UL 1128

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Marine Blowers

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UL Standard for Safety
for
Marine Blowers, UL 1128

Third Edition, Dated September 25, 1997

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

UL 1128

Standard for

Marine Blowers

First Edition – August, 1977
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Third Edition

September 25, 1997

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

The Department of Defense (DoD) has adopted UL 1128 on April 7, 1988. The publication of revised pages or a new edition of this standard will not invalidate the DoD adoption.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover electrically operated blowers, rated less than 50 volts direct current (dc), of the centrifugal axial flow and propeller types intended to be used on board a vessel of any size. The blowers are intended to provide mechanical ventilation for engine compartments, galleys, and similar areas.

1.2 The blowers covered by these requirements are intended for installation in accordance with the applicable requirements of the Standard for Fire Protection of Pleasure and Commercial Motor Craft, NFPA 302; and the United States Coast Guard.

1.3 These requirements do not cover blowers intended for use in hazardous locations aboard inspected vessels subject to United States Coast Guard regulations.

1.4 These requirements cover ignition-protected blowers that may be required on boats under 65 feet (19.8 m) in length.

1.5 These requirements cover blowers intended for continuous duty.

1.6 A combination pump and blower is judged according to these requirements and the requirements for marine electrically operated pumps for nonflammable liquids, UL 1113.

1.7 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as required to maintain the level of safety as originally anticipated by the intent of this Standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard is not judged to comply with this Standard. Where appropriate, revision of requirements are proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Glossary

2.1 For the purpose of this standard, the following definitions apply.

2.2 CONTINUOUS DUTY BLOWER – A blower that can operate continuously at a voltage of 120 percent of its rated nominal voltage.

2.3 DESIGN VOLTAGE – A voltage of 113.3 percent of the rated nominal voltage of the blower.

2.4 IGNITION-PROTECTED BLOWER – A blower constructed so that:

a) A flammable hydrocarbon mixture surrounding the blower will not be ignited if a normally occurring electrical arc, spark, or heat source ignites a flammable hydrocarbon mixture inside the blower;

b) The electrical arc, spark, or heat source has insufficient electrical or heat energy to ignite the flammable mixture; or

c) The source of ignition is hermetically sealed from the surrounding mixture.

An ignition-protected blower does not necessarily comply with the requirements for an explosion-proof device as applied to U. S. Coast Guard inspected vessels or as defined by the National Electrical Code, ANSI/NFPA 70-1996, Errata Note No. 1.

2.5 NOMINAL SUPPLY VOLTAGES – Commonly available storage battery voltages; for example, 6, 12, 24, and 32 volts dc.

2.6 NORMAL HAND TOOLS – Any standard American or metric wrench straight or cross-point screwdriver, and standard hexagonal wrench.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component.

3.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard; or

b) Is superseded by a requirement in this standard.

3.3 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

3.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions for which they have been recognized.

4 Units of Measurement

4.1 If a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

CONSTRUCTION

5 Enclosures and Guards

5.1 A blower shall be formed and assembled to have the strength and rigidity necessary to withstand the stresses to which it may be subjected without total or partial collapse, loosening or displacement of parts, or other serious defects.

5.2 An enclosure, a frame, a guard, a handle, or the like shall not have an edge, projection, or corner sufficiently sharp to constitute a risk of injury to persons in normal maintenance and use.

Exception: This requirement does not apply to a part or a portion of a part needed to perform a working function.

5.3 A mounting bracket or other means provided to secure a blower to the boat shall be constructed and located so that intended installation can be made with normal hand tools. The securing means shall maintain the blower in a fixed relationship when subjected to the vibration and shock loads of normal marine service. See Vibration Test, Section 18, and Shock Test, Section 19.

5.4 A blower housing shall be provided with drains not less than 1/8 inch (3.2 mm) in diameter or of equivalent area to reduce the likelihood of water accumulation with the blower mounted in any intended operating position.

5.5 A pulley, belt, gear, fan, or other rotating part shall be enclosed or guarded to reduce the likelihood of unintentional contact by persons.

5.6 The degree of protection required for a mechanical or electrical part is to be judged on the basis of the intended use of the blower. For example, a blower intended for use with rigid or flexible ducting is to be judged with the ducting attached.

5.7 The factors to be considered in judging the acceptability of an exposed moving part are to include, but not be limited to:

a) The portion of the part that can be contacted (trailing edge, leading edge, or periphery);

b) The material from which the part is formed;

c) The angle, type, and sharpness of the exposed edge; and

d) The available energy (see 5.8).

5.8 In general, a blower of conventional design is to be considered acceptably guarded if:

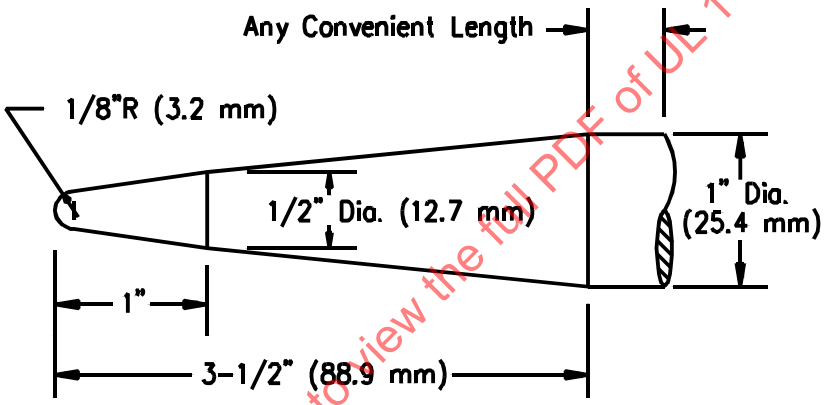
a) The relationship between total mass (W) in pounds (kg x 2.2) of all rotating parts, radius (r) in inches (mm x 0.04), and speed (N) in revolutions per minute, is such that the available energy of the rotating mass (K) in the equation:

$$K = 6 \times 10^{-7} (Wr^2N^2)$$

is less than 100; and

b) The leading edge of the blade and hub cannot be contacted by the probe illustrated in Figure 5.1 inserted into any opening in the guard with a force of 1 pound (4.5 N) when the blower is installed as intended.

Figure 5.1
Probe



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5.9 A guard relied upon for compliance with the requirement in 5.8(b) shall be attached to a blower as follows:

a) Permanently;

b) By means requiring the use of a tool for removal; and

c) By means not requiring the use of a tool for removal, provided that either of the following is required to disengage the securing means:

1) Two separate motions, such as push and turn; or

2) A force of 5 pounds (22.2 N).

5.10 The removal force specified in 5.9(c) is to be measured after conditioning the securing means by removing the guard and replacing it ten times in the intended manner.

6 Materials

6.1 A synthetic rubber or other nonmetallic material, or finish coating, that is exposed to the air flow or used for the housing shall be resistant to deterioration from exposure to gasoline, fuel oil, kerosene, and salt water. See Polymeric Materials Tests, Section 29.

7 Protection Against Corrosion

7.1 An iron or steel part shall be protected against corrosion by enameling, galvanizing, zinc or cadmium plating, or other equivalent means. See Salt Spray Corrosion Test, Section 28.

Exception No. 1: This requirement does not apply to bearings or laminations, or to parts, such as machine screws and washers, that are not necessary for the blower to perform its intended function or are enclosed within the blower or motor.

Exception No. 2: Phosphate treatment with an oil or wax coating is acceptable as corrosion protection for magnets and armatures; oil treatment is acceptable as corrosion protection for steel springs; and stainless steel is acceptable without additional protection, if properly polished or treated.

7.2 A rotating part shall be formed of material having resistance to corrosion at least equivalent to AISI Type 410 stainless steel alloy and shall be galvanically compatible with other metallic parts of the blower. A part formed of materials not known to provide acceptable resistance to corrosion and dezincification and acceptable galvanic compatibility is to be subjected to the Salt Spray Corrosion Test, Section 28.

8 Current-Carrying Parts

8.1 A current-carrying part shall be silver, copper, a copper alloy, or other metal acceptable for the particular application in a marine environment.

8.2 Ordinary iron or steel provided with a corrosion-resistant coating in accordance with 7.1 or stainless steel may be used for a current-carrying part within a motor or associated governor. The use of iron and steel is not acceptable for a current-carrying part elsewhere in a blower.

9 Wiring

9.1 A blower shall be of the two conductor type, with power and return conductors insulated from the housing.

9.2 Wiring and connections between parts shall be mechanically protected or enclosed.

Exception: A flexible cord need not be enclosed.

9.3 Conductors other than short internal jumpers and those in wound coils shall be stranded copper.

9.4 Wires within a enclosure, compartment, raceway, or the like shall be located or protected to reduce the likelihood of contact with any sharp edge, burr, fin, moving part, or the like that may abrade the insulation on conductors or otherwise damage wires.

9.5 A hole in a wall or partition through which wire or cord passes, or on which wire or cord may bear within the overall enclosure of the blower, shall be provided with a smooth rounded bushing or the hole shall have a smooth rounded surface to reduce the risk of abrasion of the insulation.

9.6 Internal wiring shall have insulation rated for the potential and temperature to which it may be subjected, and shall be a minimum of No. 18 AWG (0.82 mm^2). Insulated wire employed for internal wiring shall be stranded copper conductor marine wire or stranded copper conductor appliance wiring material rated for use in moist or wet locations.

9.7 Where stranded internal wiring is connected to a wire-binding screw, loose strands of wire shall be prevented from contacting other uninsulated live parts and dead metal parts. This may be accomplished by the use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other equivalent means.

10 Field-Wiring Connections

10.1 A blower shall be provided with:

a) Field-wiring terminals for connection of power supply conductors corresponding to the marked rating of the blower; or

b) Except as noted in 10.2, pigtail connections (leads or flexible cord) that are a minimum of 6 inches (152 mm) long.

10.2 For a combination pump and blower, a pigtail connection shall be a minimum of 16 inches (406 mm) long.

10.3 If flexible cord is used, it shall be Type SJO, SJT, SJTO, SO, ST, or STO.

10.4 Terminals shall be located or enclosed to reduce the likelihood of accumulation of water between terminals of opposite polarity and between the terminals and ground.

10.5 Conductors shall be acceptable for the maximum electrical load anticipated in service and shall be at least No. 16 AWG (1.3 mm^2) or larger if single and No. 18 AWG (0.82 mm^2) or larger if in a multiconductor sheath in accordance with one of the following types:

a) A stranded copper conductor that has insulation complying with the moisture resistance and flame retardance requirements in the National Electrical Code, ANSI/NFPA 70-1996, Errata Note No. 1.

b) Cables for Boats, UL 1426.

c) A stranded copper conductor that complies with the insulating material temperature rating requirements in the Recommended Practice for Marine Engine Wiring, January 1988, ANSI/SAE J378.

d) A flexible cord type SO, STO, ST, SJO, SJT, or SJTO.

10.6 An exposed metallic part of a blower shall have provision for connecting a bonding conductor unless the exposed part is acceptably isolated from all current-carrying parts by independent insulation provided in addition to the basic insulation. See Stray Current Leakage Test, Section 21.

11 Strain Relief

11.1 A pigtail lead or flexible cord employed for field wiring shall be provided with strain relief so that a stress on the lead or cord is not transmitted to terminals, splices, or internal wiring. See Strain Relief Test, Section 27.

11.2 A metal strain-relief clamp or band without a fiber or plastic liner is acceptable with a Type SJO, SJT, SJTO, SO, ST, or STO cord.

11.3 Pigtail leads shall be prevented from being pushed into a blower through the entry hole if such displacement subjects the leads to mechanical damage or exposure to a temperature higher than that for which the leads are rated.

11.4 If a knot in a flexible cord serves as strain relief, the surface with which the knot may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, that may abrade the insulation on the conductors.

12 Motor Protection

12.1 A blower shall be protected against locked rotor conditions by any of the following means:

a) A motor incorporating a protector that complies with the locked rotor requirements in the Standard for Overheating Protection for Motors, UL 2111;

b) An impedance-protected motor that complies with the Standard for Overheating Protection for Motors, UL 2111;

c) A marking on the blower that it is to be protected by an overcurrent means specified by the manufacturer and rated for the application; or

d) Compliance with the requirements in the Locked-Rotor Test, Section 24.

13 Insulating Material

13.1 A material used for mounting uninsulated current-carrying parts shall be porcelain, phenolic composition, or other material acceptable for a marine environment.

13.2 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not for the sole support of uninsulated current-carrying parts.

13.3 Thermoplastic materials may be employed for the sole support of uninsulated current-carrying parts, provided the material:

a) Is of a type previously investigated and found acceptable for the application; or

b) Complies with the requirements in 13.4.

13.4 Thermoplastic material not previously investigated and found acceptable for the application may be used for the sole support of uninsulated current-carrying parts if:

a) An examination of the blower following the tests described in Sections 16 – 22 reveals no cracking, distortion, or other degradation to the extent that the operation of the blower is impaired;

b) Following continuous exposure for 500 hours in an air oven maintained at a temperature of 10 to 15EC (18 to 27EF) above the maximum temperature obtained on the material during the test described in 20.2.1 – 20.2.4, an examination of the material reveals no cracking, distortion, or other degradation to the extent that the operation of the blower is impaired;

c) The blower complies with the requirements in the Stray Current Leakage Test, Section 21, following the conditioning specified in (b); and

d) The material is classed 94V-2 or less flammable in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

13.5 A small molded part, such as a brush cap, shall have the mechanical strength and rigidity necessary to withstand the stresses of actual service without cracking, distortion, or other degradation to the extent that the operation of the blower is impaired. Brush caps shall be secured or located so they are protected from mechanical damage.

14 Switches and Controllers

14.1 A switch or other control device provided with the blower shall be rated for controlling the loads involved. See Switch Overload Test, Section 26.

PERFORMANCE

15 General

15.1 A representative sample of a blower is to be subjected to each of the tests described in Sections 16 – 22 in the order presented. New samples may be used for the tests described in Sections 23 – 28, and component samples or material specimens may be used for the tests described in Sections 29 and 30.

16 Input Test

16.1 The current or wattage input to a blower shall not be more than 110 percent of the rated value when the blower is operated under maximum operating load for 5 minutes while connected to its nominal supply voltage.

17 Humidity Exposure Test

17.1 Following exposure for 96 hours to air at a relative humidity of 90 ±5 percent and a temperature of 32 ±2EC (90 ±4EF), a blower shall operate as intended for 5 minutes, during which time the electrical input shall be not more than 110 percent of the value recorded during the Input Test, Section 16. The blower is not to be energized during exposure to the humid air.

18 Vibration Test

18.1 A blower shall withstand the vibration specified in 18.3 without malfunction or damage to the mounting means that would impair intended operation. A blower shall operate as intended after the vibration exposure.

18.2 The blower is to be secured to a vibration machine test fixture in its intended operating position in accordance with the manufacturer's installation instructions.

18.3 The sample is to be subjected to variable frequency vibration in each of three rectilinear axes (horizontal, lateral, and vertical) for 4 hours in each plane (total 12 hours) at a peak-to-peak amplitude of 0.020 ±0.001 inch (0.52 ±0.03 mm). The vibration frequency is to be continuously varied, at a uniform rate, from 10 to 60 to 10 hertz every 4 minutes.

18.4 For this test, peak-to-peak amplitude is defined as the maximum displacement of sinusoidal motion (total table displacement).

19 Shock Test

19.1 A blower shall withstand shock impacts as specified in 19.2 without malfunction or damage to the mounting means that would impair intended operation. A blower shall operate as intended after the impacts.

19.2 The sample is to be mounted as intended on a fixture. The assembly (fixture and sample) is to be subjected to 5000 shock impacts. Each impact is to have a 10-g (322 feet per second per second (98 m/s^2))] peak acceleration and a 20 – 25-millisecond duration, as measured at the base of the half-sine shock envelope.

19.3 The machine used for this test is to be of the automatic cycling type producing a half-sine shock pulse at the acceleration level and duration specified. The acceleration and shock pulse duration are to be measured by a piezoelectric accelerometer mounted on the test machine platform on an axis parallel to the axis of motion.

19.4 The sample is to be mounted so that the center of gravity of the sample is as close as possible to the geometric center of the machine platform.

20 Temperature Tests

20.1 Low temperature test

20.1.1 There shall be no evidence of cracking or deterioration that could impair intended operation when a blower is subjected to the test described in 20.1.2 and 20.1.3.

20.1.2 The sample is to be placed in a cold chamber maintained at minus 30 ±3EC (minus 22 ±5EF) for 24 hours. At the end of the 24 hours, single conductor wiring subject to flexing in intended use is to be wrapped 360 degrees around a mandrel of the size specified in Table 20.1, first in one direction and then the other. Sheathed multiconductor cables are to be wrapped around a mandrel of the size specified in Table 20.2 for the number of turns specified in Table 20.2, first in one direction and then the other. These tests are to be done prior to removal of the test sample from the cold chamber.

Table 20.1
Mandrel diameters – single conductors

Wire size		Mandrel diameter	
AWG	(mm^2)	Inches	(mm)
16	1.3	0.313	7.95
14	2.1	0.313	7.95
12	3.3	0.375	9.53
10	5.3	0.563	14.30
8	8.4	0.688	17.48
6	13.3	1.250	31.75
4	21.2	1.375	34.93
2	33.6	1.563	39.70
1	42.4	2.688	68.28

Table 20.2
Mandrel diameters and numbers of turns – sheathed multi-conductors

Maximum overall diameter of finished round cord or length of minor axis of flat cord,		Mandrel diameter,		Number of complete turns of specimen around mandrel
inch	(mm)	inch	(mm)	
1/8	(3.2)	1/4	(6.4)	6
1/4	(6.4)	1/2	(12.7)	6
3/8	(9.5)	3/4	(19.1)	6
1/2	(12.7)	1	(25.4)	6
5/8	(15.9)	1-1/4	(31.8)	6
3/4	(19.1)	1-1/2	(38.1)	1
7/8	(22.2)	1-3/4	(44.5)	1
1	(25.4)	2	(50.8)	1

20.1.3 Following the cold exposure, the sample is to be subjected to 25 shock impacts as specified in the Shock Test, Section 19. The shock impacts are to be started within 30 seconds after removal from the cold chamber. If the transfer cannot be made in the time specified, the sample is to be wrapped in insulating material to prevent a temperature rise in excess of 5EC (9EF) before the initial impact.

20.2 High temperature test

20.2.1 When tested as described in 20.2.2 – 20.2.4, the external temperature on a blower shall not exceed 150EC (302EF) at any time during the test, and there shall be no softening, swelling, nor deterioration that could impair intended operation of the blower.

20.2.2 The sample is to be placed in an oven maintained at 60 ±5EC (140 ±9EF) and is to be operated continuously at 120 percent of nominal supply voltage until ultimate conditions occur, but not for more than 7 hours. For an impeller type blower, the intake and discharge ports are to be open and unrestricted. For an in-line blower, the test is to be conducted twice, once with the blower intake and discharge ports open and unrestricted, and once with the blower intake and discharge port closed with restricted ventilation. The same sample is to be used for the tests on in-line blowers. See 15.1.

20.2.3 Thermocouples are to be attached to the stator windings of the motor (or, in the case of a permanent magnet motor, to the magnet), to external parts of the sample, and to other parts providing representative indications of the operating temperatures.

20.2.4 Thermocouples consisting of No. 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer-type indicating instrument are to be used whenever referee temperature measurements by thermocouples are necessary.

21 Stray Current Leakage Test

21.1 A blower shall withstand a 500-volt, direct-current potential applied between current-carrying parts and noncurrent-carrying ground for 1 minute, during which time the leakage current shall not exceed 1 milliampere.

21.2 The test is to be conducted while the sample is still heated following the High Temperature Test, 20.2.1 – 20.2.4.

21.3 The applied potential is to be increased at a rate of approximately 50 volts per second until 500 volts is reached, and is to be maintained for 1 minute. The potential is then to be reduced to zero at the same rate at which it was applied.

22 Ignition-Protection Test

22.1 A blower intended for use in an application requiring ignition protection shall be tested in accordance with the applicable requirements for ignition-protection test for marine products, UL 1500, and shall not ignite the specified surrounding mixture of propane and air.

23 Blower Capacity (Calibration) Test

23.1 To verify the acceptability of the manufacturer's blower performance ratings (see 33.1(e)), blower performance curves are to be prepared using the test procedure described in 23.2 – 23.5, or the equivalent. The following data are to be plotted:

a) Static pressure versus air flow in cubic feet per minute (cfm),

b) Current in amperes versus air flow in cfm, and

c) Blower speed in revolutions per minute (rpm) versus air flow in cfm.

The blower capacity shall be within 95 to 110 percent of the rating specified by the manufacturer.

23.2 A sample of the blower is to be mounted on a blower airflow calibration chamber as illustrated in Figure 23.1 and all mating surfaces are to be sealed. After a run-in period of 3 hours at nominal supply voltage, the tests described in 23.4 are to be conducted.

23.3 Immediately preceding the calibration test, the barometric pressure and both wet and dry bulb atmospheric temperature readings at the calibration chamber are to be recorded.

23.4 The sample is to be operated at its nominal supply voltage, as measured at the input connections to the sample. The static pressure of the chamber is to be varied by controlling the test chamber discharge orifice in steps from zero to the maximum static pressure developed by the sample (discharge closed). An auxiliary blower connected to the chamber discharge orifice is to be used to obtain the lower static pressure readings. Chamber static pressure is to be measured with an inclined manometer connected to a piezometer ring located at the input end of the chamber. Air flow is to be determined by the pressure differential measured across the calibrated air flow nozzles. The pressure differential readings are to be made on an inclined manometer connected to the piezometer rings located on either side of the nozzle plate. The sample's input current, in amperes, and blower speed, in revolutions per minute, are to be recorded at each calibration point.