



Standard Specification for Fiber-Reinforced Plastic Fans and Blowers¹

This standard is issued under the fixed designation D 4167; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This specification covers centrifugal and axial fans and blowers with airstream components fabricated of fiber-reinforced thermoset plastics (FRP) for corrosion resistance. Internal structures may include encapsulated metal fastening devices, hubs, and shafts.

1.2 Reinforcing materials other than fibrous glass may be used in the fabrication, provided the fans and blowers produced meet all the requirements of this specification.

1.3 The term “fans” as used in this specification includes fans and blowers, both centrifugal and axial.

1.4 The purpose of this specification is to provide users, system designers, specifiers, and manufacturers of FRP fans with minimum standards for fan construction and a common basis for determining safe operating speeds.

1.5 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information only.

NOTE 1—There is no similar or equivalent ISO standard.

NOTE 2—Appendix X2 contains a list of documents that may be of interest to designers of fan systems.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

C 582 Specification for Contact-Molded Reinforced, Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment²

D 883 Terminology Relating to Plastics³

D 2563 Practice for Classifying Visual Defects in Glass-

Reinforced Plastic Laminate Parts⁴

2.2 Other Standards:

AMCA Bulletin 210 Laboratory Methods of Testing Fans for Rating Purposes⁵

ANSI S2.19 Balance Quality of Rotating Rigid Bodies⁶

3. Terminology

3.1 *Definitions*—The definitions of terms used in this specification are the same as those found in Terminology D 883.

4. Construction of Fan Housings

4.1 *Laminate Construction* shall conform to Specification C 582. The same resin shall be used throughout a housing unless the user and manufacturer agree to use a different resin for the inner surface and interior layer than for the structural layer.

4.1.1 The inner surface exposed to the chemical environment shall be a resin-rich layer 0.010 to 0.020 in. (0.25 to 0.5 mm) thick reinforced with a suitable chemical-resistant glass-fiber surface mat or with an organic-fiber surface mat.

4.1.2 The inner surface layer shall be followed with an interior layer composed of resin reinforced only with noncontinuous glass-fiber strands applied in a minimum of two plies of chopped-strand mat equivalent to a total of 3 oz/ft² (0.92 kg/m²). As an alternative, a minimum of two passes of chopped roving of minimum length of 0.5 in. (13 mm) to a maximum length of 2.0 in. (50.8 mm) shall be applied uniformly to an equivalent weight of 3 oz/ft² (0.92 kg/m²). Each ply of mat or pass of chopped roving shall be well rolled prior to the application of additional reinforcement. The combined thickness of the inner surface and interior layer shall not be less than 0.10 in. (2.5 mm).

4.1.3 The structural layer comprises the balance of the housing laminate.

NOTE 3—Although fan housings are subject to vibrational stresses, the design considerations regarding construction of the laminate are similar to those used for static FRP process system components.

⁴ *Annual Book of ASTM Standards*, Vol 08.02.

⁵ Available from Air Movement and Control Association, 30 West University Dr., Arlington Heights, IL 60004.

⁶ Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics, and is the direct responsibility of Subcommittee D20.23 on Reinforced Plastic Piping Systems and Chemical Equipment.

Current edition approved Nov. 10, 2002. Published March 2003. Originally approved in 1982. Last previous edition approved in 1997 as D 4167–97.

² *Annual Book of ASTM Standards*, Vol 08.04.

³ *Annual Book of ASTM Standards*, Vol 08.01.

*A Summary of Changes section appears at the end of this standard.

4.2 *Fastening Devices*, such as bolts, shall be made of material the user and manufacturer agree is at least as corrosion-resistant to the specified corrosive environment as is the laminate construction, or shall be embedded in a laminate in such a way that the laminate covering the device is reinforced with at least two layers of 1½ oz/ft² (4.57 g/m²) chopped-strand glass mat and with the same surface finish used in the housing laminate.

4.3 *Gasketing*, used where housings are constructed so that sections or inspection panels are removable, shall be of elastomeric material sufficiently resilient to seal the sections. The gasketing shall be of material the user and manufacturer agree is suitable for the corrosive environment.

4.4 *Housings*, shall have minimum inside corner radii of 0.6 in. (15 mm).

4.5 Suitable housing construction design shall be determined by running the fan at maximum-rated speed with the inlet blocked tight and with an open outlet. The design will be deemed acceptable if the test does not cause any part of the housing to move more than a distance equal to ½ of 1 % of the wheel diameter from the position with the fan not running.

4.6 Where the user determines that system design is such that liquid may collect in housings, the fan housings shall be specified with drains.

5. Construction of Fan Wheels

5.1 Where a history of service acceptable to the manufacturer and the user shows that resin systems and joint designs selected for use in the construction of fan wheels are acceptable, destruction tests need not be run. Where acceptable history does not exist, destruction tests shall be performed in accordance with Section 10.

5.2 Defects visible in fan wheels shall be limited to those shown in Table 1 (taken from Practice D 2563 and modified for specific use with fan wheels).

5.3 Metal hubs, fasteners, and shafts shall be made of material at least as corrosion-resistant to the specified corrosive environment as is the laminate construction, or be encapsulated with a laminate reinforced with at least two layers of 1½ oz/ft² (45.7 g/m²) chopped-strand mat with the same surface finish that is used in the laminate.

5.4 Shafts not made of corrosion-resistant alloy shall be protected by a sleeve of FRP extending out through the fan housing a minimum of 0.4 in. (10 mm) (see Section 7).

5.5 Additives that obscure visual inspection shall be used only in the final surface coat(s) for the purpose of enhancing corrosion resistance or preventing the buildup of static electricity, or both.

5.6 Acceptable surface treatments include the following: resin coating without reinforcement; resin coating with reinforcement, such as glass flakes, graphite, or surface veil; or resin coating reinforced with other materials agreed upon by the fabricator and user. Resins that exhibit air inhibition shall be paraffinated for use in the final coat.

6. Spark-Resistant Construction

6.1 Fans built in accordance with this specification will be spark-resistant, providing the outer surface of the wheel and the inner surface of the housing are rendered electrostatically

conductive (Note 4). To be considered acceptably conductive, the surface resistivity between all points of the airstream surface and ground must be no more than 1 MΩ when tested with an insulation resistance tester.⁷

NOTE 4—The user must electrically ground all fan parts in order to maintain spark resistance.

7. Shaft-Hole Closures

7.1 Gas flow may be into or out of the shaft holes of the fan housing, depending on pressure distribution in the system and type of fan wheel. The shaft-hole closure shall be one of the following types, as specified by the user:

NOTE 5—The user should determine the importance of restricting gas flow through the shaft holes before selecting the type of closure required.

7.1.1 Shaft encapsulated with an FRP sleeve to at least 0.4 in. (10 mm) outside the fan housing, with the shaft hole no larger than the sleeve diameter plus 0.08 in. (2 mm). (An acceptable alternative is to mount a membrane onto the housing to maintain the 0.08-in. maximum space).

7.1.2 Lubricated lip seals or stuffing boxes must ride on smooth metal shafts or shaft sleeves, necessitating the use of shafts or shaft sleeves made of material selected to withstand the corrosive environment.

8. Balancing and Test Running

8.1 The fan manufacturer shall perform one of the following methods of checking balance of wheel/shaft assemblies and complete fans:

8.1.1 Dynamically balance the wheel/shaft assembly as a unit in accordance with ANSI S2.19, Grade 6.3. For example: At 1000 rpm the maximum total residual unbalance of both planes is not to exceed 0.002 lb-in./lb (0.05 g-mm/g) of the total assembly weight.

8.1.2 Run the assembled fan and balance in such a way that the peak-to-peak vibration measured horizontally at the pillow blocks perpendicular to the axis of the shaft will not exceed the following:

- 8.1.2.1 2.5 mils (0.06 mm) up to 600 rpm,
- 8.1.2.2 2.0 mils (0.05 mm) up to 900 rpm,
- 8.1.2.3 1.5 mils (0.04 mm) up to 1200 rpm,
- 8.1.2.4 1.0 mils (0.025 mm) up to 1800 rpm,
- 8.1.2.5 0.6 mils (0.015 mm) up to 3000 rpm, and
- 8.1.2.6 0.5 mils (0.013 mm) above 3000 rpm.

8.2 Balance correction shall be accomplished by one or more of the following methods:

8.2.1 Removal of FRP built onto the wheel for this purpose.

8.2.2 Addition of FRP so that it becomes homogeneous with the wheel by proper surface preparation (normally by grinding away the surface to expose structural fibers) and laminating the necessary weight on so that it blends into the wheel without abrupt changes of contour.

8.2.3 Application of metal weights, where the weights and necessary fasteners are compatible with the corrosive environment.

⁷ Available from Amprobe Instrument, Division of Core Industries Inc., 630 Merrick Rd., Lynbrook, NY 11563 and from Yokogawa Corp. of America, 2 Dart Rd., Shenandoah Industrial Park, Newnan, GA 30265-1094.