INCH-POUND

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PERFORMANCE SPECIFICATION

FANS, CENTRIFUGAL, VENTILATION, 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 centrifugal fans for use in Naval shipboard heating, ventilating, and air conditioning systems.

1.2 Classification. Fans covered by this specification are of the following types, as specified (see 6.1).

Type CC - Centrifugal, motor driven (high-impact - shock)
Type X-CC - Centrifugal, motor driven (non-Shock, commercial motor)

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.

2.2 Government documents.

2.2.1 Specifications, standards. 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 be 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, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for
MIL-B-17931	Bearings, Ball, Annular, for Quiet Operation

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, SEA 05Q, Naval Sea Systems Command, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 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

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-167-1	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally excited)
MIL-STD-1399	Interface Standard for Shipboard Systems, Sect 300, Electric Power, Alternating Current
MIL-STD-2031	Fire & Toxicity Test Methods and Qualification Procedures for Composite Systems
MIL-STD-2142	Magnetic Silencing Characteristics, Measurement of

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, Casing 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 that are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN 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	Roller 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.)

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

111	Laboratory Registration Program
210	Laboratory Methods for Testing Fans for Ratings
300-96	Reverberant Room Method for Sound Testing of Fans
99-0401-86	Classification for Spark Resistant Construction
2406-66	Designations for Rotation and Discharge of Centrifugal Fans

(Application for copies should be addressed to the Air Movement and Control Association, Inc., 30 West University Drive, Arlington Heights, IL 60004-1893.)

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.)

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 specification and the references cited herein, the text of this specification 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 the fans nor shall cast iron be used in motors that are components of type CC 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 any recoverable properties before being 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.

3.2.1.2 Fan internal components. Composite material to be used for motor, vanes, impeller and conduit shall withstand small-scale material specimen fire tests as outlined in 4.8.2.

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. The fan and components shall not degrade due to 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 recycled, recovered or environmentally preferable materials. Recycled, recovered or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs. 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 and welding.

3.3.1 Factory coating. Equipment and component items shall be delivered with the manufacturers standard finish, except as to comply with the requirements of 3.2.

3.3.2 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.

3.4 Identification.

3.4.1 Fan identification code. The size and characteristics of Navy standard fan motor units shall be designated by a code formed by alternate letters and numbers arranged in the following sequence:

Symbol sequence	Characteristics	Code	Meaning
1 (letter(s))	Type of fan	See 1.2	-
2 (number)	Fan size	For size codes, see Table I	Nominal cubic feet per minute (ft^3/min) of standard air in thousands (2=2000 ft^3/min)
3 (letter)	Type of current:	A	Alternating current (ac)
4 (number)	Voltage and phase	4	440-Volt (V), 3-phase ac, 60 Hz
5 (letter)	Motor enclosures:	W X	Spraytight Explosion-proof
6 (number)	Maximum ambient temp	6	149 °F (65 °C)
7 (letter(s))	Non-magnetic structure of fan and motor	NM	(This part of the seventh symbol is omitted unless applicable.)
	Rotation, centrifugal fans, (viewed from drive side) - clockwise - counterclockwise	 CW CCW	---
	Non-sparking construction	NS	---
	Acid resisting paint on air handling parts	AR	---
	Watertight construction	WT	---
8 (letter(s))	Quiet bearings	QB	Meets MIL-B-17931

Examples:

1. CC5A4W6CW-NS-WT represents a nominal 5000 ft^3/min centrifugal, non-sparking watertight construction fan, clockwise rotation, driven by a 440-V, 3-phase, 60 Hz ac, spraytight, 149 °F ambient temperature motor. Navy standard fans with special electrical characteristics shall have shortened fan codes, with electrical characteristics identified by text and preceded by the letter “S”.
2. X-CC6A4W6CCW represents a nominal 6000 ft^3/min centrifugal fan, counterclockwise rotation, with commercial motor, driven by a 440-V, 3-phase, 60 Hz ac, 149 °F ambient temperature motor.

3.4.2 Identification plates. Each fan shall be provided with a permanently attached corrosion-resistant identification plate. The method of attachment of the identification plate shall be corrosion-resistant. The identification plate shall contain the following information:

a. Manufacturer's identification.
b. Fan code.
c. CID number.
d. Direction of airflow and rotation.
e. Manufacturer's serial number and drawing number.
f. Bearing Lubrication.

3.5 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.

3.6 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).

3.6.1 Reliability. Reliability shall meet specified values (see Appendix C).

3.7 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.

3.8 Maintainability. The fan shall be constructed so that:

a. Fan impeller and motor may be removed from the fan scroll without disconnecting the fan scroll from the discharge or intake ducts.
b. Fan impeller and bearings are removable using commonly available tools.

3.9 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 in a weather air intake of a ship when exposed to soaking atmospheric spray (rain or sea) or seawater.
c. Perform in accordance with requirements herein under ambient temperatures between 20 °F and 149 °F.

3.9.1 High impact shock resistance. Unless otherwise specified (see 6.2), Type CC fan-motor units shall meet the shock requirements of MIL-S-901 for Grade A, class 1 equipment.

3.9.2 Vibration and balance. Fan-motor units shall be designed such that no damage will occur or malfunction is 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.

3.10 Configuration. Fans and motor shall be suitable for operation in horizontal (on ship axis or athwartship) or inclined position whether installed on deck or suspended from the deck above.

3.11 Sizes. Sizes of CC and X-CC fans shall be limited to those listed in Table I.

TABLE I. Performance of type CC and X-CC fans.

Fan size	Total Pressure (TP) at stated volume	
	ft^3/min	TP (inch H_2O)
¼	250	1.74
½	500	2.5
1	900	2.5
1-1/2	1200	2.58
2	1300	3.06
3	1950	4.25
4	2500	5.25
5	3000	5.3
6	5000	4.0
8	4500	5.2
10	7000	5.0

3.12 Physical interface dimensions. In order to suit interface requirements, physical interface dimensions of the type CC and X-CC fans shall be as shown on Figure 1.

3.13 Fan scrolls and associated parts.

3.13.1 Watertightness. Scrolls shall be of watertight construction.

3.13.2 Fan scrolls. Scrolls shall be equipped with an inlet designed to reduce turbulence and noise. The interior of the fan scrolls shall be free of obstructions.

3.13.3 Rotation. Direction of rotation of impeller shall be indicated on inlet side of scroll. Discharge and rotation shall be determined by viewing the fan from the motor end. The rotation shall be designated by the terms “clockwise” and “counterclockwise”. Discharge of a fan shall be determined by the direction of the line of discharge and its relation to the motor shaft when the fan is resting on the floor, as indicated in AMCA STD 2406-66. Unless otherwise specified (see 6.2), fans shall be assembled for top-horizontal discharge.

3.13.4 Handhole opening. A watertight handhole of sufficient size shall be provided in the scroll of sizes 1-1/2 fans and larger for cleaning the impeller.

3.13.5 Flanges. Fan scrolls shall be provided with inlet and outlet flanges for attachment of ducting (see Figure 1).

3.13.6 When specified in 6.2, a fan bellmouth shall be provided.

3.14 Fan impellers. Fan impellers shall be direct-connected to the motor. Impellers in fans larger than size ¼ shall be of non-overloading type. Impellers shall have a safety factor of at least 8, based on the ultimate tensile strength of the material used.

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

3.15 Fan and motor base. The fan and motor bases shall be designed so that they can accommodate a fan discharge of any possible discharge position through 360 degrees, without modification as per AMCA 2406-66.

3.16 Electrical equipment for fans.

3.16.1 Motors. Motors shall be as specified in 3.16.1 through 3.16.8. Motors shall conform to IEEE STD 45, NEMA MG 1 and MG 13 as applicable and as augmented herein.

3.16.1.1 General requirements for motors.

Service:	Fan type CC - grade A shock qualified Fan type X-CC - commercial motor
HP:	Table II
Design:	Squirrel cage induction
Duty:	Continuous
Voltage and phase:	440-V, 60 Hz, 3-phase
Insulation:	Class F or better with Class B temperature rise. (IEEE STD 429)
Bearing:	See 3.16.3, 3.16.5
Speed:	Table II (see 3.16.4)
Enclosure:	Spraytight, or explosion-proof as specified in 6.2

3.16.2 Conduit box. A conduit box shall be provided on the motor. It shall meet tightness requirements of motor enclosure.

3.16.3 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.

3.16.4 Speed. Speed and horsepower shall be limited to Table II.

TABLE II. Speed and horsepower of 440 V,3 phase, 60 Hz motors, type CC and X-CC fans.

Fan size	No. of windings	Maximum hp	Speed	Maximum rpm
¼	1	¼	Single	1800
½	1	¾	Single	1800
1	1	1	Single	1800
1½	1	1	Single	1800
2	1	1½	Single	1800
3	2	3	Full and 2/3	1800/1200
4	2	4	Full and 2/3	1800/1200
5	2	5	Full and 2/3	1800/1200
6	2	5	Full and 3/4	1200/900
8	2	7½	Full and 3/4	1200/900
10	2	10	Full and 3/4	1200/900

3.16.5 Bearing temperature rise. Bearing temperature rise shall not exceed 63 °F in 149 °F ambient as measured on bearing outer ring. For quiet bearings, temperature rise shall not exceed 45 °F in 149 °F ambient as measured on bearing outer ring.

3.16.6 Drains. All spraytight motors shall be provided with not less than four condensate drain holes fitted with plugs. The holes shall be positioned around the motor end bell(s).

3.16.7 Test connection for explosion-proof motors. A single drilled, tapped, and plugged opening shall be provided in the front bracket of each explosion-proof motor for determining enclosure air leakage rate.

3.16.8 Torque and locked rotor current. Torque and locked rotor current shall be as specified in Table III.

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

3.17 Fan performance.

3.17.1 Volume and pressure. The design point for each size of Navy standard centrifugal fans is the volume-pressure point at the maximum total pressure (TP) shown for that size on Table I and Figure 2. The TP shall rise continually from free delivery to a value at least as high as the stated value shown in Table I, and throughout this range shall exhibit stable performance. Volume in ft^3/min shall be within 5 percent of the volume on the applicable curve of Figure 2, as indicated on system characteristic curves. Total pressure developed by a fan is the pressure at the fan discharge, and the volume is the volume at fan inlet.

3.17.2 Aerodynamic stall. Effective stall shall not occur at capacities greater than 85 percent of the air quantities given in Table I, for each fan size.

TABLE III. Torque of motors, type CC and X-CC fans.

Fan Size	Locked rotor current	TORQUE		
		Locked rotor percent minimum	Breakdown as specified	Pullup percent minimum
1/4	NEMA MG 1 + 10 percent	70	NEMA MG 1	70
1/2	NEMA MG 1 + 10 percent	70	NEMA MG 1	70
1	NEMA MG 1 + 10 percent	70	NEMA MG 1	70
1-1/2	NEMA MG 1 + 10 percent	70	NEMA MG 1	70
2	NEMA MG 1 as specified	70	NEMA MG 1	70
3	NEMA MG 1 as specified	70	NEMA MG 1	70
4	NEMA MG 1 as specified	70	NEMA MG 1	70
5	NEMA MG 1 as specified	70	NEMA MG 1	70
6	NEMA MG 1 as specified	70	NEMA MG 1	70
8	NEMA MG 1 as specified	70	NEMA MG 1	70
10	NEMA MG 1 as specified	70	NEMA MG 1	70

3.17.3 Airborne noise. The total sound power levels for the fan-motor unit shall not exceed the levels stated in Table IV when measured in accordance with procedures stated in 4.7.5. Exceeding the total sound power levels specified in Table IV shall be cause for rejection.

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

Fan size	Octave band center frequency - Hz							
	63	125	250	500	1000	2000	4000	8000
1/4	87	85	88	74	73	69	62	54
1/2	86	87	85	75	72	71	63	56
1	89	87	80	76	75	70	65	62
1-1/2	91	89	82	78	77	72	67	64
2	92	91	85	83	81	80	78	69
3	94	92	92	91	88	84	75	72
4	96	92	92	91	89	85	76	72
5	97	93	93	92	90	86	77	73
6	91	89	88	84	79	76	70	65
8	95	96	91	90	87	86	83	78
10	97	98	93	92	89	88	85	80

NOTE—An additional +3dB tolerance is allowed in each active band.

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 V. The tests specified shall be performed on each size fan-motor unit.

4.3 Conformance inspection. Conformance inspection shall consist of the examinations of 4.7 and tests as specified in Table V. 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 ensure 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 V.

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

TABLE V. Test agenda.

Applicability of test to fan type					
Tests	Requirement	Verification	First article	Conformance	Periodic
Shock	3.9.1	4.7.1	Type CC		
Vibration	3.9.2	4.7.2	Type CC		
Balance	3.9.2	4.7.3	All	All	All
Performance	3.17.1 3.17.2	4.7.4 4.7.4.1	All		All
Airborne noise by measurement by ear	3.17.3	4.7.5 4.7.5.1 4.7.5.5	All	All	All
Motor temperature	3.16.1.1	4.7.6	All	All	All
Bearing temperature	3.16.5	4.7.6	All		
Explosion-proof motors	3.16.7	4.7.7	All with explosion-proof motors		
Air leakage Explosion-proof motors	3.16.7	4.7.7.1	All with explosion-proof motors	All with explosion-proof motors	
Casing tightness	3.13.1	4.7.8	All	All	
Speed	3.16.4	4.7.9	All	All	
Composite material	3.2.1	4.8	Representative sample		
Permeability	3.2.4	4.9	All non-magnetic		All non-magnetic
Maintainability	3.8	4.10	First production unit		Representative size

4.6 Material inspection.

4.6.1 Fabricated steel casing. Visual examination for defects is required. 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 area is performed. Wall thickness shall be measured on at least 10 percent of the casing.

4.6.2 Electrical components. The quality requirements of the applicable components shall be certified by a nationally recognized test laboratory.

4.7 Tests. Tests shall be conducted in accordance with 4.7.1 through 4.9 (see 4.11 and Appendix B).

4.7.1 High-impact shock. The type CC fan-motor unit shall be shock tested on the medium weight machines as prescribed for type A of MIL-S-901 if its weight with fixture and mounting bracket exceeds 550 pounds or if the mounting bracket extends beyond the anvil; otherwise, it shall be shock tested on the light weight machine as specified for grade A shock of MIL-S-901. Shock test acceptance shall not be contingent upon the ability of the equipment to satisfy noise and vibration requirements. Evidence of fragmentation or

missile effect of parts, deformation that will cause active interference between parts, or failure to operate shall be cause for rejection. 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.

4.7.1.1 Shock on lightweight machine. The motor and fan support shall be mounted as shown on Figure 4c of MIL-S-901. The test shall consist of nine blows with the unit operating at maximum speed and nine blows with the unit not engaged.

4.7.1.2 Shock on medium weight machine. The test of a fan-motor unit shall consist of nine blows indicated in Table VI. The required mountings for required tests in Table VI are as follows: (Designations for rotation and discharge of centrifugal fans are in accordance with AMCA 2406-66).

1. CWTH or CCTH, motor and impeller shaft horizontal.
2A. CWTH or CCTH, motor and impeller shaft horizontal, mounting base inclined 30°.
2B. CWUB or CCOB, base, motor and impeller shaft inclined 30°, motor on top.

TABLE VI. 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 tests specified in Table V, the fan-motor unit shall be returned to the contractor for examination and further testing.

4.7.2 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 up to 33 Hz at the table amplitude specified herein. The vibration test shall be conducted as specified in 4.11. Any unit that fails to meet any requirement shall be rejected.

4.7.3 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 the suspension test, 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 greater than 35 inches, and the link size of the chains shall be not less than 1/4 inch nor greater than 3/8 inch. With either method, the internally excited vibrational displacement (single amplitude mils, peak) shall be measured as follows: four axial measurements 90 degree 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 limits specified in 3.9.2 is cause for rejection.

4.7.4 Performance. Performance tests shall be conducted in accordance with AMCA 210. Any of the alternate test stands and associated instrumentation may be used. The total pressure or the volume or both not being within the specified limits is cause for rejection.

4.7.4.1 Stall and recovery. Tests shall be conducted in accordance with AMCA 210.

4.7.5 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 3.17.1. 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. 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.

4.7.5.1 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.

4.7.5.2 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.

4.7.5.3 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.

4.7.5.4 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.

4.7.5.5 Airborne noise detected by ear. Fan-motor units not undergoing airborne noise testing described in 4.7.5.1 through 4.7.5.4 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 4.7.5.1, and sound power levels shall be computed to determine conformance with sound power level requirements specified in Table IV.

4.7.5.6 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.

4.7.6 Motor temperature. Motor temperature rise shall be measured as specified in the applicable motor specification. In each test, the motor shall be installed on the fan, and a duct shall be attached to the discharge. Maximum load shall be obtained by means of terminal throttle on the test duct. Since neither the fan nor a test stand will normally be available at the motor plant, the test may be conducted at the plant of the contractor. Motors with a temperature rise of any part in excess of specification limits or bearings in excess of 3.16.5 shall be rejected.

4.7.7 Explosion. This test is applicable only to electrical equipment requiring an explosion-proof enclosure. Test shall be performed in a petroleum ether atmosphere and certified by a nationally recognized laboratory. Test shall include the conduit and conduit box actually used with the fan. Prior to the explosion test, the air leakage rate of the motor enclosure shall be determined by pressurizing the interior of the motor enclosure to 10 pounds per square inch (lb/in^2) and measuring the period of time in seconds for the pressure to drop from 10 to 4 lb/in^2. The air leakage rate shall be recorded on the applicable motor drawing.

4.7.7.1 Air leakage rate. The motor of explosion-proof fan-motor units shall have motor enclosure air leakage rate measured to determine whether the rate of leakage exceeds that determined in 4.7.7. Any explosion-proof motor where there is evidence that the predetermined rate of leakage is exceeded when measured shall not be offered for delivery.

4.7.8 Casing tightness. The casing tightness test shall be conducted as follows:

a. Blank flanges (one with air supply and gauge connections) shall be bolted to gasketed fan flanges.
b. Air at a pressure 50 percent higher than the maximum pressure capability of the fan shall be supplied to the casing interior.

A pressure drop in a 10-minute period that exceeds 5 percent of the test pressure is cause for rejection.

4.7.9 Speed. The fan-motor unit shall be operated at each speed at free delivery to determine whether the motor speed is at least 97 percent of the design speed at rated voltage (see Table II). A speed of less than 97 percent of the design speed is cause for rejection.

4.8 Composite material testing. Composite material shall be tested for flame spread, smoke obscuration, combustion gas igniteability, heat release, and mass consumed.

4.8.1 Fan casing and conduit box.

4.8.1.1 Internal fire test. Fan casing and conduit box material shall be subjected to an internal fire insult as described in the full-scale Factory Mutual test for horizontal duct FM-4922 with modifications see (Figure 3).

4.8.1.2 External fire test. Fan casing and conduit box material shall be subjected to an external fire insult as outlined in Figure 4. Temperatures around outside of 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, vanes, and motor composite 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	Non-flaming
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
NH3	<3	<3
COC_2	<0.1	<0.1

4.9 Permeability tests. A permeability test on nonmagnetic material used in construction of fans 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:

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

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

a. Composite material (4.8).
b. Balance (4.7.3).
c. Casing tightness (4.7.8).
d. Performance (4.7.4), stall and recovery (4.7.4.1), speed (4.7.9) and heat (4.7.6). These tests shall be conducted concurrently.
e. Airborne noise (4.7.5, 4.7.5.1, 4.7.5.2, 4.7.5.3, 4.7.5.4, 4.7.5.5).
f. Vibration test (4.7.2). The correction of damage, which may have occurred during the vibration test, shall not be performed prior to test specified in 4.7.1.
g. High-impact shock (4.7.1). After conducting the high-impact shock test, tests specified in 4.7.4 and 4.7.4.1 shall be again conducted without correction of damages that may have occurred during the shock. Data for tests specified in 4.7.4 and 4.7.4.1, one before and one after high-impact test, shall demonstrate that the fan-motor unit satisfies performance and aerodynamic stall to within 5 percent of the volume indicated on Figure 2.
h. Explosion (4.7.7 and 4.7.7.1).
i. Permeability (4.9).
j. Maintainability (4.10).

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 for 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 is not mandatory.)

6.1 Intended use. The fan-motor units specified herein are intended for ventilation and air conditioning applications only onboard ships and craft of the United States Navy. The direction of airflow into and out of the fans is radial. The fans are of non-sparking construction. Fans with motors rated for 149 °F ambient temperature are standard.

6.2 Acquisition requirements. Acquisition documents must 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 2.3).
d. Whether nonmagnetic fan-motor units are required (see 3.2.4).
e. Fan characteristic code in accordance with 3.4.1 including size (see 3.11), discharge and rotation (see 3.13.3), type of motor current,

voltage and phase (see 3.16.1.1), motor enclosure (see 3.16.1.1), ambient temperature (see 3.16.1.1).
f. Shock requirements (see 3.9.1).
g. Motor bearings quiet bearings (see 3.16.3).
h. Bellmouth required (see 3.13.6).
i. Type of motor enclosure (see 3.16.1.1)
j. Resilient mountings (see 4.7.1).
k. Level of preservation packing required (see 5.1).
l. Final drawings are required (see 6.5)
m. Shock and vibration mitigation: In addition to packaging requirements specified in the contract, all levels of packing 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 shipment.
n. Verification tests should be conducted after award of contract.

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 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract. When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.5 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 and motor drawings to acquisition activity; and (2) include special requirements of the contract or order prior to distribution of final drawings. (See Appendix A)

6.6 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.

6.7 Recommended practices. The following documents provide information for the design, manufacture, testing, and qualification of centrifugal fans previously supplied to the United States Navy, and may be used for guidance:

a. MIL-F-19004 – Fans, Centrifugal, Fixed and Portable Ventilation, Naval Shipboard.
b. Fan, Centrifugal (CC Type), NAVSHIPS Drawing 803-5001058.

c. MIL-STD-889 –Dissimilar Metals.

6.8 Performance review. The fan may be acceptable if some part of the fan characteristic curve falls outside of the tolerance band of the stable operation region, as specified in 3.17, provided the measurement uncertainty (maximum 2 percent), as defined in AMCA 210, extends into the acceptable region. For this situation, NAVSEA will review and approve/ disapprove a waiver based on measurement uncertainty tolerance.

6.9 Design reviews.

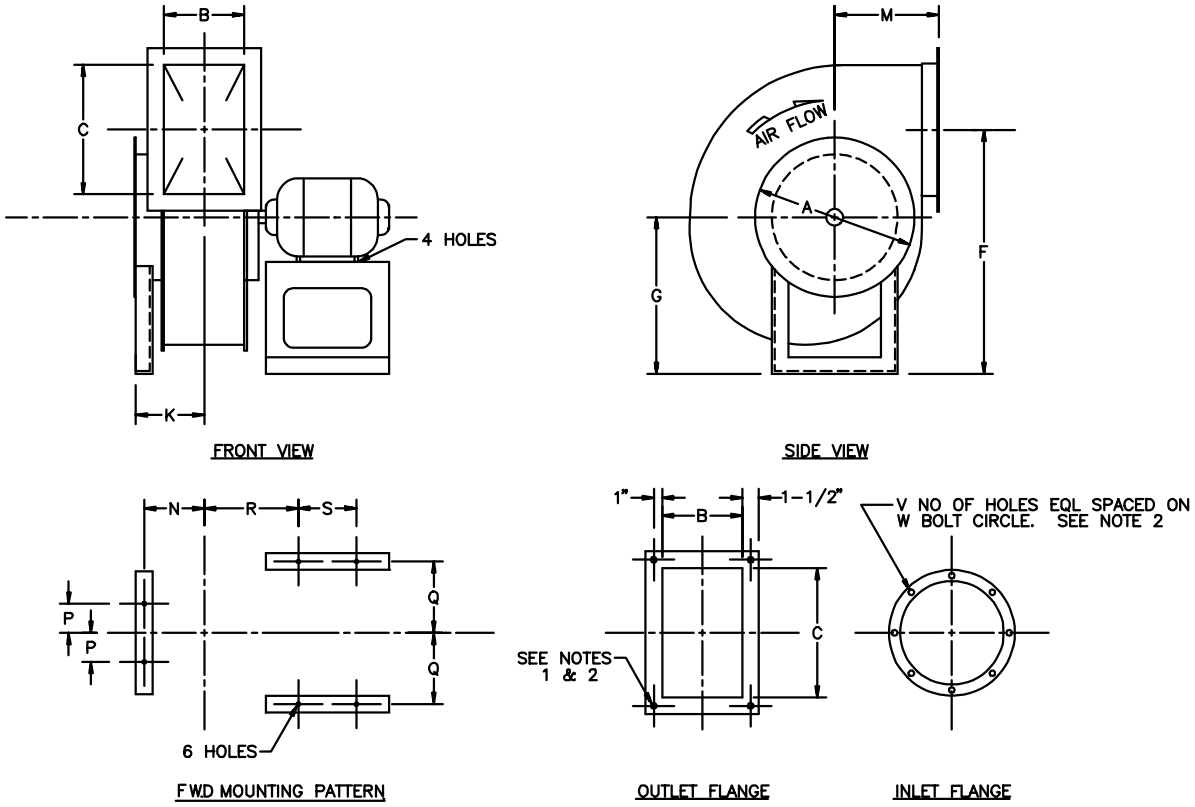
6.9.1 The reliability assurance program should include provisions for the reliability review and evaluation of design as an integral part of the contractor's engineering design procedures. Design or engineering changes occurring during development or production should be submitted to comparable review procedures.

6.9.2 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.

6.10 Subject term (key word) listing.

Scroll
Hub
Impeller
Vanes

6.11 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 PHYSICAL DATA																	
MOTOR DATA			MAX DIMENSIONS (INCHES)														MAX WEIGHT (POUNDS)
SIZE	MAX HP	RPM	A	B	C	F	G	K	M	N	P	Q	R	S	V	W	
CC1/4	1/4	1800	6	4 3/4	5 3/4	14 11/16	8 1/2	4 3/8	8 3/8	–	–	4 7/8	5 1/8	5 1/4	8	7 1/2	100
CC1/2	3/4	1800	9 5/8	4 3/16	11	20 3/8	13	5 1/4	10 5/8	–	–	6 1/8	5 1/4	8	12	11 1/8	170
CC1	1	1800	11 1/4	5 7/8	11 9/16	21 13/16	14	6 3/4	11 1/4	6	6 3/8	6 3/8	6	9 1/4	14	12 3/4	190
C1 1/2	1	1800	18 1/4	10 3/8	14 1/2	22 3/4	15	9 1/8	11 1/2	8 1/8	6 5/8	6 5/8	8 1/8	9 1/8	20	19 3/4	215
CC2	1 1/2	1800	19 3/8	11 1/2	16 1/8	23 11/16	16 1/2	10	12 1/4	9	7 1/8	7 1/8	9	9 7/8	22	20 7/8	310
CC3	3	1800/1200	22 3/4	11 3/4	19 3/8	29 15/16	20	10 5/16	14 1/2	9 1/4	8 3/8	8 3/8	9 1/4	12 1/2	26	24 1/4	560
CC4	4	1800/1200	24 1/2	12 7/8	21 1/2	32 1/2	21 3/4	10 13/16	15 3/4	9 3/4	9 1/8	9 1/8	9 3/4	14 1/2	28	26	610
CC5	5	1800/1200	24 1/2	13 3/4	21 1/2	32 1/2	21 3/4	11 1/4	15 3/4	10 3/16	9 1/8	9 1/8	10 3/16	14 1/2	28	26	955
CC6	5	1200/900	33	18	29	44 1/4	29 1/2	14 3/8	20 1/2	13	10 7/8	10 7/8	13	17 1/8	36	34 1/2	1110
CC8	7 1/2	1200/900	36 7/8	19 3/8	32 1/4	49 1/8	32 3/4	15 1/16	23 1/2	13 3/4	11 7/8	11 7/8	13 3/4	18	42	38 3/8	1210
CC10	10	1200/900	36 7/8	20 9/16	32 1/4	49 1/8	32 3/4	15 5/8	23 1/2	14 5/16	11 7/8	11 7/8	14 5/16	19	42	38 3/8	1260

NOTES:
1. BOLT HOLE DIAMETER FOR OUTLET AND INLET FLANGES SHALL BE $^{17}/_{32}$ INCH.
2. OUTLET FLANGES SHALL BE DRILLED ON 3-INCH CENTERS, WORKING FROM THE FLANGE CORNERS TOWARDS THE AIR OUTLET CENTER LINES. WHEN THE SPACE BETWEEN THE CENTER LINE AND THE ADJACENT HOLE EXCEEDS 2 INCHES, THERE SHALL BE A HOLE ON THE CENTER LINE.
3. ALL WEIGHTS ARE APPROXIMATE.
4. WEIGHT FOR FAN WITH 65°C (149°F) AMBIENT MOTOR.

FIGURE 1. Centrifugal fan (type CC) physical data.

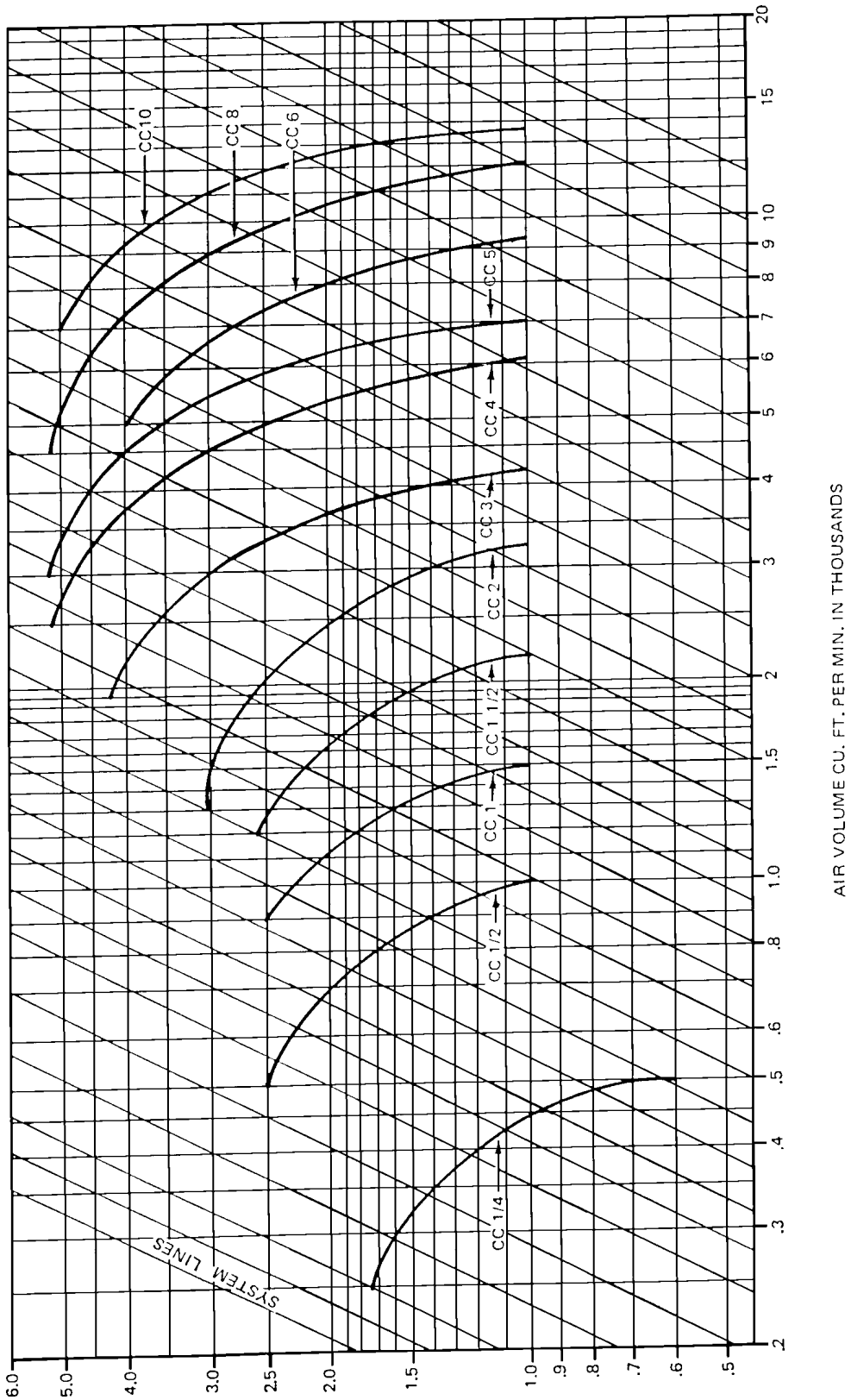
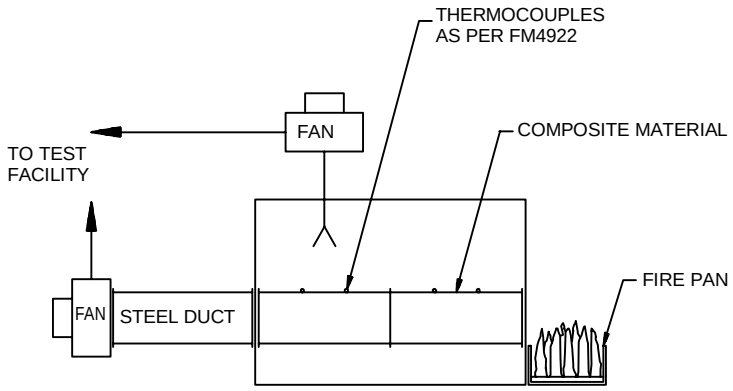


FIGURE 2. Centrifugal fan performance curves.



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 re-ingested into the ship.

Modifications to FM4922 are as follows:

Test material

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

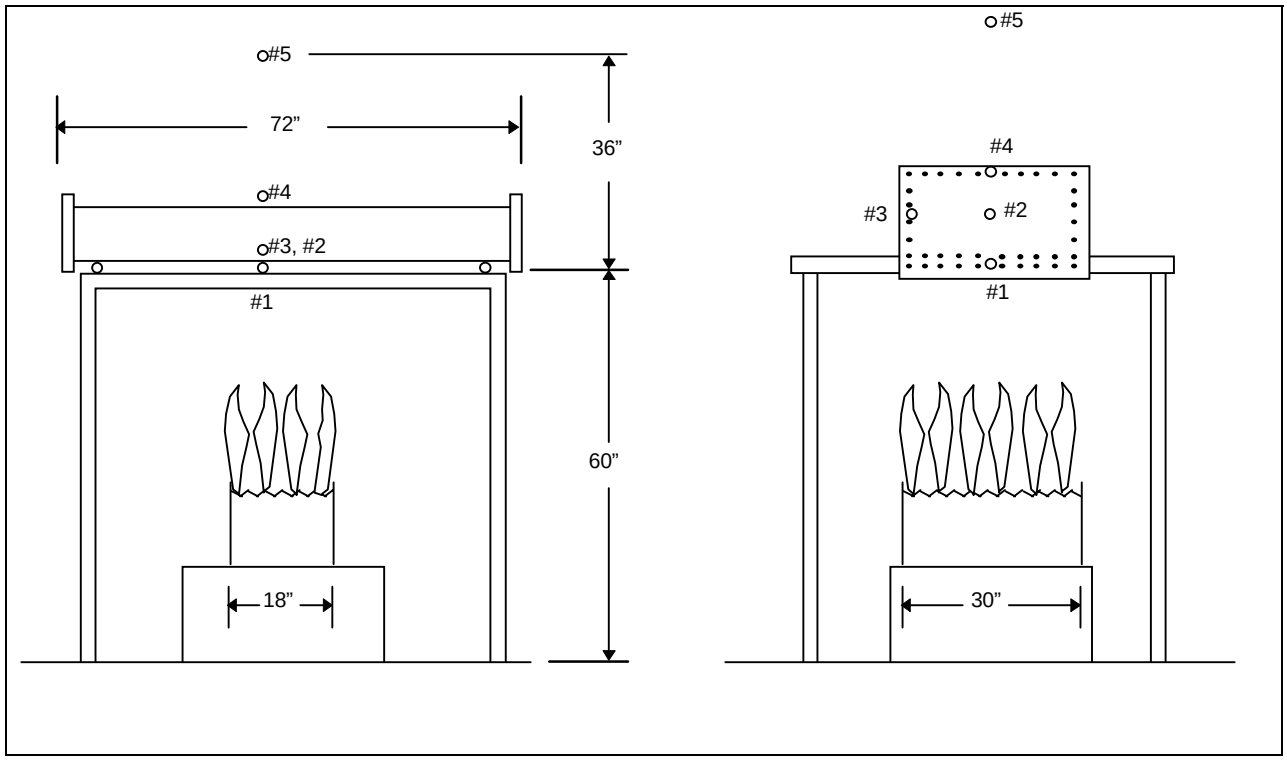
a. Two 24-ft long composite ducts incorporating at least two factory or field assembled joints (as appropriate to the application) or
b. Two 12-ft long composite ducts incorporating at least two factory or field assembled joints along with two 12-foot heavy-gage steel ducts (uncoated carbon steel or stainless steel) to be connected downstream 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 6ft 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 3. Modified 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 should 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 4. 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-T-31000	Drawings, Engineering and Associated Lists

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-740-2	Structureborne Vibratory Acceleration Measurements and Acceptance Criteria of Shipboard Equipment

(Unless otherwise indicated, copies of the above publication are available from the Naval Publications and Forms Center, 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-T-31000 for level 2 drawings as normally requested or level 3 drawings, and should contain the following information:

A.3.1.1 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. Keyway dimensions of the impeller hub, impeller hub bore diameter and tolerance expressed in ten thousands of an inch.
    2. Location on the scroll of fan and motor identification plates.

b. An end view of the fan, showing the direction of impeller rotation.
c. If necessary for clarity, separate details of the motor mounting, conduit, and conduit box.
d. The quantity, size, and tolerance of equally spaced mounting holes and the bolt center diameter with tolerance in the fan flanges and motor-mounting flange.
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 that the fan conforms to the MIL-PRF-19004.
2. 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.
3. A statement of the permissible tolerance for all untoleranced dimensions.
4. Indication of the method of securing the impeller hub in the backplate.
5. Statements identifying the plating, welding, and painting of components or assemblies.
6. Indication of the method of balancing the fan impeller.
7. A statement of the minimum scroll wall thickness.
8. Identification of any carbon steel surface which may be machined after plating, and a statement of the treatment of such are prior to painting.
9. A graph, either log-log or nonlogarithmic, with a cubic foot of standard air per minute as the abscissa, and total and static pressure in inches of water gauge (in H_20), speed revolutions per minute, brake horsepower, power input kilowatts (kW), or horsepower as ordinates. The graph should be identified by fan code if it applies to a Navy standard fan, and by the test number and date.
10. Any other statements necessary for clarity.
11. At the manufacturer’s option, statements for manufacturer’s use only, so designated.

A.3.1.2 Fan detail drawings. Fan detail drawings should include the following:

a. All parts and subassembly 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.3.1.3 Auxiliary drawings. Auxiliary drawings should include the following:

a. Drawings of motors used with fans should conform to the requirements of IEEE 45. Structureborne noise level requirements 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. Motor efficiency should be shown on the nameplate.
b. Service C motor drawings should contain an identification of the bearings used, tabulation of full load heat test data at maximum fan speed, and a tabulation of performance test data, including pull up torque, locked rotor torque, full load torque, locked rotor current, and full load current.
c. Indicate pressure and pressure drop rate (that is, the maximum permitted drop in pressure over a specific length of time) of explosion-proof motor enclosure if maintain should be (see 4.7.7).
d. Drawings should identify bearing lubrication requirements.

APPENDIX B

TEST REPORT TECHNICAL CONTENT REQUIREMENTS

B.1 SCOPE

B.1.1 Scope. This appendix covers the technical content 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 REPORTS

B.3.1 Test reports. When required by the contract or order, test reports should contain the following information:

a. Results first article tests (see 4.2).
b. Results of quality conformance tests (see 4.3).
c. Results of shock test (see 4.7.1) with the following unique features:

    1. Drawing number identification of the fan and motor.
    2. Photographs of the fan-motor unit in each test mounting.

d. Results of type I vibration test (see 4.7.2).
e. Results of balance test (see 4.7.3).
f. Results of performance test (see 4.7.4) with the following unique technical features:

    1. The figure number of AMCA 210 should be identified.
    2. Dimensions of the duct or chamber and the diameter of nozzle used, should be identified.
    3. Computations, if not made strictly in accordance with AMCA 210.
    4. The following values in tabular form: ambient barometric pressure, dry bulb temperatures, wet bulb temperatures; voltage and current (in each phase if applicable); motor input (kW or horsepower); motor brake horsepower; fan speed; air velocity; total static pressure; total velocity pressure; air quantity (cubic feet of standard air per minute); mechanical efficiency (total); electrical efficiency
    5. A curve sheet, either log-log or nonlogarithmic, showing motor input (kW or horsepower), motor brake horsepower, fan speed, total and static pressure of standard air in inches of water gauge (in H_20) at fan discharge as ordinates, and cubic feed of standard air per minute at fan inlet as the abscissa.

g. Results of airborne noise test (see 4.7.5).

    1. The airborne noise test report should comply with the data reporting requirements of AMCA 300-96.
    2. Total octave band sound power levels (4.7.5.1) 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 V.
    3. 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 4.7.5.1, 4.7.5.2, and 4.7.5.3 respectively, and reported. Inlet sound power levels (4.7.5.2), outlet sound power levels (4.7.5.3) , and casing

sound power levels (4.7.5.4) for fan-motor unit operation at the design point should be reported in octave band format.

4. 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 and reported.
5. Diagrams of the test configurations employed when measuring total octave band sound power levels (4.7.5.1), inlet sound power levels (4.7.5.2), outlet sound power levels (4.7.5.3), and casing sound power levels (4.7.5.4) 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 the air outlet duct sections attached to the fan-motor unit should be included in the test report.

h. Results of heat test (see 4.7.6) including tables of motor hearing at maximum fan load for each speed.
i. Results of explosion test (see 4.7.7) with the following unique features:

1. Identify the test specimen by drawing numbers.
2. Identify the explosive vapor used.
3. Note any dimensional discrepancies.
4. Note motor enclosure test pressure, pressure drop and pressure drop period in seconds.

j. Data for the tests specified in 4.7.2 through 4.7.7, taken before and after the high-impact shock test (see 4.7.1), and data for test in 4.8.4 and 4.8.4.1 taken after high impact shock test.

APPENDIX C

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 3.6.1. 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.

Custodians:
Navy - SH

Reviewing Activity:
DLA - IS

Preparing Activity:
Navy - SH
(Project number 4140-N002)

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.
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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19004B	2. DOCUMENT DATE *(YYYYMMDD)* 25 May 2001

3. DOCUMENT TITLE
FANS, CENTRIFUGAL, VENTILATION, 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)*

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c. ADDRESS *(Include Zip Code)* Commander, Naval Sea Systems Command ATTN: SEA 05Q, 2531 Jefferson Davis Hwy Arlington, VA 22242-5160	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