INTERNATIONAL

Designation: D5365 − 23

Standard Test Method for Long-Term Ring-Bending Strain of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe[1]

This standard is issued under the fixed designation D5365; 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 test method covers a procedure for determining the long-term ring-bending strain (S_b) of "fiberglass" pipe. Both glass-fiber-reinforced thermosetting-resin pipe (RTRP) and glass-fiber-reinforced polymer mortar pipe (RPMP) are "fiberglass" pipes.

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

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* A specific warning statement is given in 9.5.

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

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D3567 Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

3. Terminology

3.1 *Definitions:*

3.1.1 *General*—Definitions are in accordance with Terminology D883 and abbreviations are in accordance with Terminology D1600 unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *end point*—the failure of the test specimen. The failure mode may be catastrophic, characterized by a sudden fracture through the pipe wall in the area of greatest strain.

3.2.2 *fiberglass pipe*—tubular product containing glass-fiber reinforcements embedded in or surrounded by curing 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.

3.2.3 *reinforced polymer mortar pipe (RPMP)*—fiberglass pipe with aggregate.

3.2.4 *reinforced thermosetting resin pipe (RTRP)*—fiberglass pipe without aggregate.

4. Summary of Test Method

4.1 This test method consists of subjecting submerged-pipe ring specimens to various increasing deflections induced by a constant load and monitoring the time to failure. A minimum of 18 samples are required. Test temperatures are obtained by testing in a fluid environment where the temperature is controlled.

4.2 The long-term ring-bending strain is obtained by an extrapolation to 50 years of a log-log linear regression line for failure strain versus time.

NOTE 2—It is the consensus of Subcommittee D20.23 that the log-log linear regression analysis of test data is a conservative approach and is representative of standard industry practice.

5. Significance and Use

5.1 This test method determines the long-term ring-bending strain of pipe when deflected under constant load and immersed in a chemical environment. It has been found that effects of chemical environments can be accelerated by strain induced by deflection. This information is useful and necessary for the design and application of buried fiberglass pipe.

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.23 on Reinforced Thermosetting Resin 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.

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

NOTE 3—Pipe of the same diameter but of different wall thicknesses will develop different strains with the same deflection. Also, pipes having the same wall thickness but different constructions making up the wall may develop different strains with the same deflection.

6. Apparatus

6.1 *Loading Device*—The testing apparatus shall be suitable for maintaining a constant load on the test specimen.

6.2 *Load Application*—The load shall be applied to the test specimens using any of three alternative pairs of parallel loading surfaces; flat plates, rods or bars of a length at least as long as the pipe ring and of sufficient strength and stiffness to ensure a straight loading surface throughout the test. The same type of loading device shall be used for each specimen in a test series. In order to achieve uniform strain along the pipe, use 0.25-in. (6-mm) thick elastomeric pads between the parallel loading surfaces and the pipe ring (see Note 4).

6.2.1 *Flat Plates*—The plates shall have a minimum 6-in. (152-mm) width.

6.2.2 *Bars*—The bars shall have a flat contact surface of 0.75 ± 0.25 in. (19 ± 6 mm).

6.2.3 *Rods*—The rod diameter shall be 2 ± 0.25 in. (51 ± 6 mm) for pipe rings 12 in. (305 mm) and greater in diameter. For smaller pipes, the rod diameter shall be 1 ± 0.25 in. (25 ± 6 mm).

6.3 *Environment Containment*—A test enclosure of sufficient size to fully immerse the test specimens shall be used to contain the test solution. The enclosure shall not chemically affect the test solution.

NOTE 4—Elastomeric pads with a hardness of Shore A40 to 70 have been used successfully.

7. Test Specimens

7.1 The test specimens shall be ring sections taken from a sample(s) of pipe selected at random from a normal production run. The test specimens shall have a minimum length of one nominal pipe diameter or 12 in. (305 mm) ± 5 %, whichever is less. Treat the cut edges of the specimens by the same procedure as production products.

8. Test Conditions

8.1 The standard temperature shall be 23 ± 5°C (73.4 ± 9°F).

9. Procedure

9.1 *Test Specimen Measurements:*

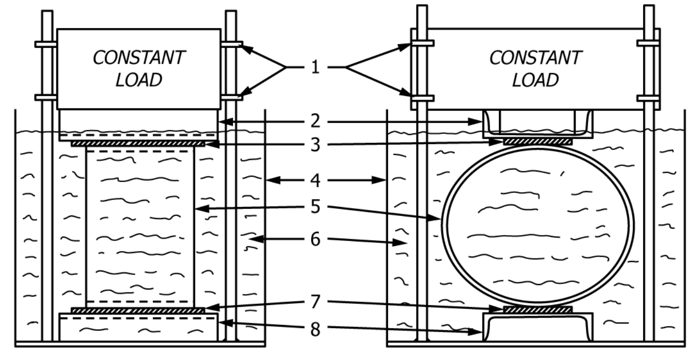
9.1.1 *Wall Thickness*—Determine in accordance with Test Method D3567.

9.1.2 *Inside Diameter*—Determine in accordance with Test Method D3567 at both ends prior to deflection and average the measurements.

NOTE 5—It is recommended that the inside diameter be measured with the axis vertical.

9.2 Place the test apparatus into the test enclosure.

9.3 Place the pipe ring in the test apparatus (see Fig. 1) and apply force to deflect the specimen at a rate not to exceed 10 % of its diameter per minute while keeping the top and bottom loading devices (plates, bars, or rods) of the apparatus as near parallel as practical. When the desired deflection is obtained cease adding load to the apparatus.



Side View
1 Load-Application Guides
2 Load-Application Device
3 0.25 in (6 mm) Rubber Pad
4 Test Enclosure

Front View
5 Submerged Test Specimen
6 Test Solution
7 0.25 in. (6 mm) Rubber Pad
8 Load-Applicatiion Device

FIG. 1 Long-Term Ring Bending Test Apparatus

NOTE 6—Alignment of the specimen within the loading devices is critical. The loading devices should not only be parallel with the load points 180° opposite, but the pipe ring should also be centered between the load-application guides. Additionally, the load-application guides should permit complete vertical freedom of movement, so the specimen remains under constant load.

9.4 Measure the vertical inside diameter of the deflected pipe specimen at both ends to the nearest 0.01 in. (0.25 mm). Average the measurements and determine the initial deflection by subtracting the average vertical inside diameter after loading from the measurement determined in 9.1.2.

NOTE 7—Deflections in excess of 28 % of diameter may cause local flattening of the pipe and lead to erratic test results. For deflections approaching 28 %, improved accuracy is obtained by use of strain gages or by establishing, for each pipe product, a calibration of deflection versus measured strain. This calibration technique may also be useful at all deflection levels.

9.5 Introduce the test solution to completely submerge the pipe ring as quickly as possible after loading. The solution may be added prior to loading the pipe ring and shall be added within 30 min of loading the pipe ring. Testing time commences only after both specimen loading (deflection) and the addition of solution are complete. (**Warning—**Since the failure mode could be catastrophic, take precautions to prevent or contain splashing or spilling of the test solution or other damages resulting from the sudden collapse of the pipe specimen.)

9.6 Periodically check and maintain the test solution within ±5 % of the specified strength or concentration for the duration of the test. The test specimen must remain completely submerged.

NOTE 8—As some solutions become more concentrated with the evaporation of water, care must be exercised in replenishment to prevent a build-up in strength. It may be necessary, with some reagents, to periodically clean the deflected specimen and replace the test solution with a fresh mixture. The use of plastic film, cut carefully to fit around the test