MILITARY SPECIFICATION

BLOWERS, ELECTRONICALLY COMMUTATED BRUSHLESS, DIRECT CURRENT, (ECDC) MOTOR DRIVEN, FOR COOLING ELECTRONIC EQUIPMENT, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers ECDC fractional horsepower blowers (see 6.4.1) required for high reliability applications in general and specifically for cooling all types of military electronic equipment. The blowers shall be capable of withstanding extreme service and environmental conditions such as shock, high and low temperatures, vibration, humidity, salt spray, and fungus.

1.2 Classification.

1.2.1 Military part number. The military part number shall consist of the letter M, the basic specification number, the specification sheet number, and an assigned dash number as shown in the following sample (see 3.1):

M28873	/1	-001
Military designator	Specification sheet number	Dash number

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

J-W-1177	Wire, Magnet, Electrical
PPP-B-576	Boxes, Wood, Cleated, Veneer, Paper Overlaid
PPP-B-601	Boxes, Wood, Cleated Plywood
PPP-B-636	Boxes, Shipping, Fiberboard
PPP-T-60	Tape: Packaging, Waterproof
PPP-T-76	Tape, Packaging, Paper (For Carton Sealing)

MILITARY

MIL-P-116	Preservation, Methods Of
MIL-B-131	Barrier, Materials, Watervaporproof, Greaseproof, Flexible, Heat Sealable
MIL-D-3464	Desiccants, Activated, Bagged, Packaging Use And Static Dehumidification

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Electronic Systems Command (ELEX-8111), Washington, DC 20363, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

MIL-C-5015	Connectors, Electrical, Circular Threaded, AN Type, General Specification For
MIL-M-13231	Marking For Electronic Items
MIL-E-16298	Electric Machines Having Rotating Parts and Associated Repair Parts; Packaging Of
MIL-W-16878	Wire, Electrical, Insulated, General Specification For
MIL-C-26482	Connectors, Electrical, (Circular, Miniature, Quick Disconnect, Environment Resisting) Receptacle And Plugs; General Specification For
MIL-I-46058	Insulator, Compound, Electrical (For Coating Printed Circuit Assemblies)
MIL-P-55110	Printed-Wiring Boards

STANDARDS

FEDERAL

FED-STD-H28	Screw Thread Standards For Federal Services

MILITARY

MIL-STD-129	Marking For Shipment And Storage
MIL-STD-130	Identification Marking Of U.S. Military Property
MIL-STD-147	Palletized Unit Loads
MIL-STD-195	Marking Of Connections For Electrical Assemblies
MIL-STD-202	Test Methods For Electronic And Electrical Component Parts
MIL-STD-454	Standard General Requirements For Electronic Equipment
MIL-STD-461	Electromagnetic Emission And Susceptibility Requirements For The Control Of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement Of
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-810	Environmental Test Methods

(Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

UNIFORM CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 W. Jackson Boulevard, Chicago, IL 60606.)

NATIONAL CLASSIFICATION BOARD

National Motor Freight Classification Rules

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., 1616 P Street, NW, Washington, DC 20036.)

AIR MOVEMENT AND CONTROL ASSOCIATION, INC.

Standard Test Code For Air Moving Device,	Bulletin 210-74

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME Power Test Codes, Part 5,
Chapter 4, Bulletin PTC 19.5; 4-1959

(Application for copies should be addressed to the American Society of Mechanical Engineers, Unit Engineering Center, 345 E 47th Street, New York, NY 10017.)

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI S1.21-72 Methods For The Determination Of Sound Power Levels Of Small Sources In Reverberation Rooms

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 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 shall take precedence.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and shall be in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualifications. Blowers furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

3.3 Material. The materials and finishes used in the construction of blowers shall be as specified herein and shall ensure that the blowers conform to the performance and environmental requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

3.3.1 Flammable and explosive material. When specified (see 6.2), blowers shall contain the least possible amount of flammable or explosive material consistent with good design practice.

3.3.2 Corrosive material. Corrosive material used in any of the processes for the manufacture of blowers shall be neutralized to minimize corrosion in the completed blower.

3.3.3 Fungus and moisture resistant materials. Fungus-inert materials in accordance with Requirement 4 of MIL-STD-454 and moisture resistant materials shall be used.

3.3.4 Wire. The wire used in the construction of the blowers shall be as specified in 3.3.4.1 and 3.3.4.2.

3.3.4.1 Magnet wire. Magnet wire shall be in accordance with J-W-1177.

3.3.4.2 Leads. Lead wires shall be in accordance with MIL-W-16878. Color coding shall be in accordance with MIL-STD-195. Soldering shall conform to Requirement 5 of MIL-STD-454.

3.3.5 Magnets. The permanent magnets used in the motor shall be of sufficient stability to maintain blower performance when subjected to the performance and environmental requirements of this specification.

3.4 Design and construction. Blowers shall be designed and constructed as specified in 3.4.1 through 3.4.8.

3.4.1 Motor frame and housing. The motor frame and housing shall be constructed of aluminum alloy unless otherwise specified in the applicable specification sheet (see 3.1 and 6.2), and shall be finished with sufficient protective coating to pass the environmental tests of 4.8.

3.4.2 Blower housing. The blower housing shall be smoothly finished to minimize audible noise caused by the airflow. The housing shall be securely attached to the motor and, when used as a means of support for the blower, shall withstand the vibration and shock requirements of MIL-STD-202, (see 4.8.2 and 4.8.3). The blade housing finish shall be black, unless otherwise specified in the specification sheet (see 3.1).

3.4.3 Impeller. The impeller blades shall be smoothly finished and of an aerodynamic shape to maximize efficiency and minimize noise. The impeller shall be securely attached to the motor to ensure that the impeller does not come loose during the performance tests of 4.7 and the environmental tests of 4.8.

3.4.4 Electronic circuit board. The printed circuit board shall be a glass epoxy laminate that conforms to MIL-P-55110. The board assembly shall withstand the environmental tests specified in 4.8.

3.4.4.1 Electronic components. The electronic components used in the commutation circuit shall withstand the performance tests of 4.7 and the extended life tests of 4.9.

3.4.4.2 Electronic assembly insulation. The electronic components and circuit board shall have a continuous coating of insulating and protective material as specified in MIL-I-46058.

3.4.5 Threaded parts. Threaded parts shall conform to FED-STD-H28 and shall be designed and constructed so as to remain electrically (where applicable) and mechanically secure for the entire life of the blower and under the environmental conditions specified herein. Dissimilar metals may not be used unless specifically protected from electrolytic corrosion. Where practical, the Unified National Coarse Thread series shall be used.

3.4.6 Locking of screw-thread assemblies. All screw-thread assemblies shall be rendered resistant to loosening during vibration and handling.

3.4.7 Electrical connections. Electrical connections shall be made with solder connectors or solderless (crimp) connectors conforming to MIL-C-26482 or as specified in the specification sheet (see 3.1). For motors having American Wire Gage 12 wire and larger, the connections shall be made with connectors using solder or crimp type pins and conforming to MIL-C-5015 or as specified in the specification sheet (see 3.1). Lead wires shall be used when required by the specification sheet (see 3.1).

3.4.8 Mounting. Unless otherwise specified in the applicable specification sheet (see 3.1.and 6.2), blowers shall be capable of being mounted in any orientation. Blowers with identical mountings and silhouette dimensions shall have the same specification sheet number but will be assigned different dash numbers (where applicable).

3.5 Performance requirements. Unless otherwise specified in the applicable specification sheet (see 3.1), blower performance tests including speed, current, and temperature rise shall be conducted at 0 inches (in.) water column (W.C.) (see 6.4.4) static pressure (SP) (see 6.4.5) and at the rated voltage specified in the applicable specification sheet (see 3.1).

3.5.1 Visual and mechanical requirements. Visual and mechanical requirements shall be in accordance with 4.7.1.

3.5.1.1 Weight. The blower shall be weighed in accordance with 4.7.1.1 and shall not exceed the maximum specified in the specification sheet (see 3.1).

3.5.1.2 Lead wire stress. The lead wires shall be tested in accordance with 4.7.1.2. Any indication of the wire pulling loose, wire strands breaking, or a permanent deformation of the insulation shall constitute a failure.

3.5.2 Warm-up period. All blowers shall be subjected to a warm-up period as specified in 4.7.2 prior to all the speed, current, generated vibration, airflow performance, and temperature rise tests performed for the qualification tests and for the Group B and Group C tests of the quality conformance inspection.

3.5.3 Speed. The blower impeller speed shall be measured as specified in 4.7.3.

3.5.3.1 Speed (reference). The reference speed (initial value prior to any possibly damaging tests) shall be determined for future reference. The nominal speed specified in the applicable specification sheet shall approximate the reference speed.

3.5.3.2 Speed (subsequent). All subsequent speeds measured after the reference speed shall be not less than 95 percent of the reference speed of 3.5.3.1.

3.5.4 Input current. The input current shall be measured as specified in 4.7.4.

3.5.4.1 Running current. The running current shall not exceed the value required by the specification sheet (see 3.1 and 4.7.4.1).

3.5.4.2 Starting current. The starting current shall not exceed the value required by the specification sheet (see 3.1 and 4.7.4.2).

3.5.5 Low voltage starting. The blower shall not fail to rotate continuously when energized as specified in 4.7.5.

3.5.6 Burn-in. Burn-in shall be performed as specified in 4.7.6 and afterwards the blower shall conform to the requirements of 3.5.3.2 and 3.5.4.1.

3.5.7 Power supply. The blower shahl not fail when subjected to the power supply voltage characteristics specified in 4.7.7.

3.5.7.1 Reverse polarity protection. When tested as specified in 4.7.7.1 the motor and electronics shall not fail and the blower shall pass the requirements of 3.5.3.2 and 3.5.4.1.

3.5.7.2 Line voltage. When tested as specified in 4.7.7.2, the minimum speed shall be measured as required by the specification sheet (see 3.1).

3.5.8 Generated vibration. The generated vibration of the blower shall not exceed the root-mean-square (rms) force pounds specified in the applicable specification sheet when measured as specified in 4.7.8 (see 3.1). After the life test the generated vibration shall not have increased more than 25 percent over the initial value.

3.5.9 Dynamic balance. The dynamic balance of the blower shall not exceed the rms velocity specified in the applicable specification sheet when measured as specified in 4.7.9 (see 3.1).

3.5.10 Dielectric withstanding voltage. There shall be no arcing or breakdown when voltage is applied as specified in 4.7.10. Leakage current shall not exceed 100 microamperes.

3.5.11 Insulation resistance. The insulation resistance shall be greater than 12 megohms when measured as specified in 4.7.11.

3.5.12 Airflow performance. When tested as specified in 4.7.12, the blower(s) shall deliver the minimum airflows at two SPs required by the specification sheet (see 3.1 and 6.4.5).

3.5.13 Temperature rise. Unless otherwise specified (see 6.2), the winding temperature rise shall not exceed the maximum value required in the specification sheet when measured as specified in 4.7.13.

3.5.14 Electromagnetic compatibility. When specified (see 6.2), the blower shall conform to the limit requirements of MIL-STD-461 for Class A5 equipment, as specified in the specification sheet (see 3.1).

3.5.15 Acoustic noise. When tested as specified in 4.7.15, the noise level in decibels (dB) (Sound Pressure Level) at 3 feet shall not exceed the requirement of the specification sheet (see 3.1).

3.6 Environmental requirements. Tests to support the requirements of 3.6.1 through 3.6.5 shall be conducted in the sequence shown in TABLE I.

3.6.1 Cold start. Unless otherwise specified (see 6.2), after exposure as described in 4.8.1, the blower shall conform to at least 80 percent of the reference speed specified in 3.5.3.1 and shall conform to the requirements of 3.5.4.1.

3.6.2 Vibration. When tested as specified in 4.8.2, the blower shall conform to the requirements of 3.5.1, 3.5.3.2, 3.5.4.1, and 3.5.8.

3.6.3 Shock. When tested as specified in 4.8.3, the blower shall conform to the requirements of 3.5.1, 3.5.3.2, 3.5.4.1, and 3.5.8.

3.6.4 Humidity. When tested as specified in 4.8.4, there shall be no significant deterioration of the finishes on any part of the blower and the blower shall conform to the requirements specified in 3.5.1, 3.5.3.2, 3.5.4.1, 3.5.10, and 3.5.11.

3.6.5 Salt spray. When tested as specified in 4.8.5, there shall be no significant corrosion on any part of the blower and the blower shall conform to the requirements of 3.5.1, 3.5.3.2, 3.5.4.1, 3.5.10, and 3.5.11.

3.7 Extended life. When operated for 1000^{+100}_{-0} hours as specified in 4.9, the blower shall conform to the requirements of 3.5.3.2, 3.5.4.1, and 3.5.8.

3.8 Marking. Blowers shall be marked in accordance with MIL-STD-130 with military part number, manufacturer's name or symbol,FSCM, (if used, National Stock Number (if known)), serial number, terminal identification, wiring diagram, voltage, current, air delivery (cubic feet per minute (CFM)) (see 6.4.2) at zero SP, revolutions per minute (rpm) of motor, and maximum operating temperature. Markings shall be applied by acid, or electric etching, permanent marking ink, or engraving applied directly to the housing or identification label. The markings shall be as permanent as the normal life expectancy of the blower on which it is applied and shall withstand the same environmental tests required of the blower (see 4.8). Metal decals conforming to MIL-M-13231 may be used.

3.9 Definitions. For definitions of abbreviations used herein and in the detailed specification sheets, see 6.4.

3.10 Workmanship. The blowers shall be smoothly finished. Burrs and sharp edges shall be removed to minimize damage to personnel and to inhibit audible noise.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Government verification. All quality assurance operations performed by the contractor will be subject to Government verification at any time. Verification will consist of, but is not limited to, a) surveillance of the operations to determine that practices, methods, and procedures of the written quality program are being properly applied, b) Government product inspection to measure quality of the product to be offered for acceptance, and c) Government inspection of delivered products to assure compliance with all inspection requirements of this specification. Failure of the contractor to promptly correct deficiencies discovered by the inspector or of which he is notified shall be cause for suspension of acceptance until corrective action has been taken or until conformance of the product to prescribed criteria has been demonstrated.

4.2 Classification of inspections. The inspection requirements specified herein are classified as specified in a through c:

a. Qualification inspection (see 4.3)

b. Quality conformance inspection (see 4.4)

c. Inspection in preparation for delivery (see 4.10)

4.3 Qualification inspection. A qualification sample of six blowers manufactured in accordance with the applicable specification sheet shall be subjected to the tests in TABLE I. Production of blowers prior to qualification approval shall be at the contractor's risk. Satisfactory completion of the qualification tests (see TABLE I) will be evidence for qualification approval. In the event of a nonconformance during testing, the procedure of 4.5.1 shall be followed. After samples have been approved for qualification, changes shall not be made in materials, design, or manufacturing processes without approval of the activity responsible for qualification.

TABLE I. Qualification inspection.

Examination or test	Requirement paragraph	Test paragraph
Group I (six samples)		
Visual and mechanical examination	3.5.1	4.7.1
Weight	3.5.1.1	4.7.1.1
Lead wire stress	3.5.1.2	4.7.1.2
Warm-up period	3.5.2	4.7.2
Speed (reference)	3.5.3.1	4.7.3
Running current	3.5.4.1	4.7.4.1
Starting current	3.5.4.2	4.7.4.2
Low voltage starting	3.5.5	4.7.5
Power supply	3.5.7	4.7.7
Reverse polarity protection	3.5.7.1	4.7.7.1
Speed (subsequent)	3.5.3.2	4.7.3
Running current	3.5.4.1	4.7.4.1
Line voltage	3.5.7.2	4.7.7.2
Generated vibration	3.5.8	4.7.8
Dielectric withstanding voltage	3.5.10	4.7.10
Insulation resistance	3.5.11	4.7.11
Group II (two samples)		
Airflow performance	3.5.12	4.7.12
Temperature rise	3.5.13	4.7.13
Electromagnetic interference	3.5.14	4.7.14
Acoustic noise	3.5.15	4.7.15
Cold start	3.6.1	4.8.1
Speed (subsequent)	3.5.3.2	4.7.3
Running current	3.5.4.1	4.7.4.1
Vibration	3.6.2	4.8.2
Visual examination	3.5.1	4.7.1
Speed (subsequent)	3.5.3.2	4.7.3
Running current	3.5.4.1	4.7.4.1
Generated vibration	3.5.8	4.7.8
Shock	3.6.3	4.8.3
Visual examination	3.5.1	4.7.1
Speed (subsequent)	3.5.3.2	4.7.3
Running current	3.5.4.1	4.7.4.1
Generated vibration	3.5.8	4.7.8
Humidity	3.6.4	4.8.4
Visual examination	3.5.1	4.7.1
Speed (subsequent)	3.5.3.2	4.7.3
Running current	3.5.4.1	4.7.4.1
Dielectric withstanding voltage	3.5.10	4.7.10
Insulation resistance	3.5.11	4.7.11
Salt spray	3.6.5	4.8.5
Visual examination	3.5.1	4.7.1
Speed (subsequent)	3.5.3.2	4.7.3
Running current	3.5.4.1	4.7.4.1
Dielectric withstanding voltage	3.5.10	4.7.10
Insulation resistance	3.5.11	4.7.11
Group III (four samples)		
Extended life	3.7	4.9
Speed (subsequent)	3.5.3.2	4.7.3
Running current	3.5.4.1	4.7.4.1
Generated vibration	3.5.8	4.7.8

4.3.1 Retention of qualification. To retain qualification, the contractor shall forward a report at 24-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of the results specified in a and b:

a. A summary of the results of the tests performed for inspection of product for delivery (Group A and Group B and so forth), indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.

b. A summary of the results of tests performed for periodic inspection (Group C), indicating as a minimum the subgroup failures. The summary shall include the results of all periodic inspection tests performed on completed lots during the 24-month period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 24-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 24-month period that the inspection data indicates failure of the qualified product to conform to the requirements of this specification. In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If, during two consecutive reporting periods, there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit his qualified products, (a representative product of each type, grade, class, and so forth) to testing in accordance with the qualification inspection requirements and the reason for no production.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the Group A, Group B, and Group C tests (TABLES II, III, and V, respectively) and shall be performed in the order shown.

4.4.1 Group A tests. The Group A tests in TABLE II shall be performed on 100 percent of the production blowers. Should an inspection lot be rejected due to a failure in any of the tests, the procedures of 4.5 shall be followed.

TABLE II. Group A tests.

Examination or test	Requirement paragraph	Test paragraph	AQL 1/ (percent defective)	
			Major	Minor
Visual and mechanical examination	3.5.1	4.7.1	1.0	4
Starting current	3.5.4.2	4.7.4.2		
Running current	3.5.4.1	4.7.4.1		
Speed (reference)	3.5.3.1	4.7.3		
Insulation resistance	3.5.11	4.7.11		
Dielectric withstanding voltage	3.5.10	4.7.10	1.0	
Burn-in	3.5.6	4.7.6		
Dynamic balance	3.5.9	4.7.9		

1/ Acceptable Quality Level

4.4.2 Group B tests. The Group B tests in TABLE III shall be performed on sample blowers having passed the Group A tests. The number of sample units submitted to Group B testing is specified in TABLE IV. If a lot is rejected due to a failure in any of the tests, the procedure of 4.5.2 shall be followed. No further lots will be accepted until the contractor has demonstrated to the satisfaction of the Government that adequate corrective measures have been taken.

TABLE III. Group B tests.

Examinations or test	Requirement paragraph	Test paragraph
Warm-up period	3.5.2	4.7.2
Low voltage starting	3.5.5	4.7.5
Line voltage	3.5.7.2	4.7.7.2
Reverse polarity protection	3.5.7.1	4.7.7.1
Airflow performance	3.5.12	4.7.12
Temperature rise	3.5.13	4.7.13
Lead wire stress	3.5.1.2	4.7.1.2
Cold start	3.6.1	4.8.1

TABLE IV. Sampling for Group B tests.

Number of blowers in lot	Number of blowers in sample	Acceptance number defectives	Rejection number defectives
40 or less	2	0	1
41 to 110	3	0	1
111 to 300	4	0	1
301 to 500	6	0	1
501 to 800	10	1	2
801 to 3200	15	1	2
3201 and greater	25	2	3

4.4.3 Group C tests. The Group C tests shall consist of the tests in TABLE V. A minimum of two blowers which have not been subjected to the Group B tests shall be selected from the blowers which have passed the Group A tests at a frequency of once every 2 years for Group I and Group II and once every 6 months for Group III. The manufacturer is afforded the option of submitting three blowers, one to be subjected to each of the three test groups. If only two blowers are selected, one shall be subjected to Group I and Group II and the other blower shall be subjected to Group III. Delivery on the contract or order shall not be delayed pending the results of the Group C tests. Blowers subjected to the Group C tests shall not be delivered on the contract or order. If a sample unit fails any of the tests, the procedure of 4.5.2 shall be followed. No further shipments shall be accepted until the manufacturer has taken the necessary corrective action, and has demonstrated to the Government that such action is adequate.

TABLE V. Group C tests.

Group tests	Requirement paragraph	Test paragraph
Group I (2 years)		
Vibration	3.6.2	4.8.2
Shock	3.6.3	4.8.3
Group II (2 years)		
Humidity	3.6.4	4.8.4
Salt spray	3.6.5	4.8.5
Group III (6 months)		
Extended life test	3.7	4.9

4.5 Rejection and retest. Rejection and retest shall be as specified in 4.5.1 and 4.5.2.

4.5.1 Qualification test. Unless otherwise specified (see 6.2), any rejected blowers may be reworked or have parts replaced to correct the nonconformance and may be resubmitted for qualification. Before resubmitting formerly rejected blowers for qualification, a detailed report explaining the rejection and corrective action shall be submitted to the Government quality assurance representative (QAR) and shall be included in the final test report. Upon QAR approval, requalification testing may begin. Blowers rejected twice for the same nonconformance shall not be submitted again without specific approval of the command or agency concerned.

4.5.2 Group A, Group B, and Group C tests. Blowers from rejected lots may be reworked or have parts replaced to correct the nonconformance. Before resubmitting formerly rejected blowers for qualification, a detailed report explaining the nonconformance and corrective action shall be submitted to the QAR for approval before retesting the blowers. Blowers rejected twice for the same nonconformance shall not be submitted again without specific approval of the command or agency concerned.

4.6 Test equipment and inspection facilities. The test equipment and inspection facilities shall be of sufficient accuracy and quality to permit performance of the required tests. The contractor shall establish calibration of test equipment to the satisfaction of the command or agency responsible for qualification.

4.7 Performance tests. Unless otherwise specified in the applicable specification sheet (see 3.1), performance tests and measurements shall be conducted with the blower operating at 0 in. W.C. SP and at the rated voltage called for in the applicable specification sheet (see 3.1). The tests shall be conducted at an ambient temperature of 25° Celsius (C) ±5°C, at atmospheric pressure of 30 ±2 in. of mercury.

4.7.1 Visual and mechanical examination. The blower shall be visually examined for workmanship, cleanliness, and tightness of fittings. The blower shall be examined to determine that the dimensions, markings, and finishes conform to the applicable specification sheet (see 3.1).

4.7.1.1 Weight. The blower weight in pounds, as specified in the applicable specification sheet (see 3.1), shall be measured using a scale capable of ±2 percent accuracy.

4.7.1.2 Lead wire stress. Each wire shall be tested in accordance with MIL-STD-202, Method 211A, Test Conditions A and C. The weight of the load shall be 10 pounds for condition A and 5 pounds for Condition C, or as specified in the applicable specification sheet (see 3.1).

4.7.2 Warm-up period. The blower shall be fitted with a thermocouple and mounted as specified in 4.7.13.1. The blower shall then be energized with nominal voltage; when five successive temperature readings at 1-minute intervals are equal, the blower shall be considered thermally stable and performance measurements may be taken.

4.7.3 Speed. Impeller speed shall be measured using a stroboscope. The accuracy of the equipment used for measuring blower speed shall be within ±2 percent of the measured value.

4.7.4 Input current. The input current shall be measured with an ammeter.

4.7.4.1 Running current. The input current shall be measured with an ammeter.

4.7.4.2 Starting current. The starting current shall be measured with any fast response device capable of monitoring the transient starting current of a dc motor

4.7.5 Low voltage starting. With the impeller free to rotate, the blower shall be energized at a rate of 1 volt (V) per second to 75 percent of rated voltage. It shall be noted whether or not the blower started.

4.7.6 Burn-in. The blower shall be placed in an oven at its rated maximum ambient operating temperature (see 3.1.) for 48 hours while operating at rated voltage.

4.7.7 Power supply. The blower shall be energized with a direct current (DC) power supply with characteristics conforming to MIL-STD-704, TABLE II, DC normal operations, characteristics, and the limits for DC overvoltage or undervoltage for 28 V (nominal) DC system figure for 28 V blowers. The specification sheet shall specify, when required, the power supply characteristics for blowers of other than 28 V input.

4.7.7.1 Reverse polarity protection. The blower shall be connected to a power supply such that the positive power lead is connected to the negative blower lead and the negative power lead is connected to the positive blower lead. Rated voltage shall be applied.

4.7.7.2 Line voltage. The blower shall be energized at rated voltage and speed measurements shall be taken.

4.7.8 Generated vibration. Generated vibration examinations shall be conducted as specified in 4.7.8.1 through 4.7.8.4.

4.7.8.1 Blower mounting. The blower shall be positioned with the shaft horizontal and elastically supported to allow vibration in all axes. The elastic members of the mounting shall be either tension or compression types and shall be directly attached to the blower motor. Cradles and other mounting devices shall not be used. The weight of the suspended blower, accelerometer, and accelerometer adapting block (if used) shall cause the elastic support to compress or stretch at least the amount given by the following formula:

$$d = \frac{880{,}000}{N^2}$$

where: d = minimum compression or stretch, in.

N = blower motor speed, rpm

4.7.8.2 Accelerometer mounting. The accelerometer shall be attached directly to the motor frame between the bearings (see applicable detail specification) with its sensing axis perpendicular to the motor shaft. An intermediate adapting block may be used to match mating surfaces. Accelerometer and adapting block, if used, shall be attached by stud mounting, Eastman 910 cement, or other equally rigid adhesives. With blowers operating at speeds greater than 6000 rpm, only stud mounting, Eastman 910 cement, or equal shall be used. The combined weight of the accelerometer, mounting stud, and adapter block shall not exceed 1.60 ounces.

4.7.8.3 Instrumentation. A calibrated accelerometer system output shall be fed directly into an rms voltmeter having an input impedance of at least 1.0 megohm and a time constant of 6 seconds to 10 seconds (see 6.4.6). Conditioning of the accelerometer output by filtering or any other means is not permitted.

4.7.8.4 Rms force calculation. The blower shall be operating at least 15 minutes prior to testing. The mean steady-state rms acceleration in g's shall be determined. The blower weight in pounds shall be determined. The weight in pounds of the accelerometer, mounting stud, and adapting block, if used, shall be determined. The blower rms force output from the following formula shall be determined:

$$F_{rms} = wa$$

where: w = combined weight of blower, mounting stud, and adapter block, pounds

a = measured acceleration, g-rms

4.7.9 Dynamic balance. Dynamic balance shall be conducted as specified in 4.7.9.1 through 4.7.9.3.

4.7.9.1 Mounting. The blower shall be elastically mounted to allow vibration in all axes. A cradle may be used to support the blower in the elastic mounting providing the cradle weight is not greater than 15 percent of the sum of the weight of the accelerometer, mounting block (if used), and blower. The elastic members may be in tension or compression but shall deflect under the weight of the blower and cradle, if used, an amount at least equal to the amount given in the following formula:

$$d = \frac{880{,}000}{N^2}$$

where: d = minimum stretch or compression, in.

N = blower speed, rpm

The deflection should not be so great that the elastic members are exceeded or that the limit of deflection is reached (that is, elastic members shall not bottom out).

4.7.9.2 Instrumentation. A calibrated accelerometer system output shall be fed through a suitable filter which shall be tuned to read the vibration at the running speed of the blower. Since vibration frequencies below the running speed are not expected, a low-pass filter may be used. The output of the filter should not attenuate or amplify the input signal from the accelerometer system, or, if it does, an appropriate correction factor shall be determined for the frequency being measured and applied to the voltmeter reading. The output signal from the filter shall then be fed to an rms voltmeter, preferably one with sufficient damping (no greater than 10 seconds) to eliminate sporadic momentary deflections of the voltmeter readings, and with an input impedance of at least 1.0 megohm.

4.7.9.3 Measurements. The accelerometer readings shall be taken on the bearing housings in a plane perpendicular to the blower's rotational axis or, if the bearing housings are not accessible, the vibration shall be measured at the extremities of the blower in a plane perpendicular to the blower's rotational axis. The accelerometer may be mounted permanently to the blower or the cradle or, if the blower speed is less than 24,000 rpm, the accelerometer may be equipped with a pointed rod or screw and held with fingers pointed end against the blower. The voltmeter reading shall be converted using the accelerometer system sensitivity given as millivolts rms per g rms to g's rms and, using the following formula, the velocity reading in in. per second rms shall be calculated.

$$V_{rms} = \frac{3690\ g_{rms}}{\text{Blower rpm}}$$

4.7.10 Dielectric withstanding voltage. A test potential of 500^{+0}_{-20} V DC shall be applied from each lead to frame. The test potential shall be raised slowly (minimum time 3 seconds) to 500 V and maintained for 1 minute, then reduced slowly (at least 3 seconds) to zero. The leakage current shall be measured and shall not include the current drawn by the equipment capacitance.

4.7.11 Insulation resistance. The blower shall be tested in accordance with MIL-STD-202, Method 302, Condition B, unless otherwise specified in the applicable specification sheet (see 3.1). The test voltage shall be applied between ground (frame) and each lead which is not permanently grounded.

4.7.12 Airflow performance. Blowers intended for application at approximately sea level atmospheric pressure conditions shall have their airflow performance measured as CFM versus SP with any apparatus applying the principle of nozzles generally described in the ASME Power Test Codes, Part 5, Chapter 4, Bulletin PTC 19:5:4-1959 or the AMCA Standard for Air Moving Devices,

4.7.13 Temperature rise. Temperature rise shall be conducted as specified in 4.7.13.1 and 4.7.13.2.

4.7.13.1 Mounting and instrumentation. The temperature rise of the motor windings shall be determined using a thermocouple imbedded in a motor slot. Care shall be taken to ensure that the thermocouple makes good thermal contact with the winding using wedges, thermal conducting epoxy, or another suitable method. The thermocouple shall be imbedded as close to the center of the motor in a winding slot as possible. The thermocouple shall be connected to an appropriately calibrated thermocouple temperature bridge. The blower shall be mounted by its normal means to a surface of low thermal conductivity.

4.7.13.2 Measurements. The blower shall be energized with nominal voltage. Winding temperature shall be measured until five successive readings at 1-minute intervals are equal, indicating that the motor temperature is stable. The steady-state motor temperature and room ambient temperature shall be determined. The ambient temperature subtracted from the total motor temperature gives the motor temperature rise. The thermocouple may be removed after testing, provided the removal does not damage the motor parts or insulation. If the thermocouple cannot be removed, the blower shall not be returned to the production lot.

4.7.14 Electromagnetic compatibility. Measurements to determine conformance to the requirements of 3.5.14 shall be performed in accordance with MIL-STD-462.

4.7.15 Acoustic noise. Acoustic noise measurements shall be made in accordance with ANSI S1.21-72. The blower shall be resiliently supported as specified in 4.7.9.1. The noise test shall be performed with the blower operating at 0 in. W.C.

4.8 Environmental tests. The test samples shall be subjected to the environmental tests specified in 4.8.1 through 4.8.5. Unless otherwise specified in the applicable specification sheet (see 3.1), the temperature rate of change used for the tests shall be approximately 0.5°C per minute or 30°C per hour.

4.8.1 Cold start test. The nonenergized blower shall be subjected to the minimum ambient temperature in accordance with the applicable specification sheet (see 3.1) for a minimum of 16 hours. The blower, while at the low temperature, shall then be continuously energized at rated voltage for 8 hours. Five minutes after energizing the blower, the blower's speed shall be measured as specified in 4.7.3. The blower shall then be de-energized and the cycle shall be repeated once.

4.8.2 Vibration test. The blower shall be rigidly mounted on the vibration equipment utilizing the normal blower mounting surface and subjected to the requirements of MIL-STD-202, Method 201 and to the acceleration level required in the specification sheet (see 3.1).

4.8.3 Shock test. Unless otherwise specified in the applicable specification sheet (see 3.1), the nonenergized blowers shall be securely mounted to the shock mounting fixture utilizing the normal blower mounting surface and subjected to the requirements of MIL-STD-202, Method 213B the tolerances for half sine shock pulse figure, Test Condition A, or as specified in the applicable specification sheet (see 3.1).

4.8.4 Humidity test. Humidity test shall be conducted as specified in 4.8.4.1 and 4.8.4.2.

4.8.4.1 Nonoperating humidity cycling. The nonenergized blowers shall be subjected to five 24-hour temperature variations consisting of approximately 16 hours at 60°C ±3°C and 8 hours at 30°C ±3°C. The relative humidity shall be maintained above a minimum of 95 percent during the steady-state conditions. The transitions between temperatures shall be accomplished within the 8-hour period so that the time at the high temperature is 16 hours. Two hours after temperature stabilization and during the high and low temperature portions of the first or second cycle, a sample of the atmosphere in the chamber shall be made to determine the conditions of temperature and relative humidity throughout the chamber.

4.8.4.2 Operating humidity cycling. After remaining inoperative for not less than 12 hours or more than 24 hours at a temperature of 25°C ±3°C and 50 percent minimum relative humidity, the blower shall be operated continuously at rated voltage and frequency in an ambient temperature of 50°C ±3°C for a period of 8 hours. The relative humidity shall be increased to 95 percent minimum during the first 2 hours and maintained at 95 percent ±5 percent for 4 hours, then reduced to the conditions of 4.7 during the final 2 hours.

4.8.5 Salt spray. The blowers shall be tested in accordance with MIL-STD-202, Method 101D, Condition B and with 5 percent salt solution. The blower shaft shall be horizontal when the blower is placed in the test chamber.

4.9 Extended life test. With the exception that an intermittent duty blower will be operated at a specified duty cycle, the blower shall be continuously energized at rated excitation for 1000 hours and at a maximum temperature specified in the applicable specification sheet (see 3.1).

4.9.1 Mounting. The blower shall be placed in a chamber in such a position that no obstruction shall be within one impeller diameter of the blower outlet or inlet.

4.9.2 Operation. With the blower continuously operated at rated excitation and output load conditions of 100 percent of maximum CFM volume rate, the chamber temperature shall be increased to that specified in the applicable specification sheet (see 3.1). This temperature shall be maintained within a ±5°C tolerance until specimen failure or until the specimen has met the 1000 hour requirement specified in the applicable specification sheet (see 3.1). At the conclusion of the test, the blower shall be cooled to room temperature before taking the subsequent measurements.

4.10 Inspection of preparation for delivery. Inspection shall be performed to ensure conformance with the requirements of Section 5.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract or order. Preparation for delivery requirements for products procured by contractors shall be specified in the individual order.)

5.1 Preservation. Preservation shall be Level A or C, as specified (see 6.2).

5.1.1 Level A. Level A requirements shall be as specified in 5.1.1.1 through 5.1.1.4.

5.1.1.1 Cleaning. Cleaning shall be in accordance with Process C-1 of MIL-P-116.

5.1.1.2 Drying. Drying shall be in accordance with MIL-P-116.

5.1.1.3 Preservative application. Surfaces subject to corrosion shall be treated with preservative in accordance with MIL-E-16298.

5.1.1.4 Unit packs. Blowers shall be individually packaged in accordance with Method IIb of MIL-P-116, ensuring compliance with the General paragraph under Methods of preservation (Unit Protection) and the Physical protection paragraph therein and conform to the rough handling tests of MIL-P-116. Cushioning and dunnage shall be used to prevent physical or mechanical damage. Particular emphasis shall be placed on protecting exposed impellers from damage during rough handling by use of mounting boards, blocking and bracing, or by use of other equivalent methods of protection. Desiccant shall conform to MIL-D-3464, Type II or III. The cushioned blower shall be placed in a close-fitting fiberboard box conforming to PPP-B-636 and the box shall be closed in accordance with the appendix thereto. The blower container shall then be placed within a close-fitting, water-vaporproof barrier bag made of material conforming to MIL-B-131, Class 1. Technical literature shall be packaged in a waterproof, heat sealed bag, minimum 4 mil thick, and shall not be placed within the barrier used to package the blower. The blower and technical literature which constitute one complete equipment shall be packaged in a consolidation package conforming to PPP-B-636, Class weather-resistant. Closures and waterproofing shall be accomplished by sealing the center seams, corners, and manufacturer's joint with waterproof tape, 2 in. minimum width, conforming to PPP-T-60, Class 1, or PPP-T-76.

5.1.2 Level C. Each complete blower shall be packaged to afford adequate protection against corrosion, deterioration, and damage during shipment from the supply source to the first receiving activity.

5.2 Packing. Packing shall be Level A, B, or C, as specified (see 6.2).

5.2.1 Level A. Blowers, packaged as specified in 5.1, shall be packed in containers conforming to PPP-B-601, Type overseas, style optional. Packing containers shall be closed and strapped in accordance with the Appendix to PPP-B-601.

5.2.2 Level B. Blowers, packaged as specified in 5.1, shall be packed in containers conforming to PPP-B-601 or PPP-B-576, Class 2.

5.2.3 Level C. Blowers, packaged as specified in 5.1 shall be packed in containers acceptable to the common carrier and which will ensure safe delivery at destination in a satisfactory condition at the lowest applicable rate. Containers, packing, or method of shipment shall comply with Uniform Freight or National Motor Freight Classification Rules, or regulations of other carriers, as applicable to the mode of transportation.

5.3 Unitized loads. Unitized loads, commensurate with the level of packing specified in the contract or order, shall be used whenever total quantities for shipment to one destination equal 40 cubic feet or more. Quantities less than 40 cubic feet need not be unitized. Unitized loads shall be uniform in size and quantities to the greatest extent practicable.

5.3.1 Level A. Blowers, packed as specified in 5.2.1, shall be unitized on pallets in accordance with MIL-STD-147, load type I, with a fiberboard cap (storage aid 4) positioned over the load.

5.3.2 Level B. Blowers, packed as specified in 5.2.2, shall be unitized as specified in 5.3.1, except that the fiberboard caps shall be Class weather-resistant or domestic.

5.3.3 Level C. Blowers, packed as specified in 5.2.3, shall be unitized as specified in 5.3.1, except that pallets and caps shall be of the type, size, and kind commonly used for the purpose and shall comply with the rules and regulations of the common carriers as applicable to the mode of transportation.

5.4 Marking. In addition to any special marking required by the contract or order (see 6.2), each unit pack, exterior container, and unitized load shall be marked in accordance with MIL-STD-129. Marking shall include special marking for Method II packs.

5.5 General. Exterior containers (see 5.2.1, 5.2.2, and 5.2.3) shall be of a minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent possible. Loose-fill polystyrene shall not be used for packaging or packing. Adhesives shall not be used in the closure of wraps, bags, or boxes. Special measures shall be taken to ensure that blowers are packaged and packed to prevent damage to impellers.

6. NOTES

6.1 Intended use. The blowers covered by this specification are intended for cooling communication, special military equipment, and other electronic equipment.

6.2 Ordering data. Procurement documents should specify:

a. Title, number, and date of this specification

b. Title, number, and date of the applicable detail specification and the part number

c. Use of flammable and explosive material (see 3.3.1)

d. Aluminum or specified alloy (see 3.4.1)

e. Type of electrical connector when different from MS3112E84P (see 3.4.7)

f. Mounting (see 3.4.8)

g. Temperature rise (see 3.5.13)

h. Electromagnetic compatibility (see 3.5.14)

i. Cold start (see 3.6.1)

j. Qualification test (see 4.5.1)

k. Levels of preservation, packaging, packing, and marking (see 5.1, 5.2, 5.3, and 5.4)

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List, whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Electronic Systems Command, ELEX 8111, Department of the Navy, Washington, DC 20363; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC-EQ), Dayton, OH 45401. Application for Qualification tests shall be made in accordance with SD-6, "Provisions Governing Qualification" (see 6.3.1).

6.3.1 Application for qualification. Copies of SD-6 may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.4 Definitions. Definitions of terms used in this specification are given in 6.4.1 through 6.4.6.

6.4.1 Blower. The term blower refers to any air moving device which includes, but is not limited to, centrifugal blowers, multistage blowers, propeller fans, tubeaxial fans, and vaneaxial fans.

6.4.2 CFM. A unit of measure for air flow or air volume rate. It represents an air flow rate of 1 CFM.

6.4.3 Standard air. Air having a density of 0.075 pound per cubic foot and an absolute viscosity of 1.225×10^{-5} (pounds-mass per foot-second).

6.4.4 W.C. A unit of measure for static pressure of air. One inch W.C. represents a pressure equal to a one inch column of water in a manometer.

6.4.5 SP. An abbreviation for static pressure which is the non-velocity portion of the total air pressure within an apparatus.

6.4.6 Time constant. That interval necessary for a measuring device to rise to 63 percent of its final value with a steady voltage applied to its input.

Custodians:
Army - ME
Navy - EC
Air Force - 82

Review activities:
Navy - AS, SH

User activities:
Navy - MC
Air Force - 11, 17, 70

Prepring activity:
Navy - EC
(Project 4140-0120)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-B-28873	BLOWERS, ELECTRONICALLY COMMUTATED BRUSHLESS, DIRECT CURRENT, (ECDC) MOTOR DRIVEN, FOR COOLING ELECTRONIC EQUIPMENT

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
	☐ USER
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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