



Designation: D6396 – 99 (Reapproved 2020)

Standard Test Method for Testing of Pipe Thread Sealants on Pipe Tees¹

This standard is issued under the fixed designation D6396; 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 procedures used to assemble, evaluate and test pipe thread sealants.

1.2 Test procedures included in this test method are cure speed versus temperature, primer cure, instant seal/sealability, heat aging, solvent resistance, hot strength, steam resistance, and specimen preparation for high pressure testing.

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

1.4 *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.*

1.5 *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

D907 Terminology of Adhesives

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

3. Terminology

3.1 *Definitions*—Many of the terms in this test method are defined in Terminology D907.

3.2 *Definitions of Terms Specific to This Standard:*

¹ This test method is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.80 on Metal Bonding Adhesives.

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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.

3.2.1 *removal torque, n*—the torque required to unseat an installed pipe plug from a pipe tee.

4. Summary of Test Method

4.1 Pipe tee and plug fittings, assembled with the sealant under test, are subjected to a variety of conditions and tested for sealability and removal torque, 1/2 in. cap, coupling and nipple assemblies are prepared with the sealant under test for high pressure testing (typically 10 000 psi).

5. Significance and Use

5.1 Many of the tests that have been employed in the past to evaluate thread sealant products have not consistently targeted the most significant product features of a thread sealant. For instance, one of a thread sealant's primary performance features is its ability to maintain a seal under a range of conditions. The procedures in this test method assess the important characteristic properties of a thread sealant.

5.2 Because of the variability of the test specimens and the techniques employed by each operator, the assembly and test procedures and the testing apparatus have been designed to reduce the variability of the test results.

6. Apparatus

6.1 *Torque Testing Device*, of suitable capacity, for testing assemblies.

NOTE 1—Using automated torque testers to test the assemblies generally produces more reproducible results.

6.2 *Torque Wrench*, of suitable capacity, for providing installation torque.

6.3 *Pipe Tee Assembly Block*, 3/8 in. (10 mm), as shown in Fig. 1, or equivalent.

6.4 *Pipe Tee Torque Test Block*, 3/8 in. (10 mm), as shown in Fig. 2, or equivalent.

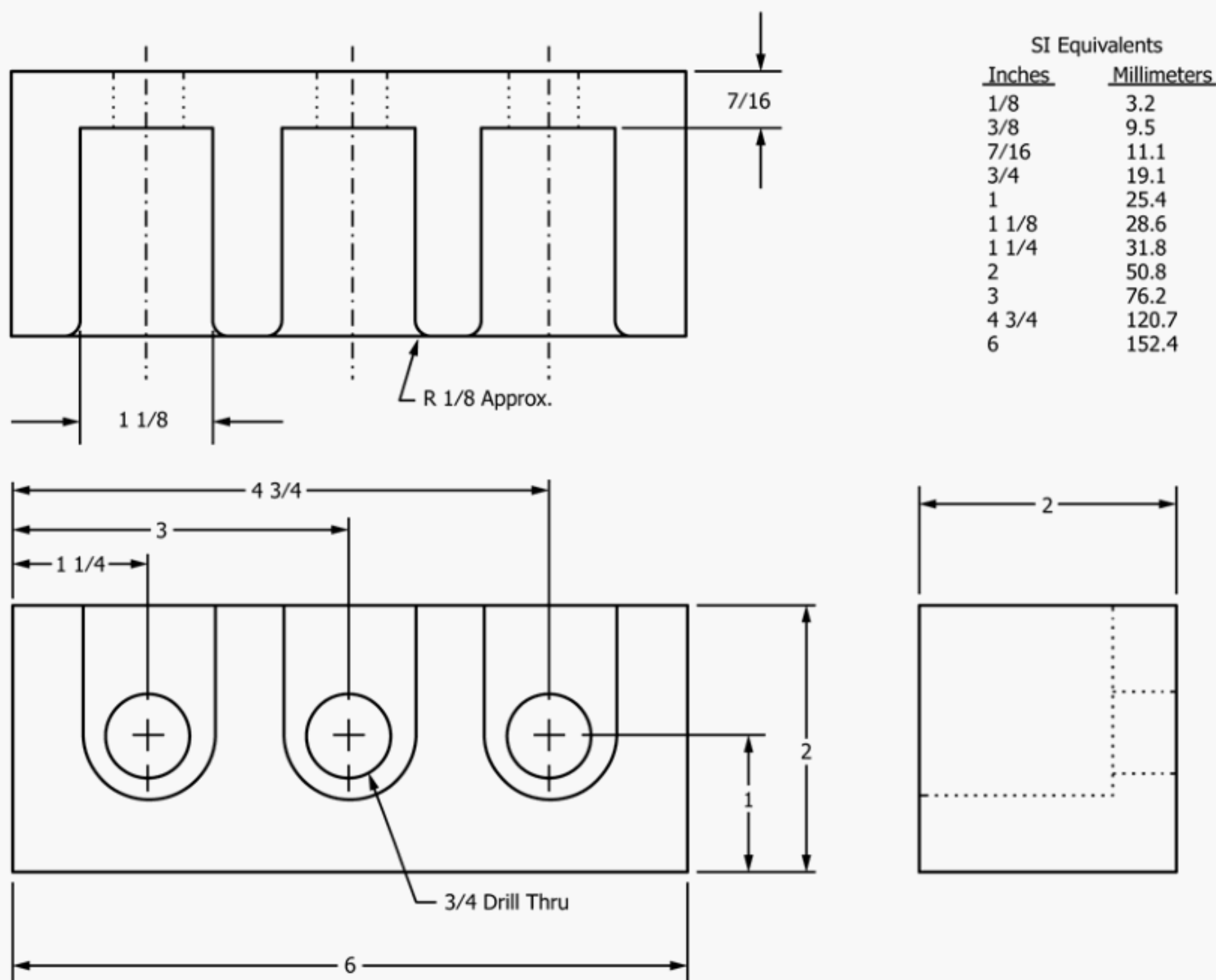
NOTE 2—The pipe tee torque test block is designed to fit an automated torque tester, but it can also be used in a vise with a torque wrench.

6.5 *Pipe Tee Sealability Test Clamp*, as shown in Fig. 3.

6.6 *Temperature Chamber*.

6.7 *Pressurized Pots*, for solvent resistance and steam resistance testing.

(All dimensions in inches unless otherwise stated)



NOTE: Break all sharp edges and corners

FIG. 1 $\frac{3}{8}$ Pipe Tee Assembly Block

7. Test Specimen

- 7.1 Malleable Iron Pipe Tees, $\frac{3}{8}$ in. (10 mm).
- 7.2 Forged Steel Pipe Plugs, $\frac{3}{8}$ in. (10 mm).
- 7.3 Stainless Steel Pipe Tees, $\frac{3}{8}$ in. (10 mm), 304SS.
- 7.4 Stainless Steel Pipe Plugs, $\frac{3}{8}$ in. (10 mm), 304SS.
- 7.5 Brass Pipe Tees, $\frac{3}{8}$ in. (10 mm).
- 7.6 Brass Pipe Plugs, $\frac{3}{8}$ in. (10 mm).
- 7.7 Malleable Iron Pipe Tees, $\frac{1}{2}$ in. (13 mm), Class 300.
- 7.8 Forged Steel Pipe Plugs, $\frac{1}{2}$ in. (13 mm).
- 7.9 Hex Reducing Coupling, $\frac{1}{2}$ in. (13 mm) FNPT by $\frac{1}{8}$ in. (3 mm) FNPT, 316 stainless steel.
- 7.10 Cap, $\frac{1}{2}$ in. (13 mm) pipe cap.
- 7.11 Hex Long Nipple, 316SS.

8. Assembly

- 8.1 Assemble not less than three assemblies for each test.
- 8.2 Degrease all pipe tees and plugs. Allow specimens to cool to room temperature prior to sealant application.

8.3 Apply sealant as follows:

- 8.3.1 Apply sealant uniformly to the second through the sixth threads of the male fitting for each test joint.
- 8.3.2 Ensure that the average height of the sealant reaches the thread crown (major diameter), and that the sealant completely wets the thread roots.
- 8.3.3 Note any separation or visible defects with the products. Also note any problems with wettability or excessive running due to low viscosity or a low thixotropy level.

8.4 Assemble test specimens as follows:

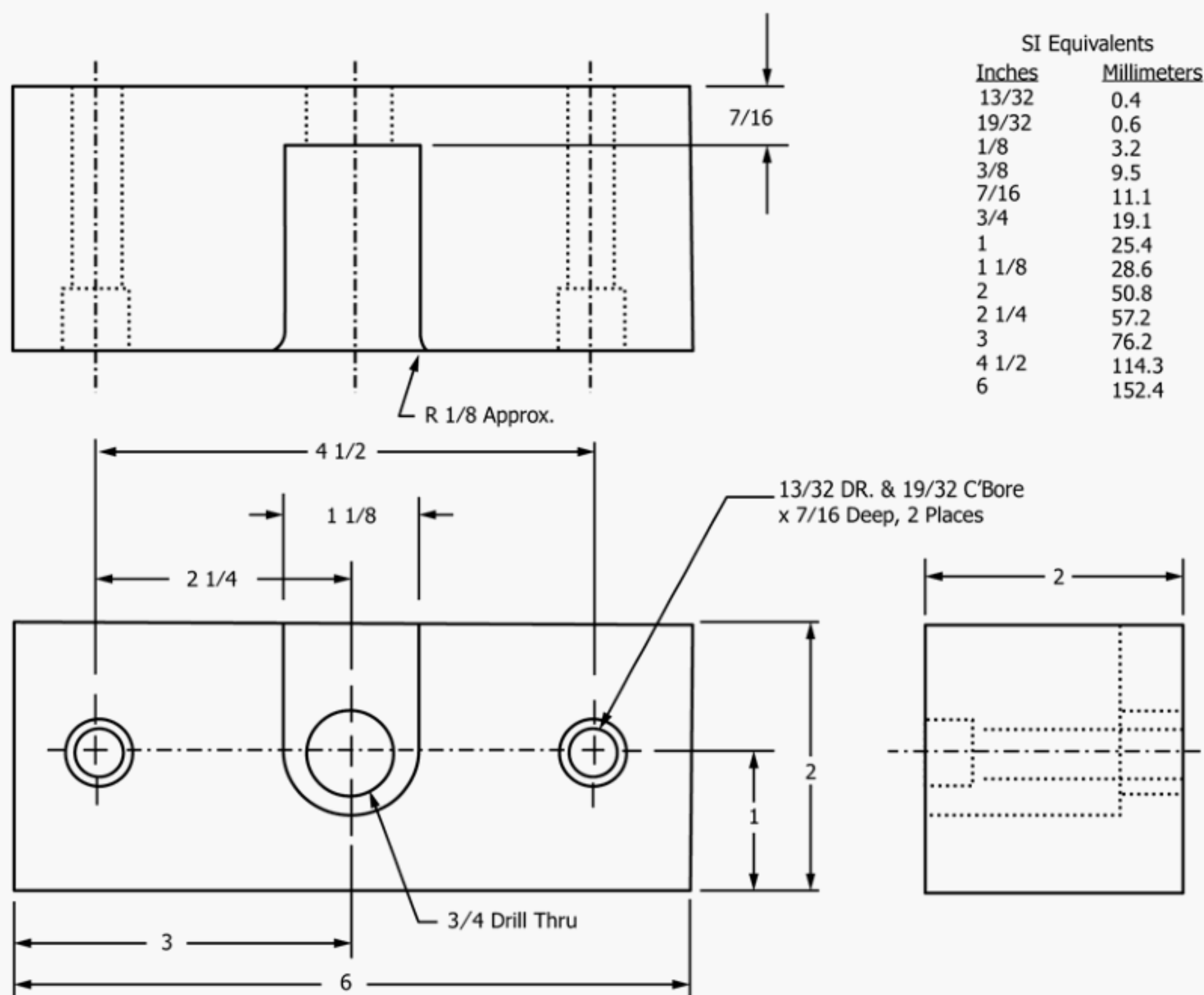
- 8.4.1 Using a torque wrench and the pipe tee assembly block fixture, install two sealant coated pipe plugs for each pipe tee. Install with the application of 240 in.-lb (27.1 N·m) of torque.
- 8.4.2 Remove excess sealant to avoid excess specimen weight loss that may be caused by charred sealant flaking off during initial heat exposure and in steam resistance tests.

9. Procedure

9.1 Cure Speed Versus Temperature:

- 9.1.1 Use $\frac{3}{8}$ in. (10 mm) pipe tees and plugs.

(All dimensions in inches unless otherwise stated)



NOTE: Break all sharp edges and corners

FIG. 2 3/8 Pipe Tee Torque Test Block

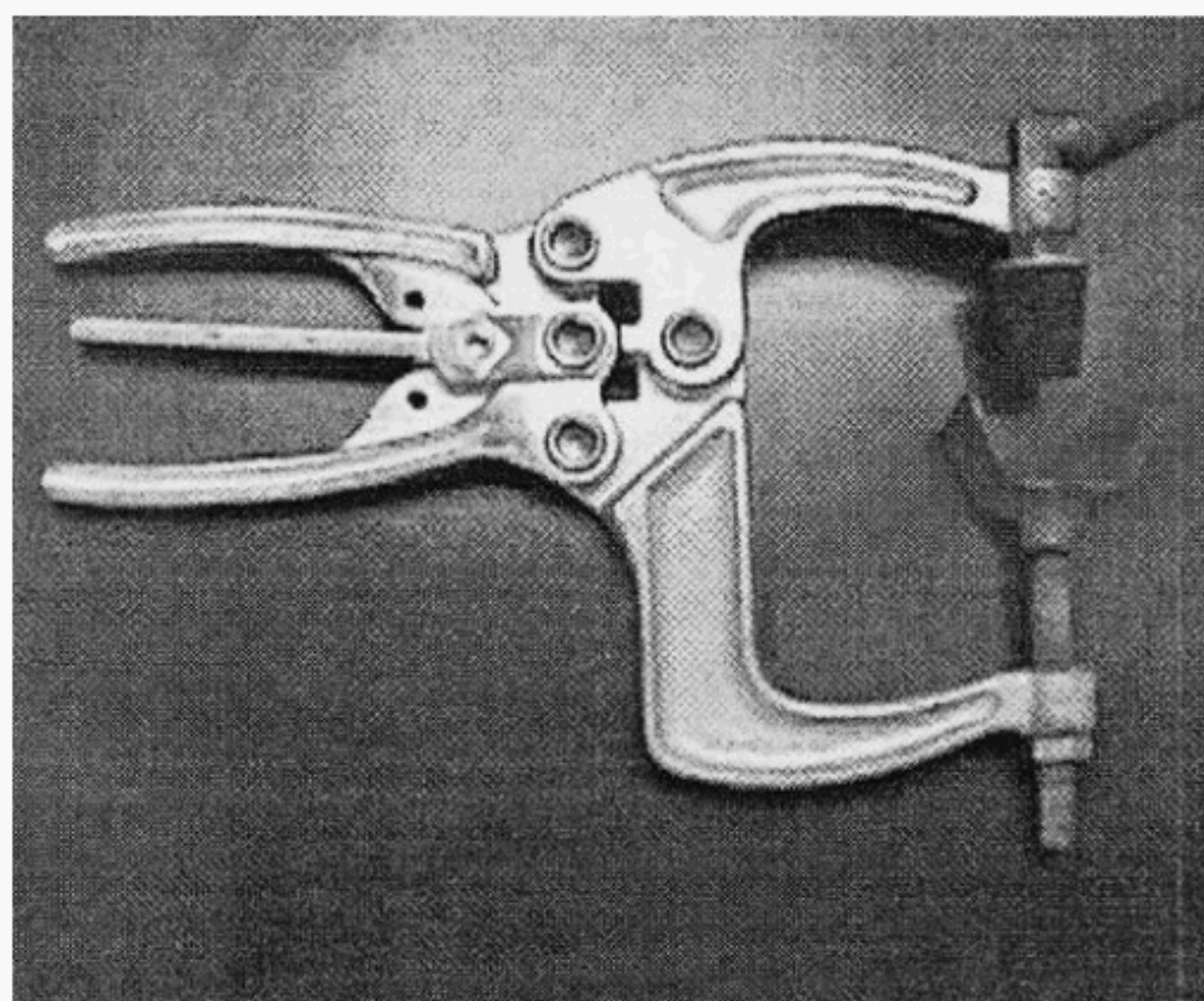


FIG. 3 Pipe Tee Sealability Test Clamp

9.1.2 Condition pipe tees and plugs in a temperature chamber at the cure temperature specified by the adhesive manufacturer for a minimum of 2 h.

NOTE 3—A temperature chamber is not needed for conditioning specimens for curing at room temperature.

9.1.3 Remove the specimens from the temperature chamber, and immediately apply the sealant, which has been held at room temperature, in accordance with 8.3, and assemble the specimens in accordance with 8.4.

9.1.4 Cure the assemblies for the time and at the temperature specified by the adhesive manufacturer.

9.1.5 After the specified cure time period, determine removal torques for each assembly using the pipe tee torque test block fixture, within 30 s of removal from the temperature chamber. Record the results.

9.2 Primer Cure:

9.2.1 Use 3/8 in. (10 mm) pipe tees and plugs.

9.2.2 Apply the primer specified by the adhesive manufacturer to the plugs and allow them to dry vertically until all the solvent has evaporated.

9.2.3 Apply the sealant in accordance with 8.3. Within 30 s of sealant application assemble the specimens in accordance with 8.4.

9.2.4 Cure the assemblies for the times specified by the adhesive manufacturer.

9.2.5 At the end of each specified cure time, test each assembly for sealability in accordance with 9.9.

9.2.6 Determine removal torques for each assembly using the pipe tee torque test block fixture. Record the results.

9.3 Heat Aging:

9.3.1 Use $\frac{3}{8}$ in. (10 mm) pipe tees and plugs.

9.3.2 Apply the sealant in accordance with 8.3, and assemble the specimens in accordance with 8.4.

9.3.3 Cure the assemblies for 72 h at room temperature.

9.3.4 Test each assembly for sealability in accordance with 9.9. All assemblies used for heat aging must be leak-free.

9.3.5 Place assemblies in a temperature chamber for the time and temperature specified by the adhesive manufacturer.

9.3.6 Remove assemblies from the temperature chamber and allow to return to room temperature for a period of 1 h \pm 5 min prior to testing.

9.3.7 Test each assembly for sealability in accordance with 9.9.

9.3.8 Determine removal torques for each assembly using the pipe tee torque test block fixture. Record the results.

9.4 Solvent Resistance:

9.4.1 Use $\frac{3}{8}$ in. (10 mm) pipe tees and plugs.

9.4.2 Apply the sealant in accordance with 8.3, and assemble the specimens in accordance with 8.4.

9.4.3 Cure the assemblies for 72 h at room temperature.

9.4.4 Test each assembly for sealability in accordance with 9.9. All assemblies used for solvent resistance must be leak-free.

9.4.5 Place the assemblies in the solvents, at temperatures specified by the adhesive manufacturer. Ensure that the level of solvent in the pressurized solvent pot is such that the assemblies are completely immersed.

NOTE 4—Typical solvents and temperatures are listed in Table 1.

9.4.6 Carry out the solvent exposure for the 30 days.

9.4.7 Remove the assemblies from the solvent, remove any solvent inside the tee, wipe assemblies thoroughly, and allow assemblies to return to room temperature for a period of 1 h \pm 5 min prior to testing.

9.4.8 Test each assembly for sealability in accordance with 9.9.

9.4.9 Determine removal torques for each assembly using the pipe tee torque test block fixture. Record the results.

9.5 Hot Strength:

9.5.1 Use $\frac{3}{8}$ in. (10 mm) pipe tees and plugs.

9.5.2 Apply the sealant in accordance with 8.3, and assemble the specimens in accordance with 8.4.

9.5.3 Cure the assemblies for 72 h at room temperature.

9.5.4 Place the assemblies in a temperature chamber at the temperature specified by the adhesive manufacturer for 2 h.

9.5.5 After the specified time period, determine removal torques for each assembly using the pipe tee torque test block fixture, within 30 s of removal from the temperature chamber. Record the results.

9.6 Steam Resistance:

9.6.1 Use $\frac{1}{2}$ in. (13 mm) pipe tees and plugs. Ensure that the pipe tees are Class 300 (see Note 5).

9.6.2 Apply the sealant in accordance with 8.3, and assemble the specimens in accordance with 8.4 using a vise in place of the assembly block fixture.

9.6.3 Through the opening in the tee, add sufficient water to contact all the joints. Add the same amount of water to all test assemblies.

9.6.4 Install the third sealant coated plug in accordance with 8.4, using a vise in place of the assembly block fixture, and wipe off any excess sealant.

9.6.5 Prepare one assembly without water as a control.

9.6.6 Cure the assemblies for 72 h at room temperature.

9.6.7 After curing, weigh each assembly and record the weight.

9.6.8 Place the assemblies in a pressurized pot and place the pot in a temperature chamber at 400°F (204.4°C).

NOTE 5—400°F provides an internal pressure of 235 psi (1.65 MPa). Class 300 pipe tees are adequate for this pressure. If testing is performed at higher temperatures (higher internal pressure), appropriately rated pipe tees must be used.

9.6.9 At one week intervals, up to a maximum of six weeks, remove the assemblies from the temperature chamber and allow them to return to room temperature for a period of 1 h \pm 5 min prior to testing.

9.6.10 Reweigh the assemblies and record any weight loss.

9.7 High Pressure Testing:

9.7.1 Use $\frac{1}{2}$ in. (13 mm) couplings, caps, and nipples.

9.7.2 Rinse all couplings, caps, and nipples with isopropyl alcohol and allow to dry.

9.7.3 Apply the specified primer to the female threads of the cap and coupling fittings with a cotton tip applicator.

9.7.4 Apply the sealant uniformly to the threads on the end of each nipple, ensuring that there is complete coverage of the thread roots.

9.7.5 Note any separation or visible defects with the products. Also note any problems with wettability or excessive running due to low viscosity or a low thixotropy level.

9.7.6 Using a torque wrench and a vise, install caps and couplings with the application of 75 ft-lb (101.7 N · m) of torque.

9.7.7 Remove excess sealant.

TABLE 1 Solvents and Temperatures

| Solvent | Temperature |
|------------------------------|-----------------------|
| Air (reference) | 22°C, 87°C, and 125°C |
| Distilled Water | 87°C |
| 10W30 Motor Oil | 125°C |
| 50/50 Ethylene Glycol/Water | 87°C |
| 50/50 Propylene Glycol/Water | 87°C |
| Phosphate Ester | 87°C |
| Isopropyl Alcohol | 22°C |
| Power Steering Fluid | 87°C or 125°C |
| Automatic Transmission Fluid | 87°C or 125°C |
| Unleaded Gasoline | 22°C |

9.7.8 Cure the assemblies for one week at room temperature.

9.7.9 After curing, test each assembly for sealability at 10 000 psi in accordance with Test Method **D1599**.

9.8 *Instant Seal:*

9.8.1 Use $\frac{3}{8}$ in. (10 mm) pipe tees and plugs.

9.8.2 Apply the sealant in accordance with **8.3**, and assemble the specimens in accordance with **8.4**.

9.8.3 Within five minutes after assembly, attach the pipe tee sealability test clamp to the assembly, and submerge in a water bath.

9.8.4 Remove any air bubbles introduced during the submersion, and pressurize the assembly to 80 to 100 psi (0.56 to 0.7 MPa) for 5 min.

9.8.5 Record the presence or absence of any observed leak paths (air bubble formation) at each test joint.

9.9 *Sealability:*

9.9.1 Attach the pipe tee sealability test clamp to the assembly, and submerge in a water bath.

9.9.2 Remove any air bubbles introduced during the submersion, and pressurize the assembly to 80 to 100 psi (0.56 to 0.7 MPa) for 1 min.

9.9.3 Record the presence or absence of any observed leak paths (air bubble formation) at each test joint.

9.9.4 Release the pressure to bring the assembly back to atmospheric pressure.

10. Report

10.1 Report the following information:

10.1.1 Complete identification of the sealant used including type, source, date manufactured, manufacturer's code number, and form.

10.1.2 Identification of the specimen used including substrate and dimensions,

10.1.3 Surface preparation used to prepare the specimens,

10.1.4 Cure conditions,

10.1.5 Test conditions,

10.1.6 Environmental conditioning,

10.1.7 Number of specimens tested,

10.1.8 Removal torque results,

10.1.9 Instant seal results,

10.1.10 Sealability results, and

10.1.11 Any deviation from this method.

11. Precision and Bias

11.1 Based on limited testing (one product, two laboratories, six replicates), a repeatability standard deviation of 12 to 15 % and a reproducibility standard deviation of 16 to 20 % have been determined for measuring removal torque.

11.2 No information can be presented on the bias for measuring removal torque because no material having an accepted reference value is available.

11.3 No information is presented about either the precision or bias for measuring sealability since the test result is nonquantitative.

12. Keywords

12.1 adhesive; pipe threads; sealant; sealability; torque removal

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