Designation: D5421 – 15

An American National Standard

Standard Specification for Contact Molded "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Flanges[1]

This standard is issued under the fixed designation D5421; 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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers circular contact-molded fiberglass reinforced-thermosetting-resin flanges for use in pipe systems and tank nozzles. Included are requirements for materials, workmanship, performance, and dimensions.

1.2 Flanges (see Fig. 1) may be produced as integral flanges, Type A, or flange-on-pipe, Type B.

1.3 This specification is based on flange performance and does not cover design.

1.4 These flanges are designed for use with pipe and tanks that are manufactured to Specifications D2996, D2997, D3262, D3299, D3517, D3754, and D4097.

1.5 Selection of gaskets is not covered in this specification, refer to the manufacturer's recommendation.

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

1.7 The following precautionary caveat pertains only to the test methods portion, Section 9, of this specification: *This standard does not purport to address the safety problems, 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.*

NOTE 1—There is no known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C582 Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment

D883 Terminology Relating to Plastics

D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2996 Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

D2997 Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

D3262 Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe

D3299 Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks

D3517 Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe

D3754 Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe

D4097 Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks

2.2 *ASME Standards:*[3]

B 16.1 Cast Iron Pipe Flanges and Flanged Fittings

B 16.5 Pipe Flanges and Flanged Fittings

B 18.21.1 Type "A" Narrow Washers

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions are in accordance with Terminology D883. Abbreviations are in accordance with Terminology D1600, unless otherwise indicated. The abbreviation for reinforced-thermosetting-resin pipe is RTRP.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *contact molding (CM)*—a method of fabrication wherein the glass fiber reinforcement is applied to the mold in the form of all chopped-strand mat, or chopped-strand mat and woven roving, in alternate plies by hand with the resin matrix applied by brush or roller and the laminate consolidated by a roller.

[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.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

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

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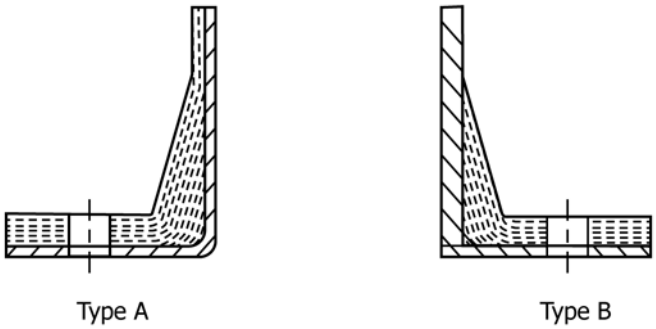


FIG. 1 Flange Types

3.2.2 *fiberglass pipe*—a tubular product containing glass-fiber reinforcements embedded in or surrounded by cured thermosetting resin; the composite structure may contain aggregate, granular or platelet fillers, thixotropic agents, pigments or dyes; thermoplastic or thermosetting liners or coatings may be included.

4. Classification

4.1 *General*—This specification covers reinforced-thermosetting-resin flanges defined by type (method of manufacture), grade (generic type of resin), class (pressure end thrust capability), and pressure rating. Flanges complying with this specification are also given numerical classifications relating to rupture pressure and sealing test pressure.

4.1.1 *Types:*

4.1.1.1 *Type A*—Integral flange, contact molded with the stub integral with the flange.

4.1.1.2 *Type B*—Flange on pipe, contact molded onto an existing pipe or fitting.

4.1.2 *Grades:*

4.1.2.1 *Grade 1*—Epoxy resin.

4.1.2.2 *Grade 2*—Polyester resin.

4.1.2.3 *Grade 3*—Phenolic resin.

4.1.2.4 *Grade 4*—Vinylester resin.

4.1.2.5 *Grade 5*—Furan resin.

4.1.3 *Classes:*

4.1.3.1 *Class I*—Hoop and axial-pressure.

4.1.3.2 *Class II*—Hoop pressure only.

NOTE 2—All combinations of type, liner, grade, and class may not be commercially available. Additional type, liner, grade, and class may be added as they become commercially available. The purchaser should solely determine or consult with the manufacturer for the proper class, type, liner, and grade to be used under the installation and operating conditions that will exist for the project in which the flange is to be used.

4.1.4 *Pressure Rating*—Pressure rating shall be categorized by single-letter designation. Pressure designations are shown in Table 1.

4.1.5 Short-term rupture pressure and sealing-test pressure limits shall be categorized by single arabic number designations as indicated by the cell classification system of Table 2.

4.2 *Designation Code*—The flange-designation code shall consist of the abbreviation for contact molded (CM) followed by the type as a capital letter, grade as an Arabic numeral, class as a Roman numeral, and the pressure-rating category as a capital letter and two Arabic numbers identifying the cell-classification designations of the short-term rupture pressure and sealing-test pressure, respectively. Thus, a complete flange-designation code shall consist of three letters, one Arabic numeral, one Roman numeral, one letter and two numerals.

4.2.1 *Example*—Contact molded fiberglass is CM-AIID-46. This designation described a stub flange, made using glass-fiber-reinforced epoxy resin for full-axial pressure thrust. The flange has a 100-psi (0.69-MPa) pressure rating, a short-term rupture pressure of 400-psi (2.76-MPa), and a sealing-test pressure of 225-psi (1. 55-MPa).

4.3 *Attachment of Flanges to Pipe, Pipe Fittings, or Tanks:*

4.3.1 Type "A" flanges are to be butt and strap welded to pipe described in Specifications D2996, D2997, D3262, D3517, and D3754, or using overlay joint into a tank as described in Specifications D3299 and D4097.

4.3.2 Type "B" flanges are built onto elbows, reducers, or other parts where the use of an integral flange (Type "A") is not practical or required.

TABLE 1 Pressure Categories

Designation	Pressure Rating[A]	
	psi	MPa
A	25	0.173
B	50	0.345
C	75	0.517
D	100	0.690
E	125	0.862
F	150	1.034

[A] Flanges with higher pressure ratings are available by agreement between the purchaser and the manufacturer.

TABLE 2 Short-Term Rupture Pressure and Sealing-Test Pressure[A]

Property/Cell Classification	1	2	3	4	5	6
Short-Term Rupture Pressure, psi (MPa)	100 (0.69)	200 (1.38)	300 (2.07)	400 (2.76)	500 (3.45)	600 (4.14)
Sealing-test pressure, psi (MPa)	37.5 (0.26)	75 (0.52)	112.5 (0.78)	150 (1.03)	187.5 (1.29)	225 (1.55)

[A] Refer to Test Method D1599 for explanation of failure.

5. Materials and Manufacture

5.1 Flanges manufactured in accordance with this specification shall be composed of reinforcement embedded in or surrounded by cured thermosetting resin.

5.2 The resins, reinforcements, and other materials, when combined into composite structure, shall produce a flange that will meet the performance requirements of this specification.

NOTE 3—The term "other materials" does not include recycled or reprocessed thermosetting plastics which might otherwise be added as fillers.

5.3 Flanges manufactured in accordance with this specification shall have an inner corrosion barrier fabricated with the same resin, reinforcement, ply sequence, and nominal glass/resin ratio as required in the applicable ASTM standard for the tank or pipe on which the flange will be used.

6. Performance Requirements

6.1 The following performance requirements are intended to provide classification and performance criteria for the purpose of qualification testing and rating of prototype constructions and periodic reevaluation of the manufacturer's stated ratings. They are not intended as routine quality assurance requirements for production runs of rated flanges:

6.1.1 *Sealing*—Flanges shall withstand a pressure of at least 1.5 times the pressure rating without leakage when tested in accordance with 9.4.

6.1.2 *Short-Term Rupture Strength*—Flanges shall withstand a hydrostatic load of at least four times their pressure rating when tested in accordance with 9.5 using flat-faced steel closure and using the gasket or "O" ring designated by the flange manufacturer.

6.1.3 *Bolt Torque*—Flanges shall withstand, without visible sign of damage, a bolt torque of two times that recommended by the manufacturer. The use of a non-fluid thread lubricant is recommended on all bolts.

7. Dimensions and Tolerances

7.1 *Flange and Bolt Dimensions*—Flanges of 24 in. (610 mm) or smaller diameter shall conform to the values for bolt circle and number and size of bolt holes, for Class-150 cast iron flanges in ASME B 16.5. Flanges larger than 24 in. (610 mm) in diameter shall conform to the values for bolt circle, number and size of bolt holes, for Class-125 cast-iron flanges in ASME B 16.1 as shown in Table 3. The tolerance for these flange dimensions shall be the same as those contained in ASME B 16.1 and B 16.5. A flat washer is to be used under all bolt heads and nuts.

NOTE 4—Interference between the hub and bolt spot face may occur, especially in high-pressure flanges. The use of ASME B 18.21.1 narrow washers is suggested because of their smaller outside diameter. The customer should be notified when these washers with smaller outside diameter are to be used.

NOTE 5—For special-design large flanges, it may be desirable to provide the required bolt area by using smaller bolts spaced closer together than is normally used for steel flanges. The minimum bolt size shall be ⅝ in. (16 mm). Flange dimensions shall be by purchaser-manufacturer agreement.

7.1.1 *Flange Face for Full-Faced Gaskets*— The flange face shall be perpendicular to the axis of the fitting within ½ °, and shall be flat to 1/32 in. (1 mm) for sizes up to and including 18-in. (457-mm) diameter and 1/16 in. (2 mm) for larger diameters. For other sealing systems the tolerances must be established to meet the requirements of 6.1.1.

7.1.2 *Washer-Bearing Surface*—Washer-bearing surface shall be flat and parallel to the flange face within 1°.

7.1.3 *Flange Outside Diameter*—Outside diameter of flanges is to be at least equal to that of ASME B 16.5 for up to 24-in. (610-mm) inside diameter and ASME B 16.1 for larger flanges. It is accepted practice to increase all flange outside diameters to provide greater strength at the bolt holes.

8. Workmanship, Finish, and Appearance

8.1 Workmanship and appearance shall conform to Table 5 on visual acceptance criteria of standard C582 for the process side, and shall be as free as commercially practical of defects, including indentations, delaminations, bubbles, pinholes, foreign inclusions, and resin-starved areas in the structural layer and outer surface as agreed upon between the purchaser and the manufacturer.

TABLE 3 Flange Dimensions

Nominal Pipe Size, in.[A]	Outside Diameter, min, in.[A]	Drilling			
		Bolt Circle Diameter[A]	Number of Holes	Diameter of Holes[A]	Diameter of Bolts[A]
1	4 ¼	3 ⅛	4	⅝	½
1 ½	5	3 ⅞	4	⅝	½
2	6	4¾	4	¾	⅝
2 ½	7	5 ½	4	¾	⅝
3	7 ½	6	4	¾	⅝
3 ½	8 ½	7	8	¾	⅝
4	9	7 ½	8	¾	⅝
5	10	8 ½	8	⅞	¾
6	11	9 ½	8	⅞	¾
8	13 ½	11 ¾	8	⅞	¾
10	16	14 ¼	12	1	⅞
12	19	17	12	1	⅞
14	21	18 ¾	12	1 ⅛	1
16	23 ½	21 ¼	16	1 ⅛	1
18	25	22 ¾	16	1 ¼	1 ⅛
20	27 ½	25	20	1 ¼	1 ⅛
24	32	29 ½	20	1 ⅜	1 ¼
26	34 ¼	31 ¾	24	1 ⅜	1 ¼
28	36 ½	34	28	1 ⅜	1 ¼
30	38 ¾	36	28	1 ⅜	1 ¼
32	41 ¾	38 ½	28	1 ⅝	1 ½
34	43 ¾	40 ½	32	1 ⅝	1 ½
36	46	42 ¾	32	1 ⅝	1 ½
38	48 ¾	45 ¼	32	1 ⅝	1 ½
40	50 ¾	47 ¼	36	1 ⅝	1 ½
42	53	49 ½	36	1 ⅝	1 ½
44	55 ¼	51 ¾	40	1 ⅝	1 ½
46	57 ¼	53 ¾	40	1 ⅝	1 ½
48	59 ½	56	44	1 ⅝	1 ½
50	61 ¾	58 ¼	44	1 ⅞	1 ¾
52	64	60 ½	44	1 ⅞	1 ¾
54	66 ¼	62 ¾	44	1 ⅞	1 ¾
60	73	69 ¼	52	1 ⅞	1 ¾
66	80	76	52	1 ⅞	1 ¾
72	86 ½	82 ½	60	1 ⅞	1 ¾
84	99 ¾	95 ½	64	2 ⅛	2
96	113 ¼	108 ½	68	2 ⅜	2 ¼
102	120	114.50	72	2.625	2.50
108	126.75	120.75	72	2.625	2.50
114	133.50	126.75	76	2.875	2.75
120	140.25	132.75	76	2.875	2.75
126	147	139.25	80	3.125	3.00
132	153.75	145.75	80	3.125	3.00
144	167.25	158.25	84	3.375	3.25

[A] 1 in. = 25.4 mm.

9. Test Methods

9.1 *Conditioning*—When conditioning is required, and in all cases of disagreement, condition the test specimens at 73.4 ± 3.6°F (23 ± 2°C) for not less than 40 h prior to test, in accordance with Procedure A of Test Methods D618.

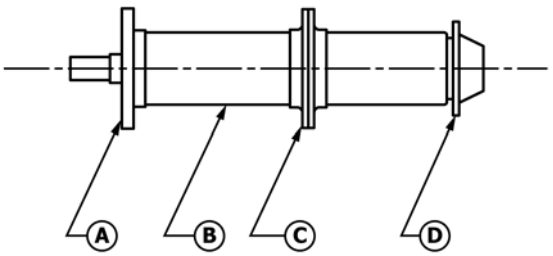
9.2 *Test Conditions*—The tests may be conducted at ambient temperature and humidity conditions. When controlled-environment testing is specified, conduct test at 73.4 ± 3.6°F (23 ± 2°C). When elevated-temperature testing is specified, conduct the tests at the design operating temperature, with a tolerance of ±3.6°F (2°C).

9.3 *Dimensions and Tolerances*—Measure flange dimensions with a micrometer, vernier calipers, or other suitable measuring devices accurate to within 50 % of the required tolerance. Determine diameters by averaging a minimum of four measurements, equally spaced circumferentially.

9.4 *Sealing*—Bolt together flanged components in general agreement with Fig. 2 using the gasket and bolt torque recommended for standard field installation by the flange manufacturer. Then pressure test the assembly and require it to hold the test pressure for a period of 168 h without leakage. Retorquing to the manufacturer's specified level after initial pressurization is permitted.

9.5 *Short-Term-Rupture Strength*—Hydrostatically test flanged components in accordance with Test Method D1599 with free-end closure for Class I flanges and fixed-end closure for Class II flanges except as herein noted. Increase the pressure in the specimen until failure of the flange occurs. Pressure testing in an atmospheric environment is permissible. Minimum-failure time shall be 60 s; no restriction shall be placed on maximum time-to-failure. Leaking past the gasket interface is permissible during this test. Bolt torque may be increased as necessary during the test in order to minimize gasket leaking and to achieve the pressure necessary to cause flange failure. The assembly used for the test in 9.4 may be used for this test. (**Warning—**DO NOT TEST WITH AIR PRESSURE.)

9.6 *Maximum Bolt Torque*—Using the gasket and hardware recommended by the flange manufacturer, bolt the flange against a flat-face steel flange. Tighten the nuts by hand until they are snug. Prior to fit-up, the nuts, bolts and washers should be well lubricated, using a non-fluid thread lubricant. Establish uniform pressure over the flange face by tightening bolts in 10-lb·ft (14-N·m) increments according to the sequence shown in Fig. 3. For flanges with 20 or more bolts, similar alternating bolt-tightening sequences shall be used. Increase the bolt torque uniformly until flange failure occurs, or until all bolts have been torqued to 2 times the level recommended by the manufacturer for field-installation practice to establish the bolt torque cell classification of the flange. Any sign of flange damage (crumbling, flaking, cracking, or other breaking) shall constitute failure.



A—End, plate, end cap, or quick closure with coupling for pressure source/vent line.
B—Reinforced thermosetting resin pipe (RTRP).
C—Test flange set.
D—End plate, end cap, or quick closure.

FIG. 2 Test-Assembly Configuration

NOTE 6—The torque limits determined by 11.6 apply only to flanges bolted up against a flat sealing surface. Significantly lower bolt-torque values will normally be allowed when contact-molded flanges are bolted up against other than flat sealing surfaces. When fiberglass flanges must be used against other than flat sealing surfaces, the flange manufacturer should be contacted for his torquing and installation recommendations.

10. Proof of Design

10.1 Test one each of 150-psi (1.03-MPa) flanges 8, 12, and 24 in. (203, 305, and 610 mm) as described in 6.1.2 and 9.5, to establish that the design calculations meet the test requirements and to establish rating data for the particular construction for all sizes of 150 psi or lower pressure ratings. Any change in calculation or construction will require retesting.

10.2 For individual orders conduct only those tests specifically agreed upon between the purchaser and the manufacturer prior to manufacture of flanges.

11. Product Marking

11.1 Flanges for use or installation by other than the flange manufacturer shall be marked with the following information:

11.1.1 The designation "ASTM D5421" with which the flange complies,

11.1.2 Identification of the flange in accordance with the designation code in 4.2,

11.1.3 Nominal flange size, and

11.1.4 Manufacturer's name (or trademark) and product designation.

11.2 Flanges for use and installation by the flange manufacturer shall be identified on the fabrication and assembly drawings with the following information:

11.2.1 The designation "ASTM D5421," and

11.2.2 Pressure rating.

NOTE 7—Through a quality-assurance and surveillance program the manufacturer shall ensure that the flanges used are of the designated grade and pressure rating.

12. Precision and Bias

12.1 No precision and bias statement can be made for the test methods outline in this standard since controlled round-robin test programs have not been run. The wide variations in raw materials and construction between manufacturers make round-robin testing difficult to apply.

13. Keywords

13.1 butt weld; contact molded; flange on pipe; furan; integral flange; polyester; vinylester

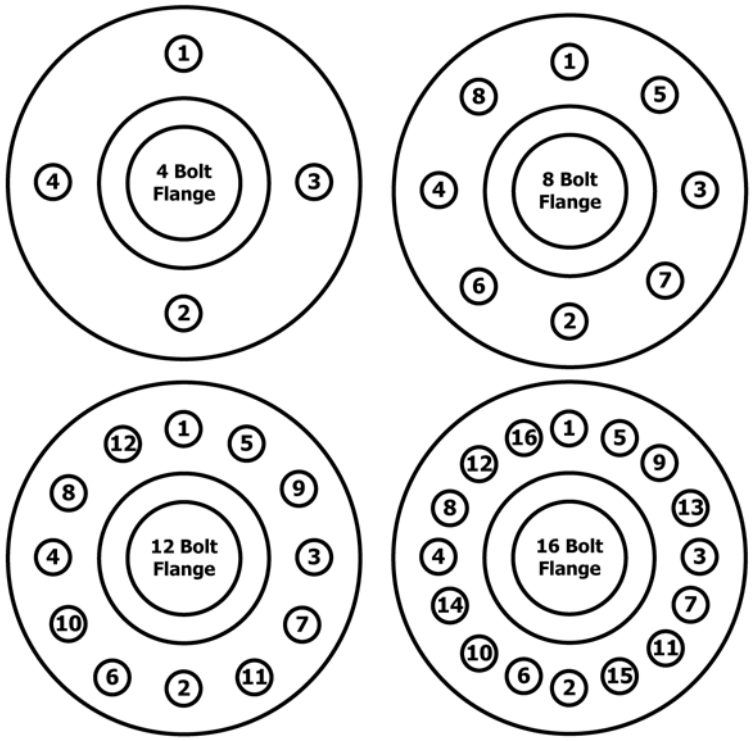


FIG. 3 Bolt Torquing Sequence

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D5421 – 05(2010)) that may impact the use of this standard. (May 1, 2015)

(1) Extended to larger diameters as now covered in many "Fiberglass" pipe standards.
(2) Corrected referenced bolting standards from ANSI to ASME.
(3) Removed references to ASTM D2310 and D3982 as not applicable.
(4) Corrected recommended bolt torqueing sequences in Fig. 3.

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