/8"	2.275" - 2.260"
2-7/8"	3/4" x 3/4"	2.450" - 2.435"
3-3/8"	7/8" x 7/8"	2.880" - 2.865"

NOTES (FOR TABLE "B")

1. DPP-DRIP PROOF PROTECTED.
2. FC - FAN COOLED. APPLIES TO TEFC, SPTFC, EXPFC.
3. OPPOSITE DRIVE END (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON THE ODE OR DE.

TABLE B - STANDARD MTG. DIMENSIONS, BEARING SIZES AND WEIGHTS FOR TYPE D FACE - MOUNTED HORIZONTAL AND VERTICAL ALTERNATING CURRENT "T" FRAME MOTORS.

FRAME NUMBER	A (MAX.)	B (MAX.)	H	E	F	D	P 1/ (MAX.)	U	V (MIN.)	AH	AJ	AK	BB (MAX.)	BC	BD (MAX.)	BG	BF HOLE NO.	BF HOLE SIZE	KEY WAY NOMINAL WIDTH	KEY WAY NOMINAL DEPTH	L MAXIMUM DPP	L MAXIMUM FC	MAX. WEIGHT (POUNDS) DPP	MAX. WEIGHT (POUNDS) FC	BEARING SIZE MIN. 4/ 5/ ODE	BEARING SIZE MIN. 4/ 5/ DE	FRAME NUMBER
182TND	9	6-1/2	17/32	3-3/4	2-1/4	4-1/2	9	1-1/8	2	2-3/4	10	9	1/4	0	8	5-3/4	4	17/32	1/4	1/8	6-1/4	9	90	100	205	206	182TND
184TND	9	7-1/2	17/32	3-3/4	2-3/4	4-1/2	9	1-1/8	2	2-3/4	10	9	1/4	0	8	6-1/4	4	17/32	1/4	1/8	6-3/4	9-1/2	105	125	205	206	184TND
213TND	10-1/2	7-1/2	21/32	4-1/4	2-3/4	5-1/4	10-1/2	1-3/8	2-3/4	3-3/8	10	9	1/4	0	8	7	4	21/32	5/16	5/32	7-1/4	10-1/4	145	160	206	207	213TND
215TND	10-1/2	9	21/32	4-1/4	3-1/2	5-1/4	10-1/2	1-3/8	2-3/4	3-3/8	10	9	1/4	0	9	7-3/4	4	21/32	5/16	5/32	7-3/4	11	175	190	206	207	215TND
254TND	12-1/2	10-3/4	25/32	5	4-1/8	6-1/4	12-1/2	1-5/8	3-1/2	4	12-1/2	11	1/4	0	14	8-7/8	4	25/32	3/8	3/16	9-1/4	13	265	280	207	209	254TND
256TND	12-1/2	12-1/2	25/32	5	5	6-1/4	12-1/2	1-5/8	3-1/2	4	12-1/2	11	1/4	0	14	9-3/4	4	25/32	5/16	5/32	10	14	335	350	207	209	256TND
286TND	14	14	25/32	5-1/2	5-1/2	7	14	1-7/8	4-5/8	4-5/8	12-1/2	11	1/4	0	14	10-1/4	4	25/32	1/2	1/4	12-1/4	15-1/2	475	490	207	309	286TND
286TNSD	14	14	25/32	5-1/2	5-1/2	7	14	1-5/8	2-1/2	3-1/4	12-1/2	11	1/4	0	14	10-1/4	4	25/32	3/8	3/16	12-1/4	15-1/2	475	490	207	209	286TNSD
326TND	16	15-1/2	15/16	6-1/4	6	8	16	2-1/8	5-3/8	5 1/4	16	14	1/4	0	18	11-1/4	4	15/16	1/2	1/4	13-1/4	17	700	800	209	311	326TND
326TNSD	16	15-1/2	15/16	6-1/4	6	8	16	1-7/8	3	3-3/4	16	14	1/4	0	18	11-1/4	4	15/16	1/2	1/4	13-1/4	17	700	800	209	309	326TNSD
365TND	18	16-1/4	1-1/16	7	6-1/8	9	18	2-3/8	6-1/8	5-7/8	18	16	1/4	0	20	12	8	25/32	5/8	5/16	14-3/4	18	870	1290	310	313	365TND
365TNSD	18	16-1/4	1-1/16	7	6-1/8	9	18	1-7/8	3-1/2	3-3/4	18	16	1/4	0	20	12	8	25/32	1/2	1/4	14-3/4	18	870	1290	310	310	365TNSD
405TND	20	17-3/4	1-1/16	8	6-7/8	10	20	2-7/8	6-7/8	7-1/4	20	18	1/4	0	22	13-1/2	8	25/32	3/4	3/8	16-1/2	19-1/4	1250	1530	312	315	405TND
405TNSD	20	17-3/4	1-1/16	8	6-7/8	10	20	2-1/8	4	4-1/4	20	18	1/4	0	22	13-1/2	8	25/32	1/2	1/4	16-1/2	19-1/4	1250	1530	311	311	405TNSD
445TND	22	20-1/2	1-3/16	9	8-1/4	11	22	3-3/8	8-3/8	8-1/2	20	18	1/4	0	22	15-3/4	8	15/16	7/8	7/16	18-1/2	21-1/2	1750	2375	313	317	445TND
445TNSD 2/	22	20-1/2	1-3/16	9	8-1/4	11	22	2-3/8	4	4-3/4	20	18	1/4	0	22	15-3/4	8	15/16	5/8	5/16	18-1/2	21-1/2	1750	2375	313	313	445TNSD
445TN2D 3/	22	20-1/2	1-3/16	9	8-1/4	11	22	2-1/8	4	4-1/4	20	18	1/4	0	22	15-3/4	8	15/16	1/2	1/4	18-1/2	21-1/2	1750	2375	311	311	445TN2D
505TND 2/	25	23	1-5/16	10	9	12-1/2	24	2-5/8	6-1/4	6-1/2	22	18	1/4	0	25	18-1/2	8	13/16	5/8	5/16	20-1/2	23	2300	2800	311	314	505TND
505TN2D 3/	25	23	1-5/16	10	9	12-1/2	24	2-1/8	4	4-1/4	22	18	1/4	0	25	18-1/2	8	13/16	1/2	1/4	20-1/2	23	2300	2800	311	311	505TN2D

1/ THIS DIMENSION SHALL NOT CAUSE INTERFERENCE IN THE PLANE OF THE FEET.
2/ 1800 R/MIN AND LESS
3/ 3600 R/MIN
4/ MAXIMUM BEARING SIZE. 312, FOR 3600 R/MIN
5/ SEE NOTE 7

FIGURE 3. STANDARDS FOR INTEGRAL HORSEPOWER ALTERNATING CURRENT TYPE D FACE-MOUNTED HORIZONTAL AND VERTICAL "T" FRAME MOTORS.

TABLE A - FRAME SIZE ASSIGNMENTS FOR D FACE DESIGN A, B AND C
CONSTANT SPEED, 'T' FRAME MOTORS.

Hp	3600 R/MIN		1800 R/MIN		1200 R/MIN		900 R/MIN	
	DPP	FC	DPP	FC	DPP	FC	DPP	FC
1 1/	182TN	182TN	182TN	182TN	182TN	182TN	182TN	184TN
1-1/2	182TN	182TN	182TN	182TN	182TN	184TN	184TN	213TN
2	182TN	182TN	182TN	182TN	184TN	213TN	213TN	215TN
3	182TN	184TN	182TN	184TN	213TN	215TN	215TN	254TN
5	182TN	213TN	184TN	213TN	215TN	254TN	254TN	256TN
7-1/2	184TN	215TN	213TN	215TN	254TN	256TN	256TN	256TN 286TN
10	213TN	254TN	215TN	254TN	256TN	256TN	286TN	
15	215TN	256TN	254TN	256TN	286TN	286TN	286TN	326TN
20	254TN	286TN	254TN	286TN	286TN	326TN	326TN	326TN
25	256TN	286TN	286TN	286TN	326TN	326TN	326TN	365TN
30	286TN	326TN	286TN	326TN	326TN	365TN	365TN	365TN
40	286TN	326TN	326TN	326TN	365TN	365TN	365TN	405TN
50	326TN	365TNS	326TN	365TN	365TN	405TN	405TN	405TN
60	326TN	365TNS	365TN	365TN	405TN	405TN	405TN	445TN
75	365TNS	405TNS	365TN	405TN	405TN	445TN	445TN	445TN
100	365TNS	445TN2	405TN	445TN	445TN	445TN	445TN	-----
125	405TNS	445TN2	405TN	445TN	445TN	445TN	-----	-----
150	445TN2	445TN2	445TN	445TN	-----	-----	-----	-----
200	445TN2	-----	445TN	-----	-----	-----	-----	-----
250	445TN2	-----	-----	-----	-----	-----	-----	-----

1/ INCLUDES 1/2 AND 3/4 HP.

HORSEPOWER, SYNCHRONOUS SPEED, FRAME SIZE AND DEGREE OF ENCLOSURE SHALL BE IN ACCORDANCE WITH TABLE 'A' AND WHERE A CHOICE EXISTS, WILL BE SPECIFIED IN THE CONTRACT OR ORDER.

EXCEPT FOR MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES, MOTOR WEIGHTS SHALL NOT EXCEED THE MAXIMUM LIMITS OF TABLE "B". MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES SHALL NOT EXCEED THE MAXIMUM WEIGHT LIMITS OF TABLE "B", FOR (FC) ENCLOSURES, BY MORE THAN 4 PERCENT.

NOTES (FOR TABLE 'A')

1. DPP-DRIPPROOF PROTECTED.
2. FC-FAN COOLED. APPLIES TO TEFC, SPTFC, EXPFC.
3. MOTORS WITH ENCLOSURES OTHER THAN DPP AND THE AIR-OVER AND SUBMERSIBLE TYPES, SHALL HAVE THE SAME FRAME SIZE AS THE FAN COOLED (FC) TYPES. MOTORS WITH AIR-OVER OR SUBMERSIBLE ENCLOSURES SHALL HAVE FRAME SIZES NOT LARGER THAN THE (FC) TYPES.
4. SHORT SHAFT EXTENSIONS (TNS) MAY BE FURNISHED FOR COUPLED SERVICE AS SHOWN IN TABLE B.
5. FRAME SIZE MAY BE INCREASED BY ONE (1) FRAME SIZE FOR 3600 R/MIN MOTORS WHERE A NON-MAGNETIC ONE PIECE SHAFT IS REQUIRED.
6. SHORT SHAFT EXTENSIONS (TNS) SHALL BE FURNISHED ON 3600 R/MIN MOTOR 365 FRAME AND 405 FRAME. THE TN2 SHAFT EXTENSION SHALL BE FURNISHED ON 3600 R/MIN MOTORS 445 FRAME AND LARGER.
7. OPPOSITE DRIVE END (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON THE ODE OR DE.
8. MOTORS WITH A DEGREE OF ENCLOSURE OF TOTALLY ENCLOSED (TE) MAY USE A FRAME SIZE APPLICABLE TO THE NEXT LARGER HP RATING INDICATED IN TABLE A FOR FC ENCLOSURES OF THE SAME SPEED RATING.

FIGURE 3. STANDARDS FOR INTEGRAL HORSEPOWER ALTERNATING CURRENT TYPE D FACE-MOUNTED HORIZONTAL AND VERTICAL 'T' FRAME MOTORS. -CONTINUED

STRUCTURAL BORNE NOISE REQUIREMENT (ABS RE 10^{-3} CM/SEC^2) AT RATED VOLTS & FREQ
1/3 OCTAVE BANDCENTER--MEASURED ON FOOT WITH HIGHEST OVERALL A/B LEVEL

HZ	10	12 1/2	16	20	25	31 1/2	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
RADIAL																													
AXIAL																													
TANG																													

STRUCTURAL BORNE NOISE (ABS RE 10^{-3} CM/SEC^2)
1/3 OCTAVE BANDCENTER--MEASURED ON FOOT WITH HIGHEST OVERALL A/B LEVEL

HZ	10	12 1/2	16	20	25	31 1/2	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
RADIAL																													
AXIAL																													
TANG																													

NOISE TEST

AIRBORNE NOISE TEST DATA			GUARANTEED AIRBORNE NOISE AT RATED VOLT & FREQ	
OCTAVE BAND CENTERS (HZ)	dB LEVEL RE 20u PA SOUND PRESSURE		dB LEVEL RE 20u PA SOUND PRESSURE	
	HS	LS	HS	LS
315				
63				
125				
250				
500				
1000				
2000				
4000				
8000				

ROTOR RESISTANCE AT LOCKED ROTOR AND TORQUE

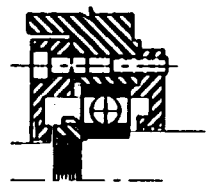
VOLTS	AMPS	R/W	LB FT

FRICTION AND CORE LOSS DATA

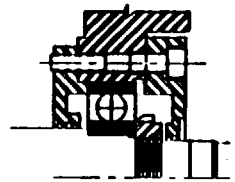
VOLTS	AMPS	WATTS

FULL LOAD LOSSES (WATTS)	
FRICTION AND WINDAGE	
CORE	
STATOR I^2R	
ROTOR I^2R	
STRAY LOAD	
TOTAL	

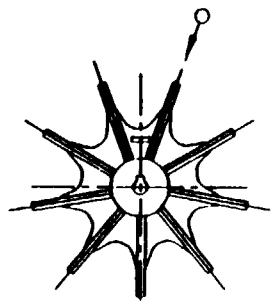
MOTOR WEIGHT	LBS
ROTOR WEIGHT	LBS
ROTOR WR^2	LB FT^2



FREE END BEARING
OPPOSITE DRIVE END



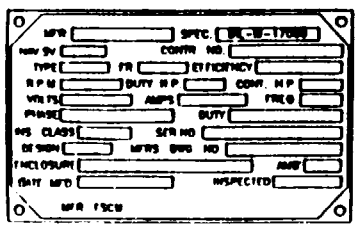
FIXED END BEARING
DRIVE END



BLADE FAN

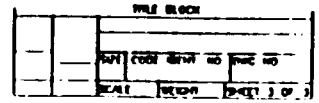
BEARING CONSTRUCTION

BEARING	
MOUNTING	
LUBRICANT	
BEARING REMOVAL TOOL	
BEARING REPLACEMENT	
F.E. END BEARING DIA.	
D.E. END BEARING DIA.	
BEARING O.D.	

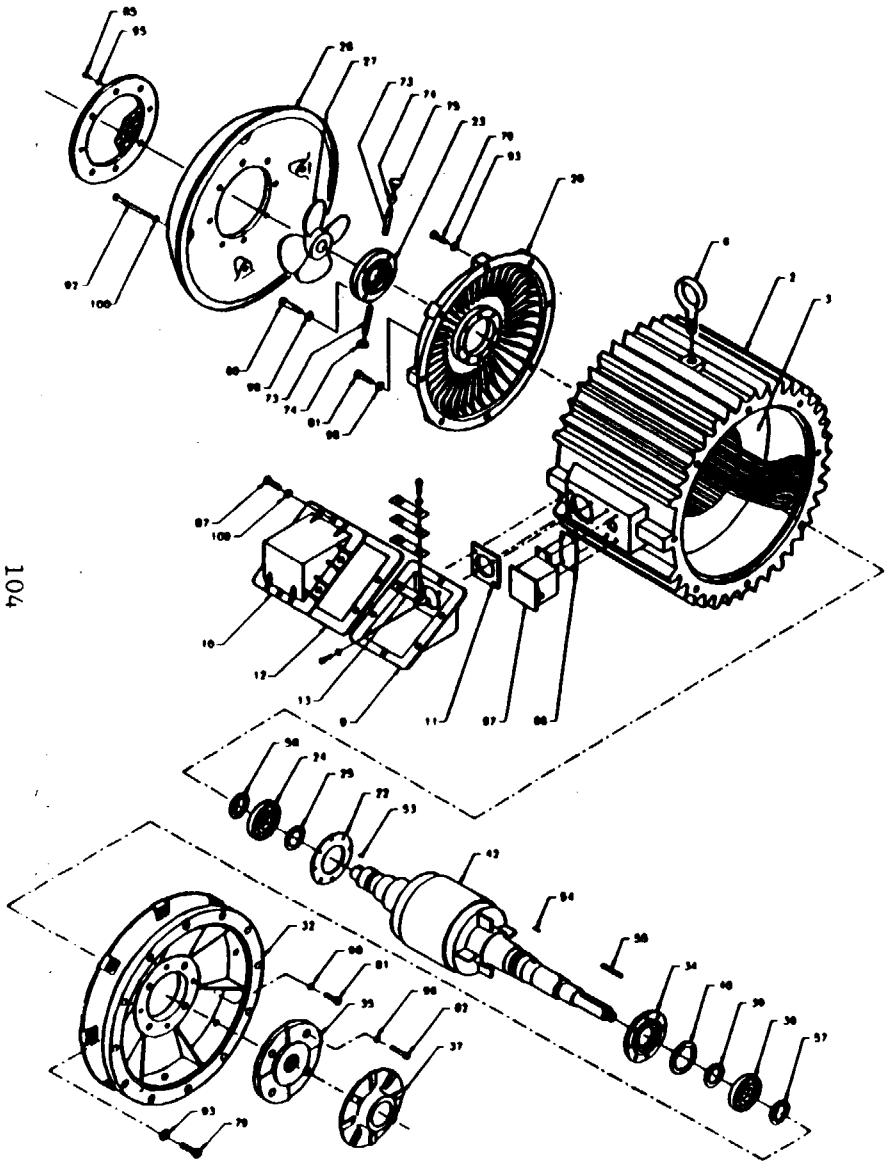


DRAW OF ITEM - ____

FIGURE 5 - SERVICE "A" MOTOR (CONTINUED)



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

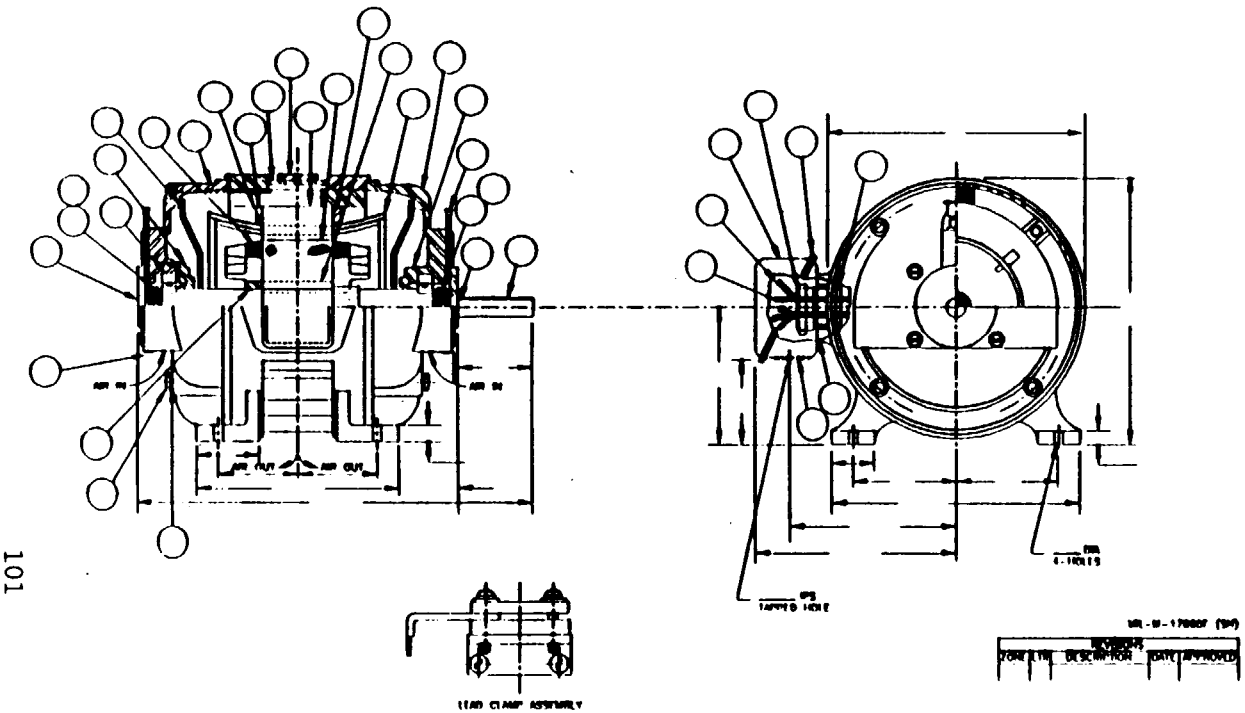


GROUP ASSEMBLY PARTS LIST (GAPL)

INDEX NUMBER	PART NUMBER/ SPEC	DESCRIPTION	MFRS CODE (FSCM)	QTY PER ASSY
1	3033-1	FRAME		1
3	2430-1	CORE, STATOR		1
6	379-14	EYEBOLT		1
9	644-8	BOX, TERMINAL		1
10	644-9	COVER, TERMINAL BOX		1
11	812-7	GASKET, INSULATING TERMINAL BOX		1
12	812-7	GASKET, COVER, TERMINAL BOX		1
13	133-010	ASSEMBLY, LEAD CLAMP		1
		TERMINAL LUG		
		SCREW, CAP, HEX HEAD, 3/8-16 X 2		
		LOCKWASHER, POS. 3/8 STUD		
		SCREW, CAP, HEX HEAD, 1/4-20 X 2-1/4		
		LOCKWASHER, POS. 1/4 STUD		
		CLAMPING PIECE (SUPPORT AND LOWER)		
		CLAMPING PIECE (MIDDLE)		
		SUPPORT, HEAD CLAMP		
20	2139-01	ASSEMBLY, END BRACKET, D.E.		1
22	2080-1	CAP, BEARING, INSIDE		1
23	2121-1	CAP, BEARING, OUTSIDE		1
24	698-10	BEARING, BALL (311)		1
25	230-13	GREASE, SLINGER		1
26	2139-01	ASSEMBLY, FAN COVER		1
27	2070-1	FAN		1
28	2131-01	ASSEMBLY, END BRACKET, O.E.		1
29	2081-0	CAP, BEARING, INSIDE		1
30	2120-1	CAP, BEARING, OUTSIDE		1
32	698-9	BEARING, BALL (311)		1
33	2130-1	SLINGER, GREASE, O.E.		1
35	230-5-13	GREASE, SLINGER		1
36	812-22	GASKET, SPIDER		1
42	2002-01	ASSEMBLY, ROTOR, COMPLETE		1
53	2123-1	KEY, FAN, F.E.		1
54	2123-2	KEY, BALANCING DISC, O.E.		1
56	2129-0	KEY, COUPLING		1
57	698-12	LOCKNUT, BEARING, F.E.		1
58	698-11	LOCKNUT, BEARING, O.E.		1
60	1633-1	GASKET, VENTILATOR DISC		1
61	B461A06	SYSTEM, INSPECTION VENTILATOR		1
75	850-8-281	NIPPLE, PIPE, F.E., 1/4 STD X 9-1/2		1
76	850-9-471	CAP, PIPE, 1/4 STD		2
78	COMM	CUP, GREASE, 600 PEDALE		2
79	77-5-88	SCREW, CAP HEX HEAD, 3/8-11 X 3		10
80	77-5-88	SCREW, CAP, SOCKET HEAD, 1/2-13 X 2-1/4		4
81	77-5-88	SCREW, CAP, SOCKET HEAD, 3/8-16 X 2-1/4		8
82	77-5-88	SCREW, CAP, SOCKET HEAD 3/8-16 X 3		4
85	77-5-88	SCREW, MACH. RD HEAD, #10-24 X 1/2		16
87	77-5-88	SCREW, CAP, HEX HEAD, 3/8-16 X 1		8
88	77-5-88	SCREW, CAP, HEX HEAD, 3/8-16 X 5		8
92	COMM	LOCKWASHER, POS. 5/8 STD		10
93	COMM	LOCKWASHER, POS. 1/4 STD		6
96	COMM	LOCKWASHER, POS. 1/2 IN-COLLAR		4
100	COMM	LOCKWASHER, POS. 3/8 IN-COLLAR		12
101	COMM	LOCKWASHER, POS. 3/8 STD		16
		(* INDICATES REPAIR PART)		

FIGURE 6 AC MOTOR - TYPICAL EXPLODED ASSEMBLY DRAWING

TITLE BLOCK			
SIZE	CODE IDENT NO	DWG NO	
SCALE	WEIGHT	SHEET 1 OF 1	



LEAD CLAMP ASSEMBLY

FIGURE 9 SERVICE "A" MOTOR

NOTES:

ALTERNATING CURRENT MOTORS	
NEMA TYPE & CLASS	
FRAME SIZE	SUFF
DEGREE OF ENCLOSURE	
SPEED CLASS	R.P.M. SYN
H.P.	VOLTS PHASE
NAME PLATE AMPS *	TYPE OF ROTOR
DESIGN	
INSULATION CLASS	SERVICE
PERMISSIBLE AMBIENT TEMPERATURE	C OR LESS
NAVY SERVICE	

NOTE: * THIS CALCULATED VALUE OF FULL-LOAD AMPERES CAN BE USED AS A BASIS FOR SELECTING THE DISTRIBUTION SYSTEM COMPONENTS AND OVERLOAD HEATERS OR RELAYS.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

QP AND A QTY.	ITEM NO	NOMENCLATURE OR DESCRIPTION	PART NO OR IDENTIFYING NO	MATERIAL	MATL SPEC	REMARKS
LIST OF MATERIAL						

TITLE BLOCK			
		CODE IDENT NO	DWG NO
	SCALE	WEIGHT	SHEET 1 OF 3

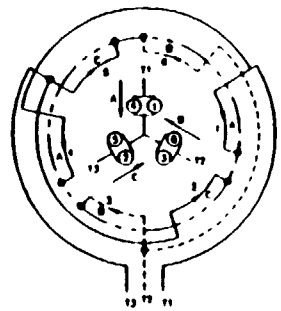
TEMPERATURE RISE DATA - DEGREES CELSIUS

LOCATION OF NUMBERED THERMOCOUPLES

GUARANTEED PERFORMANCE AT RATED VOLTAGE AND FREQUENCY

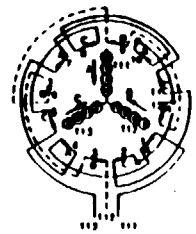
SPECIFICATIONS AND EXCEPTIONS

PERFORMANCE AT RATED VOLTAGE AND FREQUENCY



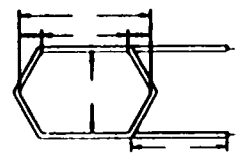
2-POLE, 3 PHASE, 2-PARALLEL STAR CONNECTION DIAGRAM

HIGH SPEED

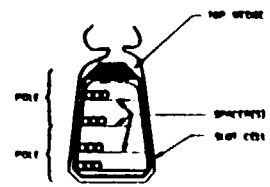


6-POLE, 3-PHASE, SERIES STAR CONNECTION DIAGRAM

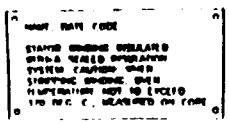
LOW SPEED



STATOR COIL



SECTION OF STATOR SLOT



INFORMATION PLATES

LOW NOISE MOTOR
HANDLE WITH CARE

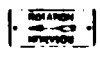
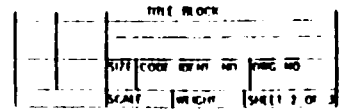
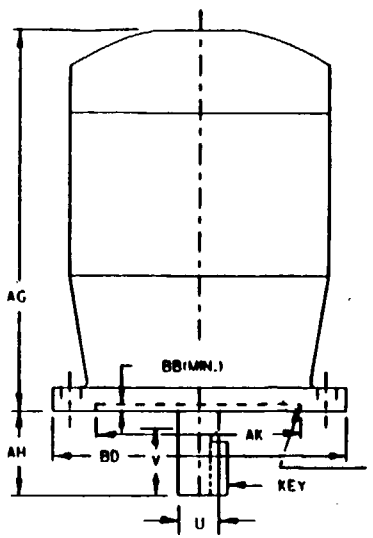
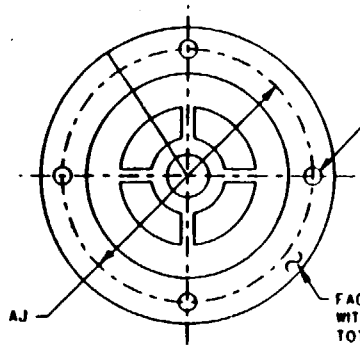


FIGURE 5. SERVICE "A" MOTOR (CONTINUED)





DIAMETER TO BE CONCENTRIC WITH SHAFT AT U * *
DIMENSIONS WITHIN 0.004 INCH TOTAL INDICATOR READING



BF HOLE - LOCATIONS
4 HOLES - ON CENTERLINE
8 HOLES - 45° FROM AND ON CENTERLINE
12 HOLES - EQUALLY SPACED, ONE ON EACH CENTERLINE

FACE OF FLANGE TO BE SQUARE WITH SHAFT WITHIN 0.004 INCH TOTAL INDICATOR READING

TYPE P - BASE INTEGRAL HORSEPOWER MOTOR FRAME

TOLERANCES

"U" DIMENSION
SHAFT DIAMETERS 1" - 1-1/2" INC. +0.0000", -0.0005"
SHAFT DIAMETERS 1-5/8" - 3-3/8" INC. +0.000", -0.001"

KEYWAYS
WIDTH +0.002", -0.000"
DEPTH

SHAFT DIAMETER	KEY DIMENSION	BOTTOM OF KEYSEAT TO OPPOSITE SIDE OF SHAFT
1-1/8"	1/4" x 1/4"	.986" - .971"
1-3/8"	5/16" x 5/16"	1.201" - 1.186"
1-5/8"	3/8" x 3/8"	1.416" - 1.401"
1-7/8"	1/2" x 1/2"	1.591" - 1.576"
2-1/8"	1/2" x 1/2"	1.845" - 1.830"
2-3/8"	5/8" x 5/8"	2.021" - 2.006"
2-5/8"	5/8" x 5/8"	2.275" - 2.260"
2-7/8"	3/4" x 3/4"	2.450" - 2.435"
3-3/8"	7/8" x 7/8"	2.880" - 2.865"

THE SHAFT RUNOUT SHALL NOT EXCEED THE FOLLOWING

FRAME SIZE	SHAFT RUNOUT (TIR)
182TNP-286TNP	0.002 INCH MAX.
326TNP-505TN2P	0.003 INCH MAX.

"AK" DIMENSION

8-1/4", 18, 13-1/2"	+0.002", -0.000"
	+0.003", -0.000"

TABLE B - STANDARD MOUNTING, DIMENSIONS, BEARING SIZES, AND WEIGHTS FOR TYPE P BASE DIRECT COUPLED VERTICAL A.C. "T" FRAME MOTORS.

FRAME NUMBER	AH	U	V (MIN.)	AK	AJ	BD (MAX.)	BB (MAX.)	BF HOLE NO.	BF HOLE SIZE	AG (MAXIMUM) DPP	AG (MAXIMUM) FC	MAXIMUM WEIGHT (POUNDS) DPP	MAXIMUM WEIGHT (POUNDS) FC	BEARING SIZE MINIMUM 3/ 4/ ODE	BEARING SIZE MINIMUM 3/ 4/ DE	FRAME NUMBER
182TNP	2-1/4	1-1/8	2	8-1/4	9-1/8	8	3/16	4	21/32	17-3/8	23-1/4	90	100	205	206	182TNP
184TNP	2-1/4	1-1/8	2	8-1/4	9-1/8	8	3/16	4	21/32	18-3/8	24-1/4	105	125	205	206	184TNP
213TNP	3	1-3/8	2-3/4	8-1/4	9-1/8	8	3/16	4	21/32	20	25-5/8	145	160	206	207	213TNP
215TNP	3	1-3/8	2-3/4	8-1/4	9-1/8	8	3/16	4	21/32	21-1/4	27-1/8	175	190	206	207	215TNP
254TNP	3-3/4	1-5/8	3-1/2	8-1/4	9-1/8	8	3/16	4	25/32	24-1/8	29-1/8	265	280	207	209	254TNP
256TNP	3-3/4	1-5/8	3-1/2	8-1/4	9-1/8	8	3/16	4	25/32	25-3/4	30-3/4	335	350	207	209	256TNP
286TNP	3-3/4	1-7/8	3-1/2	8-1/4	9-1/8	12	3/16	4	25/32	30-1/2	33-1/4	475	490	207	309	286TNP
326TNP	3-3/4	2-1/8	3-1/2	13-1/2	14-3/4	16-1/2	1/4	4	15/16	32-3/4	34-1/2	700	800	309	309	326TNP
365TNP 1/	3-3/4	2-3/8	3-1/2	13-1/2	14-3/4	16-1/2	1/4	8	25/32	35	36-1/4	870	1290	310	313	365TNP
365TN2P 2/	3-3/4	2-1/8	3-1/2	13-1/2	14-3/4	16-1/2	1/4	8	25/32	35	36-1/4	870	1290	3H	3H	365TN2P
405TNP 1/	4-1/4	2-7/8	4	13-1/2	14-3/4	16-1/2	1/4	8	25/32	36-3/4	38-1/2	1250	1530	312	315	405TNP
405TN2P 2/	4-1/4	2-1/8	4	13-1/2	14-3/4	16-1/2	1/4	8	25/32	36-3/4	38-1/2	1250	1530	3H	3H	405TN2P
445TNP 1/	4-1/4	3-3/8	4	13-1/2	14-3/4	20	1/4	8	15/16	41	43	1750	2375	313	317	445TNP
445TN2P 2/	4-1/4	1-3/8	4	13-1/2	14-3/4	20	1/4	8	15/16	41	43	1750	2375	3H	3H	445TN2P
505TNP 1/	2-11/16	2-5/8	4	18	20	22	5/16	12	13/16	43	45	2300	2800	3H	314	505TNP
505TN2P 2/	2-11/16	1-3/8	2-11/16	18	20	22	5/16	12	13/16	43	45	2300	2800	3H	3H	505TN2P

1/ 1800 R/MIN AND LESS
2/ 3600 R/MIN
3/ MAXIMUM BEARING SIZE, 312, FOR 3600 R/MIN
4/ SEE NOTE 6

FIGURE 4. STANDARDS FOR ALTERNATING CURRENT INTEGRAL HORSEPOWER TYPE P BASE DIRECT COUPLED VERTICAL "T" FRAME MOTORS.

NOTES (FOR TABLE "B")
1. DPP - DRIPPROOF PROTECTED.
2. FC - FAN COOLED, APPLIES TO TEFC, SPTFC, EXFFC.
3. OPPOSITE END DRIVE (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON THE ODE OR DE.

TABLE A- FRAME SIZE ASSIGNMENTS FOR P BASE DESIGN A, B AND C CONSTANT SPEED, "T" FRAME MOTORS.

Hp	3600 R/MIN		1800 R/MIN		1200 R/MIN		900 R/MIN	
	DPP	FC	DPP	FC	DPP	FC	DPP	FC
1 1/	182TN	182TN	182TN	182TN	182TN	182TN	182TN	184TN
1-1/2	182TN	182TN	182TN	182TN	182TN	184TN	184TN	213TN
2	182TN	182TN	182TN	182TN	184TN	213TN	213TN	215TN
3	182TN	184TN	182TN	184TN	213TN	215TN	215TN	254TN
5	182TN	213TN	184TN	213TN	215TN	254TN	254TN	256TN
7-1/2	184TN	215TN	213TN	215TN	254TN	256TN	256TN	256TN
10	213TN	254TN	215TN	254TN	256TN	256TN	286TN	286TN
15	215TN	256TN	254TN	256TN	286TN	286TN	286TN	326TN
20	254TN	286TN	256TN	286TN	286TN	326TN	326TN	326TN
25	256TN	286TN	286TN	286TN	326TN	326TN	326TN	365TN
30	286TN	326TN	286TN	326TN	326TN	365TN	365TN	365TN
40	286TN	326TN	326TN	326TN	365TN	365TN	365TN	405TN
50	326TN	365TN2	326TN	365TN	365TN	405TN	405TN	405TN
60	326TN	365TN2	365TN	365TN	405TN	405TN	405TN	445TN
75	365TN2	405TN2	365TN	405TN	405TN	445TN	445TN	445TN
100	365TN2	445TN2	405TN	445TN	445TN	445TN	445TN	-----
125	405TN2	445TN2	405TN	445TN	445TN	-----	-----	-----
150	445TN2	445TN2	445TN	445TN	-----	-----	-----	-----
200	445TN2	-----	445TN	-----	-----	-----	-----	-----
250	445TN2	-----	-----	-----	-----	-----	-----	-----

1/ INCLUDES 1/2 AND 3/4 HP.

HORSEPOWER, SYNCHRONOUS SPEED, FRAME SIZE AND DEGREE OF ENCLOSURE SHALL BE IN CORDANCE WITH TABLE "A" AND WHERE A CHOICE EXISTS, WILL BE SPECIFIED IN THE CONTRACT OR ORDER.

EXCEPT FOR MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES, MOTOR WEIGHTS SHALL NOT EXCEED THE MAXIMUM LIMITS OF TABLE "B". MOTORS WITH WATERTIGHT OR SUBMERSIBLE TYPE ENCLOSURES SHALL NOT EXCEED THE MAXIMUM WEIGHT LIMITS OF TABLE "B", FOR (FC) ENCLOSURES, BY MORE THAN 4 PERCENT.

NOTES (FOR TABLE "A")

1. DPP-DRIPPROOF PROTECTED.
2. FC-FAN COOLED, APPLIES TO TEFC, SPTFC, EXPFC.
3. MOTORS WITH ENCLOSURES OTHER THAN DPP AND THE AIR-OVER AND SUBMERSIBLE TYPES, SHALL HAVE THE SAME FRAME SIZE AS THE FAN COOLED (FC) TYPES. MOTORS WITH AIR-OVER OR SUBMERSIBLE ENCLOSURES SHALL HAVE FRAME SIZES NOT LARGER THAN THE (FC) TYPES.
4. FRAME SIZE MAY BE INCREASED BY ONE (1) FRAME SIZE FOR 3600 R/MIN MOTORS WHERE A NON-MAGNETIC ONE PIECE SHAFT IS REQUIRED.
5. THE TN2 SHAFT EXTENSION SHALL BE FURNISHED ON 3600 R/MIN MOTORS 445 FRAME AND LARGER.
6. OPPOSITE DRIVE END (ODE) AND DRIVE END (DE) BEARING SIZE SHALL DIFFER. THE LARGER BEARING MAY BE ON THE ODE OR DE.
7. MOTORS WITH A DEGREE OF ENCLOSURE OF TOTALLY ENCLOSED (TE) MAY USE A FRAME SIZE APPLICABLE TO THE NEXT LARGER HP RATING INDICATED IN TABLE A FOR FC ENCLOSURES OF THE SAME SPEED RATING.

FIGURE 4. STANDARDS FOR ALTERNATING CURRENT INTEGRAL HORSEPOWER TYPE P BASE DIRECT COUPLED VERTICAL "T" FRAME MOTORS. -CONTINUED

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the comment number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of this form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-M-17060F(SH)	2. DOCUMENT DATE (YYMMDD) 950525

3. DOCUMENT TITLE
MOTORS, 60-HERTZ, ALTERNATING CURRENT, INTEGRAL-HORSEPOWER, SHIPBOARD USE

4. NATURE OF CHANGE (identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) DSN (If applicable) 7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME Technical Point of Contact (TPOC) MR. JOHN ANDERSON, NAVSEA 03E21 ADDRESS ALL CORRESPONDENCE AS FOLLOWS:	b. TELEPHONE (Include Area Code) (1) Commercial: DSN: TPOC: 703-602-5586 8-332-5586
c. ADDRESS (Include Zip Code) COMMANDER, NAVAL SEA SYSTEMS COMMAND ATTN: SEA 03R42 2531 JEFFERSON DAVIS HIGHWAY ARLINGTON, VA 22242-5160	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403 Falls Church, VA 22041-3466 Telephone 703-756-2340 DSN 289-2340