INCH-POUND
MIL-PRF-24755B(SH)
19 April 2010
SUPERSEDING
MIL-PRF-24755A(SH)
31 May 2001

PERFORMANCE SPECIFICATION

FANS, VANEAXIAL, HIGH PRESSURE, NAVAL SHIPBOARD

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 high pressure vaneaxial fans used in collective protective systems for Naval shipboard ventilation systems.

1.2 Classification. Fans are of the following type and compositions, as specified (see 3.7.1 and 6.2):

Type A – Vaneaxial, Fixed, Navy Standard [high-impact (H.I) shock]

Composition M – Magnetic

Composition N – Nonmagnetic

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-DTL-17060	-	Motors, Alternating Current, Integral-Horsepower, Shipboard Use
MIL-B-17931	-	Bearings, Ball, Annular, for Quiet Operation

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
MIL-STD-740-2	-	Structureborne Vibratory Acceleration Measurements and Acceptance Criteria of Shipboard Equipment
MIL-STD-1399-300	-	Electric Power, Alternating Current
MIL-STD-2031	-	Fire and Toxicity Test Methods and Qualification Procedure for Composite Material Systems Used in Hull, Machinery, and Structural Applications Inside Naval Submarines
MIL-STD-2142	-	Magnetic Silencing Characteristics, Measurement of (Metric)

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9074-AR-GIB-010/278	-	Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels

(Copies of this document are available from the Naval Logistics Library, 5450 Carlisle Pike, Mechanicsburg, PA 17055 or online at https://nll.ahf.nmci.navy.mil/.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 99-0401	-	Classification for Spark Resistant Construction
AMCA 111	-	Laboratory Accreditation Program
ANSI/AMCA 210	-	Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
ANSI/AMCA 300	-	Reverberant Room Method for Sound Testing of Fans

(Copies of these documents are available from the Movement and Control Association, Inc, 30 West University Drive, Arlington Heights, IL 60004 or online at www.amca.org.)

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ANSI/ABMA 4	-	Tolerance Definitions and Gauging Practices for Ball and Roller Bearings
ANSI/ABMA 9	-	Load Ratings and Fatigue Life for Ball Bearings
ANSI/ABMA 13	-	Rolling Bearing Vibration and Noise (Methods of Measuring)
ANSI/ABMA 20	-	Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types - Metric Design

(Copies of these documents are available from the American Bearing Manufacturers Association, 2025 M. Street, NW, Suite 800, Washington DC 20036 or online at www.abma-dc.org.)

AMERICAN WELDING SOCIETY (AWS)

ANSI/AWS B2.1/B2.1M	-	Specification for Welding Procedure and Performance Qualification
ANSI/AWS B2.2	-	Brazing Procedure and Performance Qualification

(Copies of these documents are available from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 or online at www.aws.org.)

ASTM INTERNATIONAL

ASTM B26/B26M	-	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B221	-	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E119	-	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E662	-	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
ASTM E800	-	Standard Guide for Measurement of Gases Present or Generated During Fires
ASTM F1166	-	Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities

(Copies of these documents are available from ASTM International, 100 Barr Harbor Dr., P.O. Box C700, West Conshohocken, PA 19428-2959 or online at www.astm.org.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 45	-	Recommended Practice for Electric Installations on Shipboard

(Copies of this document are available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331 or online at www.ieee.org.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3290-1	-	Rolling bearings – Balls – Part 1: Steel balls

(Copies of this document are available from ISO, 1, ch. de la Voie-Creuse, Case postale 56 CH-1211 Geneva 20, Switzerland or online at www.iso.org.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	-	Motors and Generators

(Copies of this document are available from the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209 or online at www.nema.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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 in accordance with 4.2.

3.2 Materials. Fan shall be of spark-resistant construction as defined in AMCA 99-0401 Type B construction. Cast iron, excluding nodular iron, shall not be used in the construction of fans or motors that are components of fans. Materials shall be corrosion-resistant or material shall be protected against corrosion after fabrication. Material degraded during the fabrication process shall be normalized to restore those properties before assembled in any fan. Selected materials shall be capable of meeting all of the operational and environmental requirements specified herein.

3.2.1 Composite material.

3.2.1.1 Composite fan casing. Fan casing shall withstand a full-scale fire performance test, as well as all required tests of this document when used in a fan assembly. Acceptance criteria for composite casing material shall be in accordance with the fire and toxicity performance requirements of MIL-STD-2031.

3.2.1.2 Fan internal components. Composite material used for motor, vanes, impeller, and conduit shall withstand small-scale material specimen fire tests, as well as all required tests of this document when used in a fan assembly.

3.2.2 Hazardous materials. Materials for use in the construction of fans shall have no effect on the health of personnel when the materials are used for their intended purpose. Regardless of other requirements, materials and parts containing asbestos, cadmium, lithium, mercury, or radioactive material shall not be used.

3.2.3 Fasteners. Material for all bolts, nuts, studs, screws, and similar fasteners shall be corrosion-resistant passivated or of a material rendered resistant to corrosion. Sheet metal screws shall not be used. Galling shall be prevented. Tapped holes shall be reinforced where shearing of thread can occur.

3.2.4 Nonmagnetic construction. When nonmagnetic fan-motor units are specified (see 6.2), all fan parts including the casing, vanes, impeller, impeller bushing, motor mounting, fasteners, washers, conduit box, and fittings shall be of nonmagnetic material (see 6.7.1).

3.2.5 Motor material. Motor material shall conform to the requirements of IEEE 45 or NEMA MG 1 as applicable for nonmagnetic motors.

3.2.6 Dissimilar metals. Fans and components shall not be degraded by electrolysis (see 6.6).

3.2.7 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term “recovered materials” means materials that 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 unless otherwise expressly stipulated.

3.3 Painting. Equipment and component items shall be delivered with the manufacturer’s standard finish, except as to comply with the requirements of 3.2.

3.4 Welding and allied processes. Surfaces of parts to be welded or brazed shall be free from rust, scale, paint, grease, and other foreign matter. Welding and allied processes shall be performed by personnel certified to American Welding Society standards ANSI/AWS B2.1/2.1M and ANSI/AWS B2.2. NAVSEA Technical Publication S9074-AR-GIB-010/278 may be used for guidance.

3.5 Identification.

3.5.1 Fan identification code. The size and characteristics of Navy standard high pressure fan-motor units shall be designated by a code formed by alternate letters and numbers arranged in accordance with table I.

3.5.2 Identification plates. Permanent identification plates shall be mechanically fastened to the outside of the fan casing. Identification plate mounting shall not interfere with fan casing tightness. The identification plate shall contain the following information as a minimum:

a. Manufacturer's name and CAGE code number

b. Fan identification code

c. Component identification number (CID No.)

d. Direction of air flow and rotation

e. Manufacturer's serial number and drawing number

The identification plate and a duplicate motor identification plate shall be installed on the outside of the fan casing.

TABLE I. Fan identification code.

Symbol Sequence [1/]	Characteristics	Code	Meaning
1 (letter)	Type of fan	A	Vaneaxial
2 (number)	Fan size	For size code, see table II	Nominal ft^3/min. of standard air
3 (letter)	Type of current	A	AC
4 (number)	Voltage and phase	4	440 volts, 3-phase, 60 Hz AC
5 (letter)	Motor enclosure	W	Spraytight
6 (number)	Maximum ambient temperature	6	149 °F (65 °C)
7 (letter)	Nonmagnetic construction	NM	—
8 (letter)	Thermal protection	TP	—
9 (letter)	Quiet bearing	QB	—

NOTE:

1/ For example, A101A4W6-TP represents a Type A, nominal 1200 cubic feet per minute (ft^3/min) vaneaxial fan at 14-inch water gauge driven by a 440-volt (V), 60-Hertz (Hz), 3-phase, alternating current (AC) spraytight, 149 °F (65 °C) ambient temperature, thermal protection Navy service A motor.

3.6 Interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

3.7 Operating life. The equipment shall have an operating life of not less than 223,800 hours (equivalent to approximately 30 years of operation). Any part identified as planned replacement parts shall have an operating life, prior to replacement, of approximately 37,300 hours (equivalent to approximately 5 years of ship operation).

3.7.1 Reliability. Reliability shall meet the specified values (see 3.7).

3.8 Human engineering. The fan shall be arranged so as to achieve safe, reliable, and effective performance by the operator and maintenance personnel and to minimize personnel skill requirements. ASTM F1166 may be utilized as a guideline in applying human engineering design criteria for the fan-motor unit.

3.9 Maintainability. The fan shall be constructed so that:

a. Fan impeller shall be mounted on the motor shaft in such a manner that it is removable using commonly available tools.

b. Bearings shall be removable using commonly available tools.

c. Parts shall be match marked or attached so that reinstallation will be in the same position as originally installed.

d. Motor shall be removable using commonly available tools.

3.10 General shipboard design conditions. General shipboard design characteristics shall be as follows:

a. Power source quality: In accordance with MIL-STD-1399-300.

b. Able to operate satisfactorily when exposed to soaking atmospheric spray (rain or sea) or seawater.

c. Perform in accordance with requirements herein in a range of ambient temperatures between -20 °F (29 °C) and +149 °F (65 °C).

3.10.1 High-impact shock resistance. Unless otherwise specified (see 6.2), the fan-motor units shall meet the shock requirements of tests specified in MIL-S-901 for Grade A, Class 1 equipment.

3.10.2 Vibration and balance. Fan-motor units shall be designed such that no damage will occur or malfunction be caused by the environmental vibrations specified in MIL-STD-167-1. Fan-motor units shall be in static and dynamic balance. The vibration amplitude shall not exceed the limits for Type II bearing vibration as specified in MIL-STD-167-1.

3.11 Aerodynamic design parameters. The quantities of blades and vanes shall be chosen to avoid producing audible tones. The axial distance between blades and vanes shall be chosen with minimum noise amplitude as a prime consideration.

3.12 Configuration. Fans and motors shall operate in any position on shipboard including vertical (with fan impeller either up or down), horizontal (parallel to ship's centerline or athwartship), or inclined. Each fan-motor unit shall be a complete assembly (see Appendix A).

3.13 Sizes. Sizes of vaneaxial high pressure fans shall be limited to those listed in table II.

TABLE II. Fan characteristics.

Fan Size Code	Diameter (in)	Length (in)	Vol (ft^3/min) 1/	TP (in WG) 2/	Vol (ft^3/min)	TP (in WG)
101	20⅛	30	1200	14	1320	12
102	21⅛	31	1800	14	1980	12
103	21⅛	32	2400	14	2640	12
104	21⅛	33	3600	14	3960	12
105	21⅛	35	5400	14	5940	12

NOTES:

1/ Motor speed shall be 3600 revolutions per minute (r/min).

2/ Total pressure in inches water gauge.

3.14 Physical interface dimensions. Physical interface dimensions of the fans shall be as shown on figure 1.

3.15 Fan casings and associated parts.

3.15.1 Watertightness. Casings shall be watertight.

3.15.2 Flanges. Flanges for duct connections shall be provided at each end of the fan casing. These flanges shall be integral parts of the casing either through manufacture or welding. The flanges shall be drilled as shown on figure 1.

3.15.3 Directional vanes. Directional vanes shall be provided in the casing.

3.15.4 Fan bellmouth. When specified (see 6.2), a fan bellmouth shall be provided.

3.16 Motor mounting. Motors shall be face mounted. Mounting shall be designed to dampen rotor vibration.

3.17 Fan impellers. Impellers shall be designed to prevent retention of water when the fan is installed horizontally, vertically with the impeller up, and vertically with the impeller down. The total impeller shall have at least a safety factor of 8 under normal operation, based on the ultimate tensile strength of the material. Impeller factor of safety analysis shall include impeller balancing features. The hub of the impeller shall not distort or the fit loosen on the drive shaft during the life of the equipment.

3.17.1 Nose piece. If a nose piece is required, it shall be match marked with the impeller or attached to it to ensure reinstallation in the same position relative to the impeller.

3.17.2 Balancing. The impeller shall be statically and dynamically balanced.

3.18 Electric equipment.

3.18.1 Motors. In consideration of the cooling effect of the air stream, motors for vaneaxial fans need not conform to referenced motor specifications in regard to horsepower rating of a standard frame sizes. Motors shall have sufficient torque to start the fans at 90 percent of rated voltage. The motors shall conform to the following:

a. 60 Hertz, AC, integral: horsepower.

b. Service: Navy H.I. shock qualified (Type A).

c. Ambient temperature: +149 °F (65 °C).

d. Voltage, phase, and frequency: 440 volts, 3-phase, 60 Hertz.

e. Power source quality: In accordance with MIL-STD-1399-300.

f. Duty: Continuous-air over.

g. Enclosure: Spraytight.

h. Horsepower: In accordance with figure 1, IEEE 45, and NEMA MG 1.

i. Revolutions per minute (r/min): 3,600 (synchronous) constant speed.

j. Type: Squirrel cage induction, with not less than 80 percent power factor full load.

k. Mounting: Face mounted.

l. Bearings: The motor shall be designed so that the bearing temperature rise at the outer surface of the bearing shall not exceed 86 °F (30 °C) in 149 °F (65 °C) ambient. For quiet bearing, temperature rise shall not exceed 77 °F (25 °C) in 149 °F (65 °C) ambient as measured on the external surface of the outer ring.

m. Insulation required: Class F or better, sealed insulation system with Class B temperature rise, as described in MIL-DTL-17060.

n. Random wound sealed insulation systems: Each random wound sealed insulation system motor shall have a stainless steel nameplate attached near the regular nameplate stating, “Stator winding insulated to provide a sealed insulation system. CAUTION: If rewinding is required do not use burnout oven for stripping. Cut off one end turn, heat winding by radiant heat and pull windings from slot.” An additional octagonal nameplate shall be attached near the regular nameplate starting at the top using two lines “DO NOT OVERHAUL”, in the center using two lines “HIGH RELIABILITY”, and the bottom using two lines “SEE MOTOR DRAWING”.

o. Not for submarine service.

p. Motor structureborne noise levels shall not exceed the levels required in MIL-DTL-17060, or lower when specified by auxiliary manufacturer.

q. Shock test: MIL-S-901, Type A, for H.I. shock applications.

r. Air gap: In accordance with NEMA MG 1.

s. Airborne noise levels: In accordance with NEMA MG 1.

t. Locked rotor current: In accordance with NEMA MG 1.

u. Torque: The locked rotor torque, pullup torque, and breakdown torque of motors shall be at least 70 percent, 70 percent, and 200 percent, respectively, of full load torque.

v. Speed-torque characteristics: The speed-torque characteristics shall be coordinated with the combined inertia of the rotating assembly, including fan wheel. It shall be possible to accelerate the fan unit from standstill to high speed at 90 percent of rated voltage when the current rating of the controller overload protective device does not exceed the motor rated full load current.

w. Protection: Motor shall be equipped with thermal protection in each phase to detect over-temperature. Thermal protectors shall be of the automatic reset type with appropriate locked rotor temperature limit (see 6.2).

x. Design B: In accordance with MIL-DTL-17060.

y. Drains: Drain holes with plugs shall be furnished in each spraytight motor to drain condensate from the motor when fan is installed vertically with the impeller up or down, or horizontally. For drainage in the horizontal position, an adequate number of holes shall be provided to allow a 360-degree rotation of the fan.

3.18.2 Conduit box. A conduit box shall be mounted on the outside of the fan casing in line with motor lead entrance. The box shall permit connection from either side or from one end. Boxes shall have the same degree of enclosure as motors with which they are used.

3.18.3 Conduits. The lead wires from the conduit box to the motor shall be enclosed in a watertight conduit or race. An effective electrical ground shall be provided from the motor frame to the fan casing and the conduit box.

3.18.4 Bearings. Motors shall be equipped with sealed, grease-filled bearings. Bearings shall be in accordance with ANSI/ABMA precision classification of ABEC-1 in accordance with ANSI/ABMA 4, 9, 13, and 20 and ISO 3290-1. Bearings shall be Type 120 in accordance with MIL-B-17931. Means shall be provided to ensure that grease is always available to the bearing and to prevent the leakage of oil or grease along the shaft. When specified (see 6.2), special bearings for quiet operations shall be in accordance with ANSI/ABMA 4, 9, 13, and 20, ISO 3290-1, and MIL-B-17931.

3.19 Fan performance.

3.19.1 Volume and pressure. The design point for each size fan shall be volume-pressure point at 14 inches of water gauge total pressure shown for that size in table II. The total pressure shall rise continually from free delivery to a value at least as high at the stated volume as shown in table II, and throughout this range of stable performance the volume in ft^3/min shall be within 2 percent of the volume indicated in table II. The pressure developed by a fan is the pressure at the fan discharge, and the volume is the volume at the fan inlet.

3.19.2 Aerodynamic stall. Effective stall shall not occur at capacities greater than 85 percent of the fan design or rated ft^3/min.

3.19.3 Airborne noise. The total sound power levels for the fan-motor unit shall not exceed the levels stated in table III when tested in accordance with procedures in 4.7.3. Exceeding the total sound power levels specified in table III shall be cause for rejection.

3.20 Noise level. The fan-motor unit shall not exceed the sound power levels specified in table III (see 4.7.3).

TABLE III. Total sound power levels in decibels (dB) referenced to 10^{-12} watt.

Fan Size Code	Octave Band Center Frequency in Hertz (Hz)							
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
101	90	95	96	100	107	106	99	90
102	86	92	91	100	100	100	97	88
103	87	97	91	98	99	100	96	85
104	90	92	96	102	104	102	100	93
105	95	97	96	102	103	102	101	94
ANSI/AMCA 300, Standard Deviation	6	3	2	1.5	1.5	1.5	1.5	3

NOTES:

1. Measurements of total sound power levels made in accordance with ANSI/AMCA 300 result in measurement uncertainties within the standard deviations specified in table III. Acceptable fan total sound power levels for each octave band are those values which are less than or equal to the sum of the tabulated total sound power level plus the specified standard deviation.
2. The sound power levels listed in table III do not specify the sound pressure levels generated by the fan in its installed configuration. The ship designer may need to incorporate noise control/abatement measures to meet any applicable sound pressure level requirements.

4. VERIFICATION

4.1 Classifications of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.2).

b. Conformance inspection (see 4.3).

c. Periodic conformance inspection (see 4.4).

4.2 First article inspection. First article inspection shall consist of the examinations of 4.6 and tests as specified in table IV. The tests specified shall be performed on the first production unit of each size fan-motor.

4.3 Conformance inspection. Conformance inspection shall consist of the examinations of 4.6 and tests as specified in table IV. The tests specified shall be performed on each size fan-motor unit. Any unit that fails to meet any specified requirements shall be rejected.

4.4 Periodic conformance inspection. Periodic tests are required to assure continuing satisfactory operation of identical units. The tests are required under any contract or purchase order for fans of existing design when the invitation to bid is dated four years or more subsequent to the date of the last previous test of an identical unit. Periodic tests shall consist of the tests specified in table IV and shall be conducted on one of each size fan-motor unit.

4.5 Composite material. A representative fan constructed of composite material shall meet requirements of 4.8.

TABLE IV. Test agenda.

Applicability of Test to Fan Type					
Tests	**Requirements**	**Verification**	**First Article**	**Conformance**	**Periodic**
Performance	3.19	4.7.1	All	All	All
Aerodynamic stall	3.19.2	4.7.2	All	All	All
Airborne noise	-	4.7.3	-	-	-
By measurement	3.19.3	4.7.3.1	First production unit	-	First production unit
By ear	3.19.3	4.7.3.5	All	All	All
Casing sound power	3.19.3	4.7.3.4	All [1/]	All [1/]	All [1/]
Balance	3.10.2	4.7.4	All	All	All
Vibration	3.10.2	4.7.4.1	First production unit	-	-
Casing tightness	3.15.1	4.7.5	All [1/]	All [1/]	All [1/]
Speed	3.18.1	4.7.6	All	All	All
Shock	3.10.1	4.7.7	Type A, first production unit	-	-
Motor heat	3.18.1	4.7.8	First production unit	-	First production unit
Bearing temperature	3.18.1	4.7.9	First production unit	-	First production unit
Nonmagnetic	3.2.4	4.9	All [1/]	All [1/]	All [1/]
Maintainability	3.9	4.10	First production unit	-	First production unit

NOTE:
[1/] Test is required only when specified (see 6.2).

4.6 Material and dimensional examination.

4.6.1 Cast impeller and casing. Test samples shall be inspected for chemical content and mechanical properties in accordance with ASTM B26/B26M. Cast impellers can use materials not specified by ASTM B26/B26M if approved by NAVSEA. Repairs of cast impeller are not permitted. Cast casings may be repaired by welding or impregnation if completed in accordance with NAVSEA Technical Publication S9074-AR-GIB-010/278.

4.6.2 Fabricated steel casing. Steel casings shall be visually examined for defects. Cracks in the radius of spun flanges or in the welds of welded flanges may be repaired by welding, after proper preparation, provided that radiographic inspection of the repaired areas is performed. Wall thickness shall be measured on at least 10 percent of the casings.

4.6.3 Machined impeller. Machined aluminum impellers shall use 6061-T6 Grade in accordance with ASTM B221, or an alternate material if approved by NAVSEA.

4.7 Tests. Tests shall be as specified in 4.7.1 through 4.7.10 (see Appendix B).

4.7.1 Performance. Performance tests shall be conducted in accordance with ANSI/AMCA 210. Any of the test stands that utilize nozzles as a flow measuring device and associated instrumentation may be used.

4.7.2 Aerodynamic stall. The effective stall capacity shall be determined from the largest capacity measurement of the following three stall measurement methods.

4.7.2.1 Throttled stall capacity. While the fan is operating in a performance test stand (see 4.7.1), slowly throttle the flow at the test stand discharge. Record the capacity when the fan goes into stall.

4.7.2.2 Stall recovery capacity. This method is the capacity at which the fan recovers from a stalled condition when the fan is operating in a stalled condition and the discharge throttle is slowly opened while moving towards free delivery. Operate the fan in a performance test stand (see 4.7.1) at an aerodynamic stall condition resulting from a throttled discharge. Slowly open the discharge throttle towards free delivery until the fan recovers from the stall condition. Record the capacity when the fan recovers from the stall condition.

4.7.2.3 Stable start-up capacity. This method is capacity at which stable, stall free operation first occurs, as the fan is started from a no-spin condition with the throttling device fixed at progressively larger openings. With the fan in a performance test stand (see 4.7.1) with the discharge throttling device fixed at restrictive position, start the fan from a no-spin condition. If the throttling restriction results in a fan stall condition, secure the fan, change the throttling device position to reduce its restriction, and start the fan again. Repeat until starting the fan results in stable, stall free operation. Record the capacity at which the fan is first able to start-up into stable, stall free operation.

4.7.3 Airborne noise. Octave band sound power levels for a fan-motor unit shall consist of the measurement of sound pressure levels and the computation of sound power levels in accordance with procedures and instrumentation requirements defined in ANSI/AMCA 300, and amendments to those procedures as identified herein. The fan-motor unit shall be operated at the design point during airborne noise testing (see 3.19.1). Dual speed fans shall be operated at high speed during noise tests. All sound measuring instrumentation shall be laboratory calibrated within one year of the date of test, excluding the reference sound source which shall comply with the laboratory calibration requirements stated in ANSI/AMCA 300. A random incidence response microphone and a Type I (precision) sound level meter conforming to the requirements of ANSI/AMCA 300 shall be used. The minimum distance between the extreme points of the microphone swing as described in ANSI/AMCA 300 shall be 10 feet, and the speed of traverse of the microphone shall not exceed 2.4 feet per second. Sound pressure readings shall be a time-weighted average over an integral number (one or more) of microphone swings. Sound pressure level readings shall be averaged over a minimum period of observation of 30 seconds. When a duct section is attached to a fan-motor unit to facilitate measurements, it shall have the same interior, open cross-sectional dimensions as that of the fan-motor unit to which it is attached. There shall be no exposed sound absorbing material on the interior or exterior surfaces of the attached ducts. No sound attenuating devices shall be installed within attached ducts. An orifice plate shall be installed if necessary to obtain design pressure at a known operating point. If an orifice plate is installed, it shall be a quiet type that does not produce excessive flow-induced noise.

4.7.3.1 Total sound power. Test procedures and calculation procedures to determine inlet sound power levels and outlet sound power levels for a fan-motor unit shall be in accordance with ANSI/AMCA 300 and the additional test methods described in 4.7.3.1 and 4.7.3.2. For each octave band, the inlet sound power level L_{Wi} and outlet sound power level L_{Wo} shall be summed to determine the total sound power level L_W using the following equation:

$$L_W = 10\log\left[10^{\frac{L_{Wi}}{10}} + 10^{\frac{L_{Wo}}{10}}\right]$$

4.7.3.2 Inlet sound power. Test procedures and calculation procedures to determine inlet sound power levels for a fan-motor unit shall be in accordance with ANSI/AMCA 300 requirements for free inlet/ducted outlet test configurations for fan inlet sound testing. An orifice plate shall be installed within the outlet duct if necessary to obtain fan-motor unit operation at the design point. Acoustical treatments shall be placed within the chamber as necessary to provide an acoustic seal at the penetration in the wall separating the chamber from the reverberant room to ensure that no noise contributions are transmitted from the chamber into the reverberant test room.

4.7.3.3 Outlet sound power. Test procedures and calculation procedures to determine outlet sound power levels for a fan-motor unit shall be in accordance with ANSI/AMCA 300 requirements for ducted inlet/free outlet test configurations for fan outlet sound testing. An orifice plate shall be installed within the inlet duct if necessary to obtain fan-motor unit operation at the design point. Acoustical treatments shall be placed within the chamber as necessary to provide an acoustic seal at the penetration in the wall separating the chamber from the reverberant room to ensure that no noise contributions are transmitted from the chamber into the reverberant test room.

4.7.3.4 Casing sound power. When this test is required, the requirement shall be as specified (see 6.2). Test procedures and calculation procedures to determine sound power levels radiated from the casing of a fan-motor unit shall be in accordance with Appendix G of ANSI/AMCA 300. Duct sections attached to a fan-motor unit to facilitate testing to determine casing radiated sound power shall be rigid, heavy gauge metal ducts and/or solid, double wall ducts to eliminate noise contributions transmitted through duct walls. The noise transmission loss of the walls of the reverberant test room shall be such that noise transmitted into the reverberant test room from adjacent spaces does not contribute to the sound power levels of the fan-motor unit. Penetrations in the walls of the reverberant room in way of ducts shall be acoustically sealed to prevent noise contributions from being transmitted into the reverberant test room from the adjacent room.

4.7.3.5 Airborne noise detected by ear. Fan-motor units not undergoing airborne noise testing described in 4.7.3.1 through 4.7.3.4 shall be operated at either their design points or at free flow. Any unusual airborne noise or any airborne noise thought to be excessive shall be corrected if the cause is apparent. If the cause is not apparent and the condition is not corrected, the fan-motor unit shall be tested in accordance with 4.7.3.1, and sound power levels shall be computed to determine conformance with sound power level requirements specified in table III.

4.7.3.6 Airborne noise test facility. The facility wherein measurements of fan-motor unit airborne noise are performed shall be registered in accordance with AMCA 111 as being a qualified facility in which to perform octave band sound measurements in accordance with ANSI/AMCA 300.

4.7.4 Balance test. In this test, the fan-motor unit shall be operated at maximum speed and free delivery, with shaft horizontal. It shall be suspended from a stand by means of two elastic vibration cords, one secured to each end flange. The cords shall have a natural frequency of less than ¼ of the minimum rotational frequency of the unit in Hertz. The static deflection shall be within the limits of MIL-STD-167-1 for elastic mounting elements, and this shall be the basis for determining cord size for each unit tested. As an alternative to this suspension test, rigid brackets may be bolted to the fan end flanges, and these brackets shall be elastically mounted on a rigid, level floor. Another alternative is that the fan-motor unit may be resting on elastic mounts on a rigid level floor. Another alternative is that the fan-motor unit may be suspended from an electric hoist by means of two chains, one secured to the end flanges of the fan-motor unit (that is, the ends of the chain secured to opposite flanges); one secured to the electric hoist and to the center of the chain secured to the end flanges. The length of the chains shall be not less than 15 inches nor more than 35 inches, and the link size of the chains shall be not less than ¼ inch nor more than $\frac{3}{8}$ inch. With either method, the internally excited vibrational displacement (single amplitude of vibration) shall be measured in mils as follows: four axial measurements 90 degrees apart on the face of each end flange, one horizontal measurement perpendicular to the axis on the edge of each flange, and one vertical measurement on the top edge of each flange. The maximum amplitude of vibration shall be the maximum single reading, and not an average. The operating frequency at which the maximum amplitude occurs shall be measured. Exceeding vibration limit specified in 3.10.2 shall be cause for rejection.

4.7.4.1 Vibration test. Fan-motor units shall be subjected to Type I environmental vibration tests as specified in MIL-STD-167-1. The exploratory vibration test specified in MIL-STD-167-1 shall include frequencies from 4 Hertz up to and including 33 Hertz at the table amplitude specified therein. The vibration test shall be conducted in the order specified in 4.7.10. Any unit that fails to meet any requirements shall be rejected.

4.7.5 Casing tightness. When this test is required, the requirements as well as the test conditions shall be as specified (see 6.2). If conditions are not specified, the test shall be conducted as follows: Blind flanges (one with air supply and gauge connections) shall be bolted to gasketed fan flanges. Air at a pressure 50 percent higher than the maximum pressure capability of the fan shall be supplied to the casing interior. The pressure drop in 10 minutes shall not exceed 5 percent of the test pressure.

4.7.6 Speed. The fan-motor unit shall be operated at each speed at free delivery to determine whether the speed conforms approximately to design speed at rated voltage.

4.7.7 High-impact shock. The fan-motor unit shall be shock tested as specified for Grade A shock of MIL-S-901. The high-impact shock test shall be conducted after the tests specified in 4.7.1, 4.7.2, 4.7.3, 4.7.4, 4.7.4.1, 4.7.5, 4.7.6, 4.7.8, and 4.7.9. After conducting the high-impact shock test, tests specified in 4.7.1and 4.7.2 shall be again conducted without correction of damages that may have occurred during shock test. Shock testing in accordance with these requirements shall demonstrate that the fan-motor unit performs its function with acceptable changes in performance and aerodynamic stall. Shock test acceptance shall be contingent upon the ability of the equipment after shock testing to satisfy performance within ±5 percent of the volume indicated in table II, and aerodynamic stall with capacities not to occur greater than 90 percent of the fan design or rated ft^3/min. In this test, bolts shall be used in each of the flange bolt holes. Resilient mounting shall not be used unless specified (see 6.2). If resilient mountings or flexible mounting elements (vibration or shock) are specified for use, classification of shock testing shall be determined in accordance with MIL-S-901 criteria and the appropriate medium weight or heavy weight shock test will be determined and conducted. Evidence of any of the following shall be cause for rejection:

a. Fragmentation or missile effect of part.

b. Deformation that will cause active interference between parts resulting in permanent degradation of fan performance in excess of the allowable degradation noted above.

c. Failure to operate. Fan-motor units that have passed this test may be used as production units after replacement of motor bearings.

4.7.7.1 Medium weight shock test. The test of a fan-motor unit shall consist of the nine blows specified in table V. Auxiliary channels shall be used to bolt the mounting brackets or plate to standard fixtures. The required fan orientation mounting for tests required in table V are as follows:

a. Fan horizontal (motor shaft horizontal), steel mounting brackets attached to both fan flanges for mounting to test platform. This is fan orientation No. 1.

b. Fan vertical, fan impeller down (motor shaft vertical, impeller on bottom). Fan flange bolted to a steel plate for mounting to test platform. This is fan orientation No. 2A.

c. Fan inclined at 30 degrees, fan impeller up (motor shaft inclined 30 degrees from the vertical, impeller on top). Fan flange bolted to a steel plate for mounting to test platform. This is fan orientation No. 2B.

TABLE V. Medium weight shock test.

Blow No.	Group No.	Hammer Drop	Anvil Travel (inches)	Operating Condition	Fan Orientation
1	I	(Based on weight, see MIL-S-901)	3	Secured	No. 1
2	II		3	Operating	No. 1
3	III		1.5	Secured	No. 1
4	I		3	Operating	No. 2A
5	II		3	Secured	No. 2A
6	III		1.5	Operating	No. 2A
7	I		3	Secured	No. 2B
8	II		3	Operating	No. 2B
9	III		1.5	Secured	No. 2B

NOTE:

1. Upon completion of the shock test, post-shock test inspection, and specified test, the fan-motor unit shall be returned to the contractor for examination and further testing.

4.7.7.2 Heavy weight Shock Test. When heavy weight shock testing is performed, the number of test shots and test conditions shall be as specified by MIL-S-901.

4.7.8 Motor heat. Motor heating shall be measured as specified in the applicable motor specification. In each test, the motor shall be installed in the fan, and a duct shall be attached to the fan discharge. Motor heat testing shall be conducted at the fan operating point, which shall be obtained by means of a terminal throttle on the test duct. Since neither the fan nor a suitable test stand will normally be available at the motor plant, the heat test may be conducted at the plant of the fan manufacturer.

4.7.9 Bearing temperature. Bearing temperature shall be measured with the fan mounted in vertical with impeller on bottom. Full load shall be obtained by means of a terminal throttle on attached test duct. Bearing outer surface temperature shall not exceed requirements of 3.18.1(l).

4.7.10 Test schedule. The schedule for testing the fan shall be performed in the following order:

a. The following tests can be performed in any order: balance (see 4.7.4), casing tightness (see 4.7.5), performance (see 4.7.1), aerodynamic stall (see 4.7.2), speed (see 4.7.6), motor heat (see 4.7.8), bearing temperature (see 4.7.9), airborne noise (see 4.7.3), and vibration (see 4.7.4.1). The order of these tests shall be determined by the manufacturer according to schedule availability. Correction of deficiencies or damages, which may have resulted from vibration tests, shall not be performed prior to the test specified in 4.7.7.

b. High-impact shock (see 4.7.7). After conducting the high-impact shock test, tests specified in 4.7.1 and 4.7.2 shall be again conducted without correction of damages that may have occurred during the shock. Data for tests specified in 4.7.1 and 4.7.2, one before and one after high-impact test, shall demonstrate that the fan-motor unit satisfies performance and aerodynamic stall as follows: performance to be within ±5 percent of the volume indicated in table II and aerodynamic stall not to occur greater than 90 percent of the fan design or rated CFM.

4.8 Composite material testing. Composite material shall be tested for flame spread, smoke obscuration, combustion gas, ignitability, heat release, and mass consumed. Use of composite material requires NAVSEA review of the fire and toxicity performance for the composite material system. The Nonmetallic Materials Branch of NAVSEA has review responsibility for use of composite material systems on Naval vessels.

4.8.1 Fan casing and conduit box.

4.8.1.1 Internal fire insult. Fan casing and conduit box material shall withstand an internal fire insult as described in the modified full-scale factory mutual test for horizontal duct FM4922 (see figure 2).

4.8.1.2 External fire insult. Fan casing and conduit box material shall withstand an external fire insult as described on figure 3. Temperatures around the outside of the test specimen shall exceed minimum temperatures prescribed by ASTM E119 for at least 15 minutes.

4.8.2 Internal composite materials. All composite materials used on components internal to the fan, including impeller, casing, and motor shall meet the smoke obscuration (ASTM E662) test as follows:

Ds during 300 sec (flaming)	6 (4 minutes)
Ds during 300 sec (nonflaming)	1 (4 minutes)
Dmax (flaming)	81
Dmax (nonflaming)	32

and the Combustion Gas (ASTM E800) test as follows:

Combustion Gas	Flaming	Nonflaming
CO	75	10
CO_2	2.0%	0.4%
HF	<1	<1
HCl	13	1
NOx	1	<0.5
SO_2	<1	<1
HCN	1	<1
NH_3	<3	<3
COC_2	<0.1	<0.1

4.9 Permeability tests. A permeability test of nonmagnetic material used in construction of the fan shall be conducted in accordance with MIL-STD-2142, Test 501 (see 3.2.4).

4.10 Maintainability demonstration. The first production unit shall be examined after testing, and the capability to maintain, disassemble, and repair the unit shall be demonstrated. The demonstration shall be conducted utilizing the recommended tools and with other than expert mechanics. Evidence that maintainability of the fan-motor assembly cannot be accomplished by other than expert mechanics shall be cause for failure of the demonstration. The maintainability demonstration shall include but not be limited to the following (see 3.9):

a. Removal of fan impeller.
b. Removal of motor.
c. Removal of motor bearing.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. The fan-motor units specified herein are intended for ventilation applications onboard ships of the United States Navy. Fans are high efficiency units intended for systems having a resistance of 14 inches of water.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type and composition required (see 1.2).
c. The specific issue of individual documents referenced (see 2.2 and 2.3).
d. Whether nonmagnetic fan-motor units are required (see 3.2.4).
e. Shock (see 3.10.1).
f. Bellmouth (see 3.15.4).
g. Thermal protection (see 3.18.1).
h. Motor bearings, quiet operation (see 3.18.4).
i. When casing sound power testing is required (see table IV and 4.7.3.4).
j. When casing pressure test is required (see table IV), specify test conditions if other than standard (see 4.7.5).
k. Resilient mountings (see 4.7.7).
l. Packaging requirements (see 5.1).
m. Drawing approval is required (see 6.4).
n. Final drawings are required (see 6.4.1).
o. Shock and vibration mitigation (see 6.5).

6.3 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a pre-production sample, a first article sample, a first production item, a sample selected from the first lot production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.2. The contracting officer should also 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 requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.4 Approval. The contract should require (see 6.2) that two prints of the fan assembly drawing; and two prints of the motor proposed for use with the fan drawings be submitted for approval by the acquisition activity unless the drawings have been previously approved within the last five years.

6.4.1 Final drawings. When final drawings are required (see 6.2) and comments on new drawings are approved, adjudicated or reconciled, the contractor has a responsibility to: (1) forward final fan and motor drawings to acquisition activity; and (2) include special requirements of the contract or order prior to distribution of final drawings.

6.4.2 Identifying numbers. A national stock number (NSN) and a component identification number (CID No.) will be assigned by the Government after drawing approval. The contractor has a responsibility to: (1) identify these numbers in shipping papers; and (2) mark these numbers on each fan and motor identification plates.

6.5 Shock and vibration mitigation. In addition to packaging requirements specified in the contract, all levels of packaging should employ a shock and vibration system that will ensure parts of the unit, such as bearings, are not damaged due to normal shock and vibration that occur during handling and shipments.

6.6 Recommended practices. The following documents provide information for the design, manufacture, testing, and qualification of vaneaxial fans used for cooling of gas turbine machinery previously supplied to the United States Navy, and may be used for guidance:

a. MIL-PRF-24751, Fans, Vaneaxial Gas Turbine Enclosure Cooling Naval Shipboard

b. MIL-STD-889, Dissimilar Metals

6.7 Definitions.

6.7.1 Nonmagnetic material. Nonmagnetic material is defined as a material that has a maximum relative permeability of less than 2.0 after fabrication.

6.8 Subject term (key word) listing.

Blade

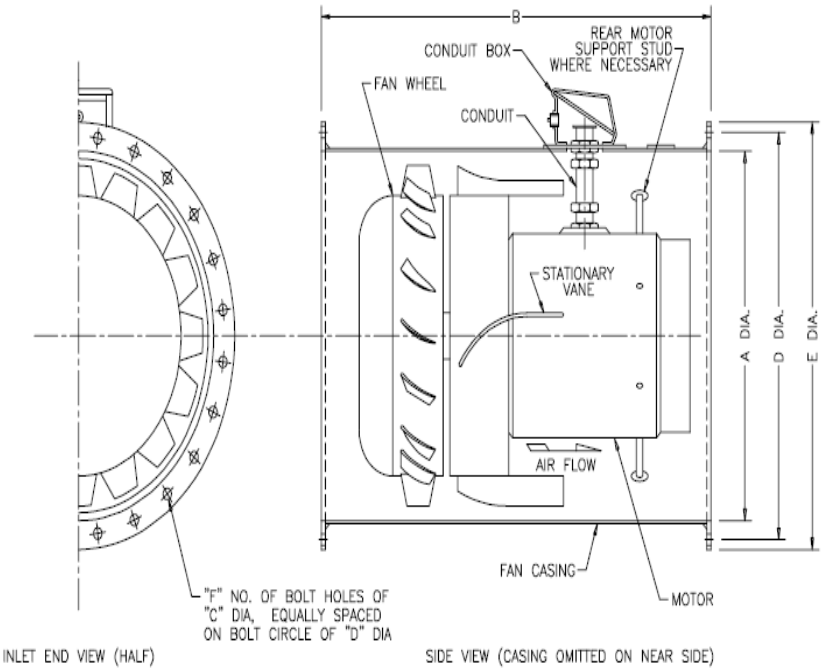
Casing

Duct

Impeller

Vane

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



Interface and Physical Data												
Fan Size Code	Motor Data [1/]		Dimensions					No. of Bolt Holes	Set [2/,3/] Weight (lb)	Airflow (CFM) [4/]		Maximum [4/] Effective Stall
	Max HP	RPM	A	B	C	D	E	F		12 in W.G.	14 in W.G.	
101	10	3600	20⅛	30	17/32	23¼	23⅝	24	580	1320	1200	1020
102	10	3600	21⅛	31	17/32	23¼	24⅝	24	750	1980	1800	1530
103	10	3600	21⅛	32	17/32	23¼	24⅝	24	750	2640	2400	2040
104	15	3600	21⅛	33	17/32	23¼	24⅝	24	750	3960	3600	3060
105	20	3600	21⅛	35	17/32	23¼	24⅝	24	750	5940	5400	4590

NOTES:

1/ Motor horsepower (HP) and speed (RPM) are given at 440 Volts Alternating Current (VAC), 3-phase, 60 Hz.

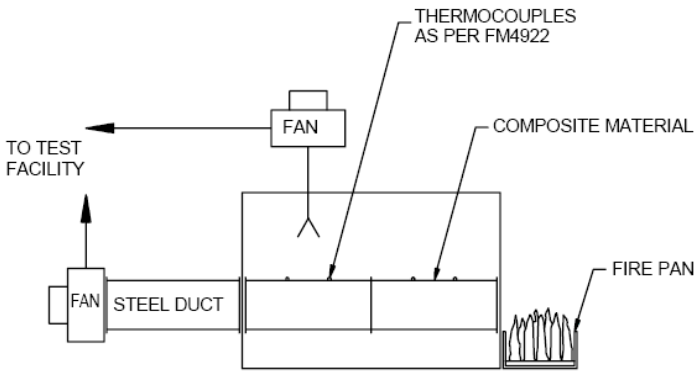
2/ Weight for fan with 149 °F (65 °C) ambient motor.

3/ All weights are approximate.

4/ Maximum effective stall shall be greater of the three following capacity values used to measure aerodynamic stall:

a. Throttled stall capacity – airflow at stall entering condition while closing discharge.
b. Stall recovery capacity – airflow at recovery from stall condition while opening discharge.
c. Stable start-up capacity – airflow at stall free operation from a no-spin condition while using consecutive larger fixed discharge openings.

FIGURE 1. High pressure fan-interface and physical data.



The purpose of the test is to assess the structural integrity and the smoke characteristics of the composite material separating the ship's internal compartments from the air flow within the confines of the composite envelope. Gases released to weather are also assessed as they can be reingested into the ship.

Modifications to FM4922 are as follows:

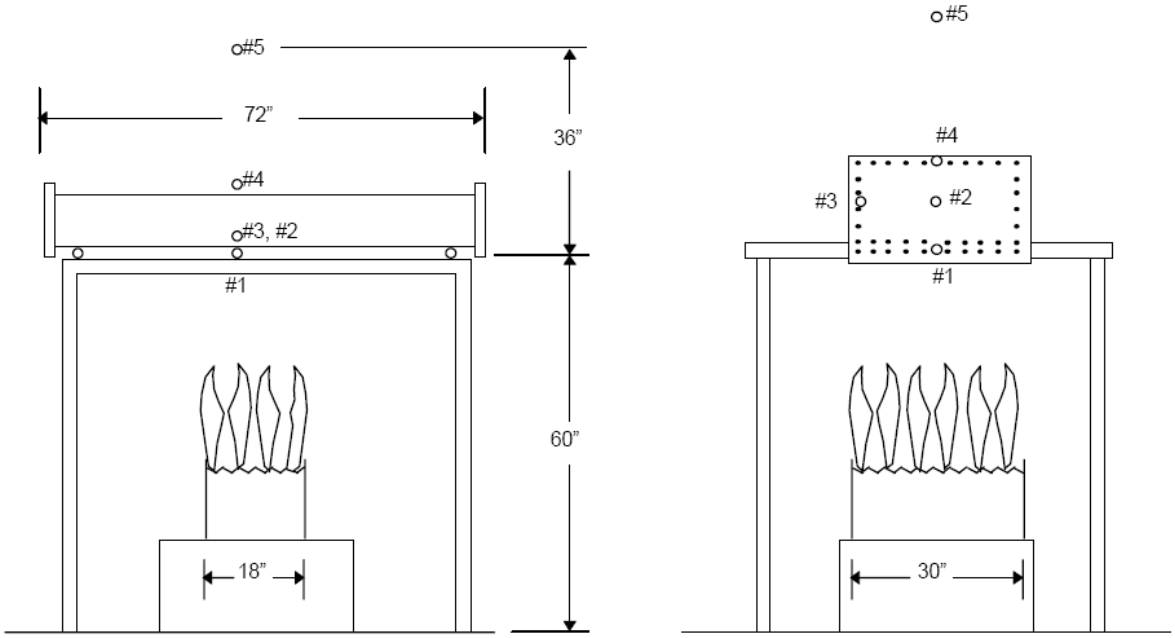
Test material. The manufacturer has the option to furnish sufficient material to assemble:

a. Two 24-foot composite ducts incorporating at least two factory or field assembled joints (as appropriate to the application) or
b. Two 12-foot composite ducts incorporating at least two factory or field assembled joints along with two 12-foot heavy-gage steel ducts (uncoated carbon steel or stainless steel) to be connected down-stream of the composite test sections to form a standard 24-foot test section.

All of the test ducting described above (composite and supplemental steel sections, if utilized), can be provided in the form of rectangular or circular cross-sections (depending on the envisioned application; i.e., round for fan casings, rectangular for cabinets) that are each 6-foot and flanged for standard 24-foot test length. If rectangular ducting cross-sections are utilized, the following nominal dimensions are commended: 12 inches by 24 inches by nominal thickness (not to exceed 1.5 inches). If circular ducting cross-sections are utilized, the internal diameter should not be less than 18 inches nor greater than 20 inches and the wall thickness of the test ducts should not exceed 1.5 inches.

Test apparatus. The standard 12-inch by 12-inch by 7-inch fire pan specified in FM4922 to simulate building fire conditions (using heptane fuel) should be enlarged to 16inches by 16 inches by 15 inches deep to more closely simulate a shipboard engine room hydrocarbon pool fire.

FIGURE 2. Modified factory mutual fire test for composite material (FM4922) subject to internal fire insult.



NOTE:

The fan-motor section material (1-foot by 2-foot by 6-foot duct) is exposed for 15 minutes to a hexane fire capable of temperatures between 1400 to 1600 °F. The sealing flanges are to be cooled by a water spray. The air pressure shall be monitored with time. The fire tray is 18 inches by 30 inches, filled with hexane fuel floating on water. The fire tray is oriented so that the longer side is perpendicular to the longitudinal axis of the duct. Five thermocouples are used to monitor the temperature:

- #1 Thermocouple: Under side of the duct in the middle, just above the fire.
- #2 Thermocouple: Inside the duct, in the middle.
- #3 Thermocouple: Along the side of the duct.
- #4 Thermocouple: On top of the duct, in the middle.
- #5 Thermocouple: About 2 feet above the duct, in the middle.

FIGURE 3. Fifteen-minute fire test with hexane fuel.

TECHNICAL CONTENT FOR ENGINEERING DRAWINGS

A.1 SCOPE

A.1.1 Scope. This appendix covers the technical content requirements that should be included on drawings when required by the contract or order. This appendix is not a mandatory part of the specification. The information contained herein is intended for guidance only.

A.2 APPLICABLE DOCUMENTS

A.2.1 General. The documents listed in this section are specified in sections 3 of this appendix. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 of this appendix, whether or not they are listed.

A.2.2 Government documents.

A.2.2.1 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-STD-31000 - Technical Data Packages

(Copies of this document are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

A.2.3 Order of precedence. Unless otherwise noted herein or in the contract, 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.

A.3 DRAWINGS

A.3.1 Drawings. When required by the contract or order, drawings should be identified by the contractor's identification and document number, and should be in accordance with MIL-STD-31000 for Level 2 drawings. When required by the contract or order, drawings should contain the following information.

A.3.2 Fan assembly drawing. The fan assembly drawing should include the following:

a. A longitudinal, sectional view of the fans, showing arrangement of component parts which are identified by piece number flagging. All welds should be indicated by standard weld symbols. The following additional data should be shown in this view:

(1) Overall (flange face-to-face) fan length and mounting flange outside diameter to the nearest $\frac{1}{16}$ inch.

(2) Fan casing inside diameter and wheel (blade) tip diameter to 0.001 inch with tolerance.

(3) Axial distance from the face of the motor mounting flange to the conduit centerline.

(4) Keyway dimensions of the wheel hub and wheel hub to bore diameter 0.0001 inch with tolerance.

(5) Indication of the area of wheel from which metal is to be removed in balancing, and the permissible depth of such removal.

(6) The nominal axial distance between the trailing edge of a blade at midpoint to the leading edge of a vane.

(7) Location on the casing of fan and motor identification plates.

b. An end view of the fan, showing the direction of impeller rotation.

(1) Direction of wheel rotation.

(2) Inside diameter of the motor mounting flange or the diameter of the rabbet in the motor mounting flange (whichever surface is used for positioning the motor) in thousandths of an inch with tolerance.

(3) The quantity and size of equally spaced mounting holes and the bolt center diameter in the fan flanges and motor mounting flange.

c. If necessary for clarity, separate details of the motor mounting (secondary mounting if provided), conduit, and conduit box.

d. Separate details of the motor mounting gasket; fan identification plate; a section of the wheel showing undimensioned end profile of a blade with stagger angle at blade root and blade tip indicated; the wheel hub insert; and the fit of the nose to the wheel (if the wheel has a separate nose or cap).

e. A complete list of material. The quantity of blades and vanes should be indicated, as well as the thickness of casing, vanes, and motor mounting flange, unless the thickness is dimension in a view. Thread data of threaded fasteners should be given.

f. General notes, including the following:

(1) A statement directing reference to a fan certification data sheet for identification of electrical components and specific fan-motor test data, and center of gravity.

(2) A statement of the permissible tolerance for all untoleranced dimensions.

(3) Indication of the method of securing the wheel hub insert in the wheel; if by press fit, the interference fit and the minimum insertion pressure should be stated.

(4) A caution statement directing connections of a ground wire if applicable.

(5) Indication of the method of balancing the fan impeller.

(6) A statement of the minimum casing wall thickness (including the fan raceway that is normally machined).

(7) Identification of any carbon steel surface which may be machined after plating, and a statement of the treatment of such area prior to painting.

(8) Any other statements necessary for clarity.

(9) At the manufacturer's option, statements for manufacturer's use only, so designated.

g. A graph, with cubic feet of standard air per minute (ft^3/min) as the abscissa, and total pressure, static pressure, speed (r/min), brake horsepower and power input kilowatts (kW) or input horsepower as ordinates. The graph should be identified by fan code and by the test number and date.

A.3.3 Fan detail drawings. Fan detail drawings should include the following:

a. Should be furnished of all parts and sub-assembly necessary for evaluation of the equipment and all parts necessary for maintenance and overhaul.

b. Sub-assemblies whose parts cannot be acquired or serviced individually should be shown as a single part.

c. Show all essential fabrication details including welding requirements and symbols.

d. Drawings are not required for those parts that are in common commercial use and can be referenced to commercial standards.

A.3.4 Auxiliary drawings. Auxiliary drawings should include the following:

a. If fans are to be flexibly mounted, the mounting brackets and mount requirements should be detailed in a separate Level 2 composite multisheet drawing.

b. Drawings of motors used with fans should conform to the requirements of MIL-DTL-17060. Structureborne noise levels in accordance with MIL-STD-740-2 should be shown on each motor drawing for information only and should not be applied to any specific requirement. Drawings should also include magnet wire size.

c. Drawings of motors should indicate the lubrication method. These drawings should also state the axial clearance between the bearing and shoulder to accommodate thermal linear expansion of the shaft, if a housing shoulder is provided.

TECHNICAL CONTENT FOR TEST REPORTS

B.1 SCOPE

B.1.1 Scope. This appendix covers the technical requirements that should be included in test reports when required by the contract or order. This appendix is not a mandatory part of the specification. The information contained herein is intended for guidance only.

B.2 TEST REPORTS

B.2.1 Report of performance, noise, balance, and motor heating. The figure number of ANSI/AMCA 210 should be identified, together with duct or chamber dimensions and the diameter of nozzle if used. The following values should be reported in tabular form: ambient barometric pressure, dry bulb and wet bulb temperatures, and air density; voltage and current (in each phase), motor input kilowatts or horsepower; brake horsepower; fan speed; air velocity; total static and velocity pressure; air quantity (ft^3/min); mechanical (total) efficiency; electrical efficiency. The maximum amplitude of vibration at free delivery and frequency at which it occurs should be reported. Computations need not be included in the report if made strictly in accordance with ANSI/AMCA 210. A curve sheet should be included in the report showing motor input, brake horsepower, fan speed, total and static pressures of standard air at fan discharge, as oriented, and cubic feet of standard air per minute at fan inlet as the abscissa. Motor heating at design point in each octave band should be included in this report. An additional curve sheet should also be included in the report showing results of the tabulated data for speed and torque. The data should be plotted with synchronous speed-percent as the ordinate and the abscissa as torque-percent of full load. The starting, pullup, breakdown and full load torque should be indicated on the curve.

B.2.2 Report of shock test. The report should be made by the shock test laboratory or the forms specified in MIL-S-901 and should include drawing number identification of the fan and motor, as well as photographs of the fan unit in each test mounting.

B.2.3 Calculations. Calculations required by the contract should be recorded.

B.2.4 Dimensional measurements and visual examinations. Records of the visual examinations and dimensional measurements made as a requirement of the specification should be recorded.

B.2.5 Chemical or mechanical analyses. A record of chemical or mechanical analyses should be maintained for castings.

B.2.6 Report of airborne noise. The airborne noise report should comply with the data reporting requirements of ANSI/AMCA 300. Total octave band sound per levels (see 4.7.3.1) for the fan-motor unit when operating at the design point should be tabulated and compared with the total sound power levels specified in table III. Measurements of sound pressure levels and computation of (a) sound power levels emitted from the fan inlet, (b) sound power levels emitted from fan outlet, and (c) sound power levels emitted from the fan casing should be performed in accordance with procedures stated in 4.7.3.2, 4.7.3.3, and 4.7.3.4, respectively, and reported. Inlet sound power levels (see 4.7.3.2), outlet sound power levels (see 4.7.3.3), and casing sound power levels (see 4.7.3.4) for fan-motor unit operation at the design point should be reported in octave band format. Measured sound pressure levels for fan-motor unit operation at the design point, sound power levels for the reference sound source, background sound pressure levels, and sound pressure levels measured when the reference sound source is operational should be tabulated in octave band format. Diagrams of the test configurations employed when determining total octave band sound power levels (see 4.7.3.1), inlet sound power levels (see 4.7.3.2), outlet sound power levels (see 4.7.3.3), and casing sound power levels (see 4.7.3.4) for the fan-motor unit, including position of the reference sound source, fan-motor unit assembly with respect to walls, floor, and ceiling, and distance of the microphone from the nearest surface of the fan-motor unit, and distance of the microphone from terminations of the air inlet and air outlet duct sections attached to the fan-motor unit should be included in the test report.

Custodian:
Navy – SH

Preparing activity:
Navy – SH
(Project 4140-2009-003)

Review activity:
DLA – IS

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.daps.dla.mil.