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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 (Hi-shock)
Composition M	Magnetic
Composition N	Non Magnetic

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in Sections 3 and 4 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 documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, SEA 5Q, Naval Sea Systems Command, 1333 Isaac Hull Ave SE, Stop 5160, Washington Navy Yard DC 20376-5160, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 4140

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, publications, 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

DEPARTMENT OF DEFENSE

MIL-S-901	Shock Tests HI (High Impact); Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-B-17931	Bearings, Ball, Annular, for Quiet Operation

STANDARDS

DEPARTMENT OF DEFENSE

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	Interface Standard for Shipboard Systems, Sect 300, Electric Power, Alternating Current
MIL-STD-2031	Fire and toxicity test methods and qualifications procedure for composite systems.
MIL-STD-2142	Magnetic Silencing Characteristics, Measurement of.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents 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 are those cited in the solicitation.

PUBLICATIONS

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

(Unless otherwise indicated, copies of the above publication are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 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).

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA	111	Laboratory registration program
AMCA	210	Laboratory methods for testing fans for ratings
AMCA	300-96	Reverberant room method for sound testing of fans
AMCA	99-0401-86	Classification for spark resistant construction

(Application for copies should be addressed to the Movement and Control Association, Inc, 30 West University Drive, Arlington Heights, IL 60004.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)/
ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

ANSI/AFBMA STD 4	Tolerance Definitions and Gaging Practices for Ball and Roller Bearings.
ANSI/AFBMA STD 9	Load Ratings and Fatigue Life for Ball Bearings.
ANSI/AFBMA STD 10	Metal Balls.
ANSI/AFBMA STD 20	Metric Ball and Roller Bearings (Except Tapered Roller Bearings) Conforming to Basic Boundary Plans.
ANSI/AFBMA STD 13	Rolling Bearing Vibration and Noise (Methods of Measuring).

(Application for copies should be addressed to the American Bearing Manufacturers Association Inc., 1101 Connecticut Avenue, NW, Suite 700, Washington, DC.)

AMERICAN WELDING SOCIETY (AWS)

B2.1-84	Welding Procedure & Performance Qualifications, Standard
B2.2-91	Procedure and Performance Qualifications & Performance Quality, Standard Brazing

(Applications for copies should be addressed to the American Welding Society (550 NW LeJeune Road, Miami, FL 33216.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE STD 45	Recommended Practice for Electric Installations on Shipboard
IEEE STD 429	Standard Test Procedure for the Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form-Wound Stator Coils

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA MG 1	Motors and Generators
ANSI/NEMA MG 13	Frame Assignments for Alternating Current Integral Horsepower Induction Motors.

(Application for copies should be addressed to the National Electrical Manufacturers Association, 2101 “L” Street, NW, Washington, DC.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 119	Method for Fire Tests of Building Construction and Materials.
ASTM E 662	Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
ASTM E 800	Guide for Measurement of Gases Present or Generated During Fires.
ASTM F 1166	Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities.

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohochen, PA 19428.)

2.4 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. A sample shall be subjected to first article inspection (see 6.3).

3.2 Materials. Fan shall be of spark-resistant construction as defined in AMCA Std 99-0401-86 Type B construction. Cast iron shall not be used in the construction of fans nor shall cast iron be used in 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 filter. 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.

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

3.2.5 Motor material. Motor material shall conform to the requirements of IEEE STD 45 or NEMA MG 1 and 13 as applicable for nonmagnetic motors.

3.2.6 Dissimilar metals. Fans and components shall not be degraded by electrolysis (see 6.7).

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. 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. The identification plate shall contain the following information as a minimum;

a. Manufacturer's name and code number
b. Fan identification code
c. CID number
d. Direction of air flow and rotation
e. Manufacturer's serial number and drawing number
f. Bearing lubrication

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	65 °C
7 (letter)	Nonmagnetic construction	NM	—
8 (letter)	Thermal protection	TP	—
9 (letter)	Quiet bearing	QB	—

[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, 65 degrees Celsius (°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 and Appendix C).

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 optimize personnel skill requirements. ASTM F 1166 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, Sect 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 minus 29 and 65 degrees Celsius (°C).

3.10.1 High impact shock resistance. Unless otherwise specified in 6.2, the fan-motor units shall meet the shock requirements of test 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 interacting frequencies within the audible range. The axial distance between blades and vanes shall be chosen with minimum noise amplitude as a prime consideration. The passing angle between a blade trailing edge and a vane leading edge shall be at least 10 degrees. The maximum blade tip clearance (radial clearance) shall not exceed 1/4 of 1 percent of the casing minimum inside diameter.

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	Max Diam (in)	Max Length (in)	Vol (ft^3/min)	TP (in WG^2)	Vol (ft^3/min)	TP (in WG)
A101	20-1/8	30	1200	14	1320	12
A102	21-1/8	31	1800	14	1980	12
A103	21-1/8	32	2400	14	2640	12
A104	21-1/8	33	3600	14	3960	12
A105	21-1/8	35	5400	14	5940	12

Motor speed shall be 3600 revolutions per minute (r/min).
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 Direction vanes. Airfoil shaped directional vanes shall be provided in the casing.

3.15.4 Fan bellmouth. When specified in 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. The fan impeller shall require no assembly or disassembly except to be removable as a unit from the drive shaft. Impellers shall be of airfoil design. Impellers shall be designed to prevent retention of water when the fan is installed vertically with the impeller up or down or horizontally. The total impeller shall have at least a safety factor of 8, based on the ultimate tensile strength of the material. 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 Hz, AC, integral-horsepower.
b. Service - Navy hi-shock qualified (Type A).
c. Ambient temperature - 65 °C.
d. Voltage, phase, and frequency - 440 v, 3-phase, 60 Hz
e. Power source quality - In accordance with MIL-STD-1399, Sect 300
f. Duty - Continuous-air over.
g. Enclosure – Spraytight.

h. Horsepower in accordance with figure 1, IEEE STD 45 and NEMA MG 1 and 13.
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 ring of the bearing shall not exceed 30 °C in 65 °C ambient. For quiet bearing, temperature rise shall not exceed 25 °C in 65 °C ambient as measured on the outer ring.
m. Insulation required - Class F or better, sealed insulation system with Class B temperature rise.

NOTE:
While procedures of IEEE STD 429 are specified for form wound coils, they are equally applicable to random wound coils.

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 shown for type IV in MIL-STD-740-2, or lower when specified by auxiliary manufacturer
q. Shock test - MIL-S-901, type A, for HI-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.
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/ AFBMA precision classification of

ABEC-5 in accordance with ANSI/AFBMA STDS 4, 9, 10, 13, and 20. 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. Special bearings for quiet operations when specified (see 6.2) shall be in accordance with ANSI/AFBMA 4, 9, 10, 13, and 20 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 on Table II. The total pressure shall rise continually from free delivery to a value at least as high at the stated volume as shown on 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 meet 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[1].

Fan Size code	Octave band center frequency in Hz							
	63	125	250	500	1000	2000	4000	8000
A101	90	95	96	100	107	106	99	90
A102	88	98	98	101	110	106	99	93
A103	87	101	102	102	112	109	101	92
A104	96	103	105	104	112	111	103	94
A105	90	101	108	105	113	112	102	97
AMCA 300, standard deviation	6	3	2	1.5	1.5	1.5	1.5	3

[1]Measurements of total sound power levels made in accordance with AMCA 300-96 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. An additional 4 dB is allowable in the octave band in which the blade passing frequency occurs to account for the tone generated at the blade passing frequency.

4. VERIFICATION

4.1 Classifications of inspections. The inspections 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 each size fan-motor unit.

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 4 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.

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	-
Airborne noise		4.7.3		-	-
by measurement	3.19.3	4.7.3.1	all	-	all
by ear	3.19.3	4.7.3.5	—	all	-
Balance	3.10.2	4.7.4	all	all	-
Vibration	3.10.2	4.7.4.1	all	-	-
Casing tightness	3.15.1	4.7.5	all[1]	-	-
Speed	3.18.1	4.7.6	—	-	-
Shock	3.10.1	4.7.7	Type A	-	-
Motor heat	3.18.1	4.7.8	all	all	all
Bearing temperature	3.18.1	4.7.9	all	-	-
Blade tip clearance	3.11	4.7.10	all	all	-
Measurement	3.2.4	4.9	all	-	all
Non-magnetic	3.9	4.10	First production unit	-	First production unit
Maintainability					

[1]Casing tightness 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 except radiography of visually sound castings is not required. 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.

4.7 Tests. Tests shall be as specified in 4.7.1 through 4.7.11 (see Appendix B).

4.7.1 Performance. Performance tests shall be conducted in accordance with 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. This method is capacity at which the fan goes into stall when slowly throttling the discharge with the fan operating.

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.

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.

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 AMCA 300-96, 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 AMCA 300-96. A random incidence response microphone and a type I (precision) sound level meter conforming to the requirements of AMCA 300-96 shall be used. The minimum distance between the extreme points of the microphone swing as described in AMCA 300-96 shall be 27 ft., and the speed of traverse of the microphone shall not exceed 2.4 ft./sec. 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 sec. The fan shall be mounted on resilient mounts, and flexible duct connections shall be installed between the fan flanges and any duct sections required for testing. Resilient mounts shall be loaded within the design load range for the type of mount selected. The frequencies of the natural modes of vibration of the mounted fan in the vertical direction shall not exceed 11 Hz or one-fourth of the lowest forcing frequency of the fan, whichever is lower. 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 total sound power levels for a fan-motor unit shall be in accordance with Appendix H of AMCA 300-96, installation type B: free inlet/ducted outlet, and Figure 4 of AMCA 300-96. The fan-motor unit and attached discharge duct with orifice plate shall be placed entirely within the reverberant test room.

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 Figure 2 of AMCA 300-96, installation type D: ducted inlet/ducted outlet. No orifice plate shall be installed in the inlet duct. The fan-motor unit and attached discharge duct with orifice plate shall be placed entirely within the chamber, and sound pressure level measurements shall be made within the reverberant test room. Acoustical treatments shall be placed within the chamber to provide an acoustic seal at the penetration in the wall separating the chamber from the reverberant room as necessary 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 Figure 3 of AMCA 300-96, installation type B: free inlet/ducted outlet. An orifice plate shall be installed within the discharge duct if necessary to obtain fan-motor unit operation at the design point. The fan-motor unit with attached discharge duct shall be placed within the chamber. A section of the discharge duct, approximately 2 to 3 duct diameters long and housing an orifice plate, shall extend into the reverberant test room, and sound pressure level measurements shall be made within the reverberant test room. 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, and to ensure that no noise contributions are transmitted from the chamber into the reverberant test room.

4.7.3.4 Casing sound power. 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 AMCA 300-96. 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 their design points. 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 AMCA 300-96.

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 1/4 of the minimum rotational frequency of the unit in Hz. 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 shall 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 shall 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 1/4 inch nor more than 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 3.6 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 Hz up to and including 33 Hz at the table amplitude specified therein. The vibration test shall be conducted in the order specified in 4.7.11. 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 specified in the contract or order (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 on the medium weight machines 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, 4.7.9, and 4.7.10. 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 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 grater than 90 percent of the fan design or rated ft^3/min. Evidence of fragmentation or missile effect of part, deformation that will cause active interference between parts, or failure to operate shall be cause for rejection. 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). Fan-motor units that have passed this test may be used as production units after replacement of motor bearings.

4.7.7.1 Shock on medium weight machine. The test of a fan-motor unit shall consist of the nine blows specified in Table V. The required fan orientation mounting for tests required in Table V are as follows:

1. Fan horizontal (motor shaft horizontal), steel mounting brackets attached to both fan flanges for mounting to test platform.
2A. Fan vertical, fan impeller down (motor shaft vertical, impeller on bottom). Fan flange bolted to a steel plate for mounting to test platform.
2B. 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.

Auxiliary channels shall be used to bolt the mounting brackets or plate to standard fixtures.

TABLE V. Test on medium weight shock machine.

Blow No.	Group No.	Hammer drop	Anvil travel (in)	Operating condition	Fan orientation
1	I	(Based on	3	Secured	No. 1
2	II	weight, see	3	Operating	No. 1

3	III	MIL-S-901)	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

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.

4.7.8 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. Full load 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 ring temperature shall not exceed requirements of 3.18.1.(l).

4.7.10 Blade tip clearance measurement. The fan blades shall be in a stationary position for the entire measurement. Inspect visually to locate an apparent maximum clearance (radial clearance) from the blade tip to the inside of fan casing. Measure this apparent maximum clearance and move the measurement to three different locations at 90, 180, and 270 degrees relative to the apparent maximum clearance. Compare the four measurements to determine the true maximum blade clearance. This maximum clearance shall not exceed 1/4 of 1 percent of the casing inside diameter.

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

a. Balance (4.7.4).
b. Casing tightness (4.7.5).
c. Blade tip clearance measurement (4.7.10).
d. Performance (4.7.1), aerodynamic stall (4.7.2), speed (4.7.6), motor heat (4.7.8), and bearing temperature (4.7.9). These tests shall be conducted concurrently.
e. Airborne noise (4.7.3).
f. Vibration test (4.7.4.1). 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.
g. High-impact shock (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 Non-metallic 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 F-4922 (see Figure 2).

4.8.1.2 External fire insult. Fan casing and conduit box material shall withstand an external fire insult as described in Figure 3. Temperatures around the outside of the test specimen shall exceed minimum temperatures prescribed by ASTM E 119 for at least 15 minutes.

4.8.1.3 Acceptance Criteria. Acceptance criteria for casing material shall be in accordance with Table I of MIL-STD-2031.

4.8.2 Internal composite materials. Fan impeller, casing, and motor composite, etc. Materials shall meet the smoke obscuration (ASTM E 662) 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-E-800) 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 actual packaging of material is to be performed by DoD 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 activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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 on board ships of the United States Navy. The direction of airflow into and out of the fans is axial. The fans are of nonsparking construction. Fans are high efficiency units intended for systems having a resistance of 14.0 inches of water.

6.2 Acquisition requirements. Acquisition documents will specify the following:

a. Title, number, and date of this specification.
b. Type required (see 1.2).
c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2 and 2.3).
d. Whether non-magnetic 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 pressure test is required (Table IV) specify test conditions if other than standard (see 4.7.5).
j. Resilient mountings (see 4.7.7).
k. Level of preservation, packing, and marking required (see 5.1).
l. Drawing approval is required (see 6.4)
m. Final drawings are required (see 6.4.1)
n. 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.

6.3 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 (2) 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 is responsible to: (1) forward final fan-coil 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 is responsible to: (1) identify these numbers in shipping papers; and (2) mark these numbers on each fan and motor identification plates.

6.5 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, military specifications and standards that have been cleared and listed in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423), which in included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

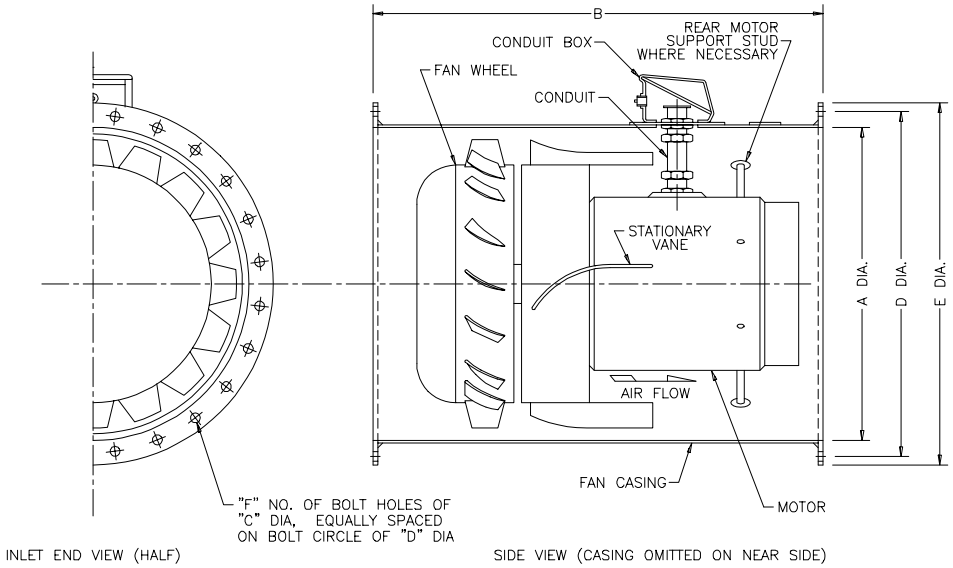
6.6 Recommended Practices The following documents provide information for the design, manufacture, testing, and qualification of vaneaxial fans used for cooling of gas turbine machinery previously supplied to the United States Navy, and may be used for guidance:

a. MIL-F-24751 Fans, Vaneaxial, Gas Turbine Enclosure Cooling, Naval Shipboard
b. Mil-STD-889 –Dissimilar Metals

6.7 Subject term (key word) listing.

Blade
Casing
Duct
Impeller
Vane

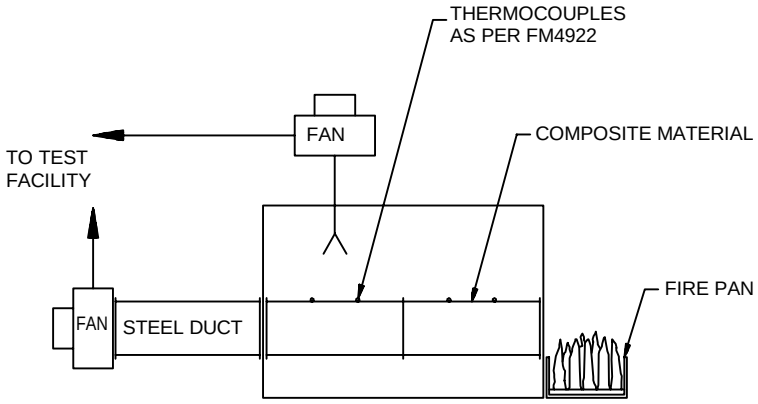
6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.



INTERFACE AND PHYSICAL DATA												
FAN SIZE	MOTOR DATA[1]		MAX DIMENSIONS (INCHES)					NO. OF BOLT HOLES F	SET[2,3] WEIGHT (LB)	AIRFLOW (CFM)[4]		MAXIMUM[5] EFFECTIVE STALL
	MAX HP	RPM	A	B	C	D	E			12 IN. W.G.	14 IN. W.G.	
A101	10	3600	20-1/8	30	17/32	23-1/4	23-5/8	24	580	1320	1200	1020
A102	10	3600	21-1/8	31	17/32	23-1/4	24-5/8	24	600	1980	1800	1530
A103	15	3600	21-1/8	32	17/32	23-1/4	24-5/8	24	620	2640	2400	2040
A104	15	3600	21-1/8	33	17/32	23-1/4	24-5/8	24	620	3960	3600	3060
A105	20	3600	21-1/8	35	17/32	23-1/4	24-5/8	24	640	5940	5400	4590

NOTES:
1. MOTOR HORSEPOWER (HP) AND SPEED (RPM) ARE GIVEN AT 440 VAC 3 PHASE, 60 HZ.
2. WEIGHT FOR FAN WITH 65°C (149°F) AMBIENT MOTOR.
3. ALL WEIGHTS ARE APPROXIMATE.
4. THE AIRFLOW RATES FOR A SINGLE, FULLY-LOADED, CBR FILTER HOUSING IS 600 CFM, THEREFORE, NAVY STANDARD HIGH PRESSURE VANEAXIAL FANS ARE AVAILABLE FOR FILTER
5. 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 & 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:

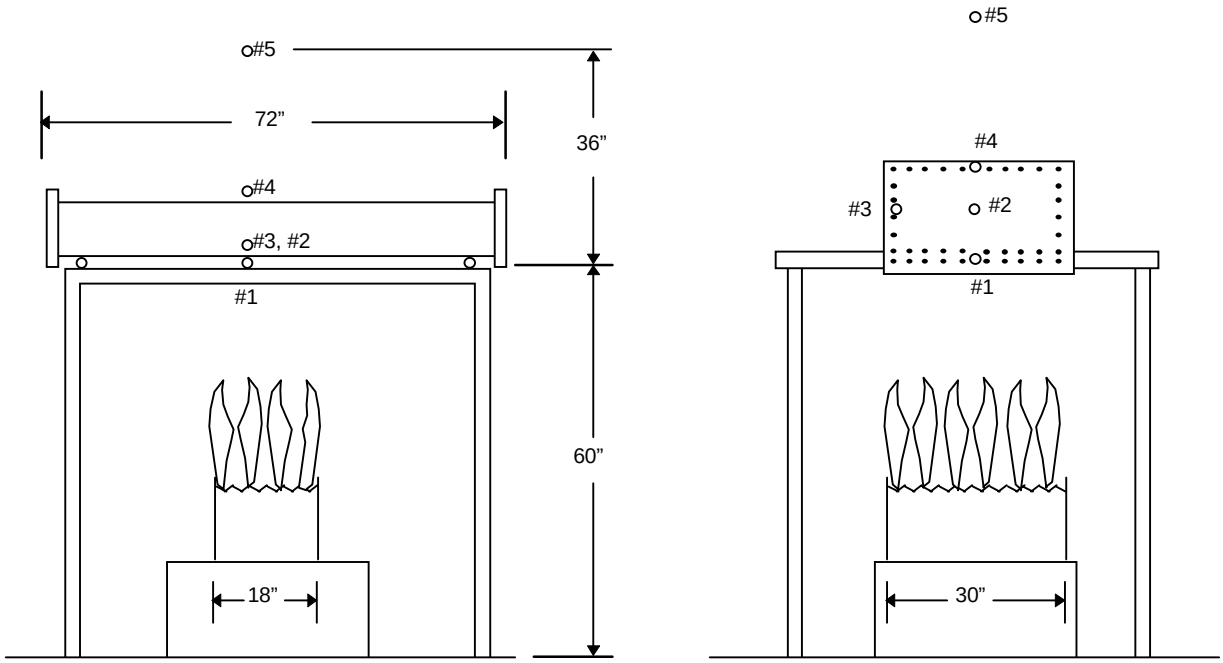
Test material
The manufacturer has the option to furnish sufficient material to assemble:

a. Two 24-ft long composite ducts incorporating at least two factory or field assembled joints (as appropriate to the application) or
b. Two 12-ft long 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-ft long 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-ft long and flanged for bolted connection (with gasketing) to each other to make up the entire standard 24-ft test length. If rectangular ducting cross-sections are utilized, the following nominal dimensions are recommended: 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 F4922 to simulate building fire conditions (using heptane fuel) should be enlarged to 16-inch by 16-inch by 15 inches deep to more closely simulate a shipboard engine room hydrocarbon pool fire.

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



Notes
The fan-motor section material (1 ft by 2 ft by 6 ft long duct) is exposed for 15 minutes to a hexane fire capable of temperatures between 1400 to 1600 degrees 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 temperatures.
#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. 15 Minute fire test with hexane fuel.

APPENDIX A

ENGINEERING DRAWINGS TECHNICAL CONTENT REQUIREMENTS

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 mandatory and is provided for informational purposes only.

A.2 APPLICABLE DOCUMENTS

A.2.1 Government documents.

A.2.1.1 Specification and standard. The following specification and standard 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.

SPECIFICATION

DEPARTMENT OF DEFENSE
MIL-DTL-31000 Drawings, Engineering and Associated Lists

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

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, should be in accordance with MIL-DTL-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 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. Axial length of vanes.
   6. Indication of the area of wheel from which metal is to be removed in balancing, and the permissible depth of such removal.
   7. The nominal axial distance between the trailing edge of a blade at midpoint to the leading edge of a vane.
   8. 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, center of gravity, and moments of inertia.
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. Statements identifying the plating, welding, and painting of components or assemblies.
6. Indication of the method of balancing the fan impeller.
7. Indication of the passing angle, viewed axially, of a blade trailing edge and a vane leading edge.
8. A statement of the minimum casing wall thickness (including the fan raceway that is normally machined).
9. Identification of any carbon steel surface which may be machined after plating, and a statement of the treatment of such area prior to painting.
10. Any other statements necessary for clarity.
11. At the manufacturer’s option, statements for manufacturer’s use only, so designated.

g. A nonlogarithmic 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. Subassemblies 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-M-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.

APPENDIX B

TEST REPORT TECHNICAL CONTENT REQUIREMENTS

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 mandatory and is provided for informational purposes only.

B.2 APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

B.3 TEST REPORTS

B.3.1 Report of performance, noise, balance, and motor heating. The figure number of 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 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 ordinated, 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, pull-up, breakdown and full load torque should be indicated on the curve.

B.3.2 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.3.3 Calculations. Calculations required by the contract should be recorded.

B.3.4 Dimensional measurements and visual examinations. Records of the visual examinations and dimensional measurements made as a requirement of the specification should be recorded.

B.3.5 Chemical or mechanical analyses. A record of chemical or mechanical analyses is required of castings.

B.3.6 Report of airborne noise. The airborne noise report should comply with the data reporting requirements of AMCA 300-96. Total octave band sound per levels (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 (4.7.3.2), outlet sound power levels (4.7.3.3), and casing sound power levels (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 (4.7.3.1), inlet sound power levels (4.7.3.2),

outlet sound power levels (4.7.3.3), and casing sound power levels (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.

RELIABILITY

C.1 SCOPE

C.1.1 Scope. This appendix covers the information and procedures necessary to ensure that the reliability requirements of this specification are met. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

C.2 APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

C.3 RELIABILITY DATA

C.3.1 Reliability analysis. Reliability analysis shall be performed by manufacturers to determine that the equipment meets the Integrated Logistic Support (ILS) requirements of 3.7.1. Manufacturers shall maintain record data to indicate degree of conformance to ILS requirements. The reliability analysis shall include:

a. A list of parts, which according to experience and judgment, are subject to wear, material deterioration, and service failures.
b. Design features employed to attain the required service life of the parts, with consideration to shipboard environmental and resultant conditions. Design features include: choice of materials, compatibility of materials, repairability and accessibility, hardness, surface finishes, fits and clearances, corrosion control, equipment protection fail-safe features, internal and external operating temperatures, and suitability of the materials at these temperatures.
c. Preventive maintenance and servicing requirements necessary for the achievement of reliable equipment. Any unusual steps or precautions necessary in carrying out maintenance and servicing requirements shall be pointed out.

C.3.2 Failure reporting, analysis, and feedback. The reliability assurance program shall incorporate a formalized system for recording, collecting, and analyzing all failures that occur during testing, installation, and operation through the tenure of the contract. Analysis shall be fed back to contractor's engineering, management, and production activities on a timely basis. Failure reports received from the using activity shall be integrated into this program for trouble analysis and for experience considerations for future design review.

Custodian:
Navy – SH
Reviewing Activity:
DLA - IS

Preparing Activity
Navy - SH
(Project number 4140-0170)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4,5,6, and 7 and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the 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	2. DOCUMENT DATE *(YYYYMMDD)*
	MIL-PRF-24755A	20010531

3. DOCUMENT TITLE
Fans, Vaneaxial, High Pressure, Naval Shipboard

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 *(YYYYMMDD)*

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE *(Include Area Code)*	
Ruth Butler	(1) Commercial (202) 781-3726	(2) DSN 326-3726
c. ADDRESS *(Include Zip Code)* Commander, Naval Sea Systems Command ATTN: SEA 05Q, 1333 Isaac Hull Ave, SE Stop 5160, Washington Navy Yard DC 20376-5160	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888	