



Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80¹

This standard is issued under the fixed designation F480; 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.

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

1. Scope*

1.1 This specification covers water well casing pipe and couplings made from thermoplastic materials in standard dimension ratios (SDR), SCH 40 and SCH 80.

1.2 Specifications are provided for the application of these materials to water well and ground water monitoring applications. Flush threaded joint systems are included for screen and casing used primarily in the construction of ground water monitoring wells (see Practice [D5092](#)).

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information only [IEEE/ASTM SI 10](#).

NOTE 1—Certain field conditions may require alternative materials to ensure safe long-term use. The user should consult federal, state, and local codes governing the use of thermoplastic materials for well casing or monitor pipe.

NOTE 2—This standard specifies dimensional, performance and test requirements for plumbing and fluid handling applications, but does not address venting of combustion gases.

1.4 Although the pipe sizes and SDR values listed in this specification are generally available, numerous other plastic pipes in Schedule 40 and 80 wall, other SDR values and various outside diameters have been used for well casing. Such products are often selected because they fulfill certain needs and [Annex A1](#) includes a list of these Plastic Pipe Well Casing Specials.

1.5 The following safety hazards caveat pertains only to the test method portion, Section 6, of this specification: *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.*

¹ This specification is under the jurisdiction of ASTM Committee [F17](#) on Plastic Piping Systems and is the direct responsibility of Subcommittee [F17.61](#) on Water.

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2. Referenced Documents

2.1 ASTM Standards:²

- [D618](#) Practice for Conditioning Plastics for Testing
- [D638](#) Test Method for Tensile Properties of Plastics
- [D653](#) Terminology Relating to Soil, Rock, and Contained Fluids
- [D1527](#) Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
- [D1600](#) Terminology for Abbreviated Terms Relating to Plastics
- [D1784](#) Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- [D1785](#) Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- [D1892](#) Specification for Styrene-Butadiene Molding and Extrusion Materials³
- [D1898](#) Practice for Sampling of Plastics³
- [D2122](#) Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- [D2235](#) Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
- [D2241](#) Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- [D2282](#) Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe³
- [D2412](#) Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- [D2444](#) Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- [D2564](#) Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

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 Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

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

D2855 Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
D3122 Specification for Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
D3965 Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings
D5092 Practice for Design and Installation of Ground Water Monitoring Wells
F402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
F412 Terminology Relating to Plastic Piping Systems
IEEE/ASTM SI 10 American National Standard for Use of the International System of Units (SI): The Modern Metric System

2.2 ANSI Standards:⁴

B1.5 ACME Screw Threads
B1.8 Stub ACME Screw Threads
B1.9 Buttress Inch Screw Threads

2.3 Federal Standard:⁵

FED-STD-123 Marking for Shipment (Civil Agencies)

2.4 Military Standard:⁵

MIL-STD-129 Marking for Shipment and Storage

2.5 Other Standards:

Screw-Threads Standards for Federal Services 1957, Handbook H28, Part III⁶

NSF 14 Plastic Piping System Components and Related Materials

NSF 61 Drinking Water System Components⁷

3. Terminology

3.1 Definitions are in accordance with Terminology **F412** and abbreviations are in accordance with Terminology **D1600**, unless otherwise specified. The abbreviation for acrylonitrile-butadiene-styrene plastic is ABS. The abbreviation for poly(vinyl chloride) is PVC. The abbreviation for styrene-rubber is SR.

3.2 Ground water investigation terms are in accordance with Terminology **D653**.

4. Classification

4.1 Well casing is produced in either plain end, belled end, or threaded, and is used for water wells, ground water monitoring, leak detection, recovery systems, dewatering systems, and waste disposal.

5. Materials and Manufacture

5.1 *Specification*—The material described shall meet or exceed the requirements of (1) Specification **D3965** for ABS

with a cell classification of 44322 or 33333, (2) Specification **D1784** for PVC with a cell classification of 12454 or 14333, or (3) Specification **D1892** for SR with a cell classification of 4434A. The material so described shall be approved for potable water.

NOTE 3—Caution should be exercised to control heat of hydration during grouting as thermoplastic materials are heat sensitive. Accelerators tend to increase the heat of hydration and are not recommended.

5.2 Acrylonitrile-butadiene-styrene (ABS) well casing pipe and couplings plastic shall be virgin plastic produced by the original compounder (see Specification **D1527**). The minimum butadiene content is 6 %; the minimum acrylonitrile content is 15 %; the minimum styrene or substituted styrene content, or both, is 15 %; and the maximum content of other monomers is 5 % and lubricants, stabilizers, and colorants.

5.3 Poly(vinyl chloride) (PVC) well casing pipe and couplings plastic shall be made of virgin plastic produced by the original compounder. It shall contain poly(vinyl chloride) homopolymer, and such additives—stabilizers, lubricants, processing aids, impact improvers, and colorants—as needed to provide the required processing and toughness characteristics (see Test Method **D638**).

5.4 The SR plastics compound shall contain at least 50 % styrene plastics, combined with rubbers to a minimum rubber content of 5 %, and compounding materials such as antioxidants and lubricants, and may contain up to 15 % acrylonitrile combined in the styrene plastics or rubbers, or both. The rubbers shall be of the poly-butadiene or butadiene-styrene type, or both, with a maximum styrene content of 25 % or nitrile type, or both. The combined styrene plastics and rubber content shall be not less than 90 %.

5.5 *Rework Material*—Clean rework material generated from the manufacturer's own well casing pipe and couplings production may be used by the same manufacturer, provided the well casing pipe and couplings produced meet all the requirements of this specification.

5.6 Solvent Cement:

5.6.1 *Specification*—The solvent cement shall meet the requirements of Specification **D2235** for ABS, Specification **D2564** for PVC, or Specification **D3122** for SR (see Supplementary Requirements S3).

6. Requirements

6.1 *Workmanship*—The pipe shall be homogeneous throughout and essentially uniform in color, opacity, density, and other properties. The inside and outside surfaces shall be semi-matte or glossy in appearance (depending on the type of plastic) and free of chalking, sticky, or tacky material. The surfaces shall be free of excessive bloom, that is, slight bloom is acceptable. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusion, or other defects that are visible to the naked eye and that may affect the wall integrity. Machined slots or holes deliberately placed in pipe are acceptable. Bloom or chalking may develop in pipe exposed to direct rays of the sun (ultraviolet radiant energy) for extended periods, and consequently these requirements do not apply to pipe after extended exposure to direct rays of the sun.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

⁶ U.S. Government Bookstore 710 North Capitol Street N.W. Washington, DC <http://bookstore.gpo.gov/>

⁷ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

6.1.1 *Ground Water Investigations*—Pipe manufactured into products used in ground water investigations should have surfaces that are visually free of oils, grease, dust, and marks imparted as a result of the manufacturing process.

6.2 Well Casing Pipe:

6.2.1 *Dimensions*—The outside diameter and wall thickness of the well casing pipe shall meet the requirements given in [Table 1](#) or [Table 2](#) when measured in accordance with Test Method [D2122](#). (See Specification [D2282](#).)

6.2.2 *Wall Thickness Eccentricity*—The wall thickness eccentricity of the pipe shall be within 12 %.

6.2.3 *Length*—The well casing pipe shall be in either 10- or 20-ft (3.05- or 6.10-m) lengths, unless otherwise specified. The allowable tolerance on length shall be $\pm \frac{1}{2}$, -0 in. (± 13 , -0 mm) when measured in accordance with Test Method [D2122](#).

6.2.4 *Flush Joint Threaded Length*—If specified by the manufacturer or purchaser, the assembled length of flush threaded casing or screen shall be a nominal length such as 5, 10, or 20 ft. Any given laying length the purchaser specifies will constitute an assembled length. The allowable tolerance shall be $\pm \frac{1}{2}$, $-\frac{1}{8}$ in. (± 13 , -3 mm) on the components of the assembled laying length. The overall length of all flush threaded screen and casing shall be the nominal or specified laying length plus the length of the exposed male thread (pin).

NOTE 4—The purchaser should specify whether the length is to be the laying length or the overall length. The term “laying length” refers to the overall length less the length required to complete the assembly.

6.3 Well Casing Pipe Couplings:

6.3.1 *Socket Dimensions*—The socket dimensions of couplings shall conform to the requirements given in [Table 3](#) and [Table 4](#) when measured in accordance with Test Method [D2122](#).

6.3.2 *Bell Socket Dimensions*—The socket dimensions of well casing pipe bell couplings shall be as shown in [Table 5](#) when measured in accordance with Test Method [D2122](#).

6.3.3 *Bell Socket Wall Thickness*—The wall thickness of an integral bell shall be considered satisfactory if formed from pipe that meets the requirements of this specification.

6.3.4 *Laying Length Dimensions*—The laying length dimensions of well casing pipe couplings shall conform to the

requirements given in [Table 3](#), [Table 4](#), and [Table 5](#) when measured in accordance with Test Method [D2122](#).

6.3.5 *Socket Concentricity or Alignment*—The maximum misalignment of axis of couplings with the pipe measured in the plane of the coupling face shall not exceed $\frac{3}{4}$ in./20 ft (3 mm/1 m) of projected axis when measured in accordance with [7.4](#).

6.4 Pipe Stiffness and Flattening:

6.4.1 *Well Casing Pipe*—The well casing pipe shall have a pipe stiffness at 5 % deflection equal to that shown in [Table 6](#) and [Table 7](#) and shall deflect 60 % of the original diameter (flattening) without cracking, rupture, or other visible evidence of failure when tested in accordance with Test Method [D2412](#). Three specimens shall be tested and all shall pass.

NOTE 5—This test is intended for use as a quality control test, not as a simulated service test.

6.4.2 *Couplings and Bells* shall meet all the designated dimensional requirements of [Table 3](#), [Table 4](#), or [Table 5](#). Molded couplings shall have a pipe stiffness at 5 % deflection equal to that shown in [Table 6](#) and [Table 7](#) and shall deflect 15 % without cracking, rupture, or other visible evidence of failure when tested in accordance with Test Method [D2412](#). Three specimens shall be tested and all shall pass.

6.5 *Impact Resistance Classification*—The impact resistance classification (IC) value for well casing pipe shall be selected from [Table 8](#) by the manufacturer based on the measured average impact values determined in accordance with [7.5](#).

6.6 *Tip Puncture Resistance*—The well casing pipe and well casing couplings shall deflect 30 % (puncture resistance) without cracking, rupture, or other visible evidence of failure when tested in accordance with [7.6](#) ([Note 7](#)). Three specimens shall be tested and all shall pass.

6.7 *Threads*—Well casing, screens, and couplings having threads shall have either American Standard ACME 2G screw threads, American Standard Stub ACME 2G screw threads, or Buttress screw threads, Class 2, or square form flush joint threads, in accordance with ANSI [B1.5](#) for ACME 2G screw threads, ANSI [B1.8](#) for Stub ACME 2G screw threads, and ANSI [B1.9](#) for Buttress screw threads. Examples of acceptable square form flush joint thread patterns for monitoring well construction are included in the annex.

6.7.1 All ACME, Stub ACME, and Buttress screw threads shall be gaged in accordance with [7.7](#).

6.7.2 Machining flush joint square threads directly into the wall of the pipe may cause difficulty in measuring the thread dimensions when the pipe is removed from the threading device. The inherent out-of-round condition of the pipe will cause the thread dimensions to conform to the irregularities of the pipe. Measurements must be taken at many points and averaged. Alternatively gages of metal or other rigid material may be used when gage dimensions or methods are available.

6.7.3 *Thread Out-of-Roundness*—Out of roundness for threaded dimensions on Schedule 40 and Schedule 80 threads, described in the annex must conform to the “Out-of-Roundness Maximum Diameter Minus Minimum Diameter” figures found in [Table 1](#).

TABLE 1 Outside Diameters and Tolerance for Thermoplastic Well Casing Pipe, in.

Nominal Pipe Size	Outside Diameter		Out-of-Roundness Maximum Diameter Minus Minimum Diameter		
	Average	Tolerance on Average	SDR41 SDR32.5 SDR26	SDR21 SDR17 SDR13.5	SCH40 and SCH80 ⁴
2	2.375	± 0.006	0.060	0.024	0.024
2½	2.875	± 0.007	0.060	0.030	0.030
3	3.500	± 0.008	0.060	0.030	0.030
3½	4.000	± 0.008	0.100	0.030	0.030
4	4.500	± 0.009	0.100	0.030	0.030
5	5.563	± 0.010	0.100	0.060	0.060
6	6.625	± 0.011	0.100	0.070	0.070
8	8.625	± 0.015	0.150	0.090	0.090
10	10.750	± 0.015	0.150	0.100	0.100
12	12.750	± 0.015	0.150	0.120	0.120
14	14.000	± 0.020	0.150	0.150	0.150
15	15.300	± 0.020	0.150	0.150	
16	16.000	± 0.020	0.150	0.150	0.150

⁴Reference [D1527](#) for ABS and [D1785](#) for PVC.

TABLE 2 Minimum Wall Thickness for Thermoplastic Well Casing Pipe, in.^A

Nominal Pipe Size	SDR41	SDR32.5	SDR26	SDR21	SDR17	SDR13.5	SCH40 ^B	SCH80 ^B
	Min	Min	Min	Min	Min	Min	Min	Min
2	..	..	..	0.113	0.140	0.176	0.154	0.218
2½	..	..	..	0.137	0.169	0.213	0.203	0.276
3	..	..	..	0.167	0.206	0.259	0.216	0.300
3½	..	..	..	0.190	0.235	0.296	0.226	0.318
4	0.110	0.138	0.173	0.214	0.265	0.333	0.237	0.337
5	0.136	0.171	0.214	0.265	0.327	0.412	0.258	0.375
6	0.162	0.204	0.255	0.316	0.390	0.491	0.280	0.432
8	0.210	0.265	0.332	0.410	0.508	..	0.322	0.500
10	0.262	0.331	0.413	0.511	0.632	..	0.365	0.593
12	0.311	0.392	0.490	0.606	0.750	..	0.406	0.687
14	0.342	0.430	0.539	0.667	..	..	0.437	0.750
15	0.373	0.471	..	..	..	..	..	..
16	0.390	0.493	0.616	0.762	..	..	0.500	0.843

^AThe minimum is the lowest wall thickness of the well casing pipe at any cross section.

^BReference: **D1527** for SCH40 and 80 ABS
D1785 for SCH40 and 80 PVC
D2241 for SDR PVC

6.7.4 Thread Eccentricity—The wall thickness eccentricity as well as the flush joint threads found in the annex shall be within 12 %.

NOTE 6—Ground water monitoring wells are usually constructed with flush joints to prevent bridging of materials placed in the well annulus during well installation. Interior surfaces are a flush finish to prevent equipment from becoming lodged at points where the inside diameter might constrict. Externally coupled pipe may be used, but the special needs of wells constructed for ground water monitoring, for example, no gravel or grout bridging, hollow stem auger inside diameter, solvent-free couplings, should be addressed.

6.8 Threaded Joints—Threaded joints including flush threaded joints made with well casing pipe and well casing couplings shall not leak. For ACME, Stub ACME, Buttress thread, and Flush Thread joints the test shall be an internal pressure of 25 psi (170 kPa) for 1 h in accordance with **7.8**.

6.9 Joint Strength—Joint tensile strength requirements will be added when test method and test results are available.

6.10 Well Screens—Screens manufactured from pipe or casing shall have uniform slots placed perpendicular to the long axis of the pipe. Slot width, length, interslot spacing, number of rows around the screen circumference and overall screen length shall comprise the product specification.

7. Test Methods

7.1 Sampling—A sample of the well casing pipe and coupling sufficient to determine conformance with this specification shall be taken at random from each lot in accordance with Section 9 of Practice **D1898**.

7.2 Conditioning—Unless otherwise specified, condition the specimens prior to test at 72.4 ± 3.6°F (23 ± 2°C) and 50 ± 10 % relative humidity for not less than 40 h in accordance with Procedure A of Practice **D618**. The manufacturer may use shorter conditioning time, but in case of disagreement Procedure A of Practice **D618** shall be used.

7.3 Test Conditions—Conduct tests in the standard laboratory atmosphere 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification.

7.4 Socket Concentricity or Alignment (see Practice **D2855**)—Select three bell socket couplings with sufficient pipe

so that concentricity and alignment tests for bell socket couplings may be made. Select three well casing pipe specimens, each specimen 12 ± ½ in. (300 ± 3 mm) in length. Cut the ends square, free of burrs and jagged edges. Solvent cement the bell socket coupling and well casing pipe together following recommended procedures. Center the coupling onto a test mandrel that has been accurately centered on a lathe or lathe-type spindle. While the assembly is being rotated, eccentricity in the plane of the bell socket coupling face may be determined by means of a dial gage bearing radially against the bell socket coupling. The extent of the angular misalignment may be determined by means of a dial gage bearing radially against the well casing pipe approximately 1 ft (0.30 m) from the bell socket coupling face or a dial gage parallel to the axis against the bell socket coupling face. Other test methods may be used when agreed upon between the purchaser and the seller.

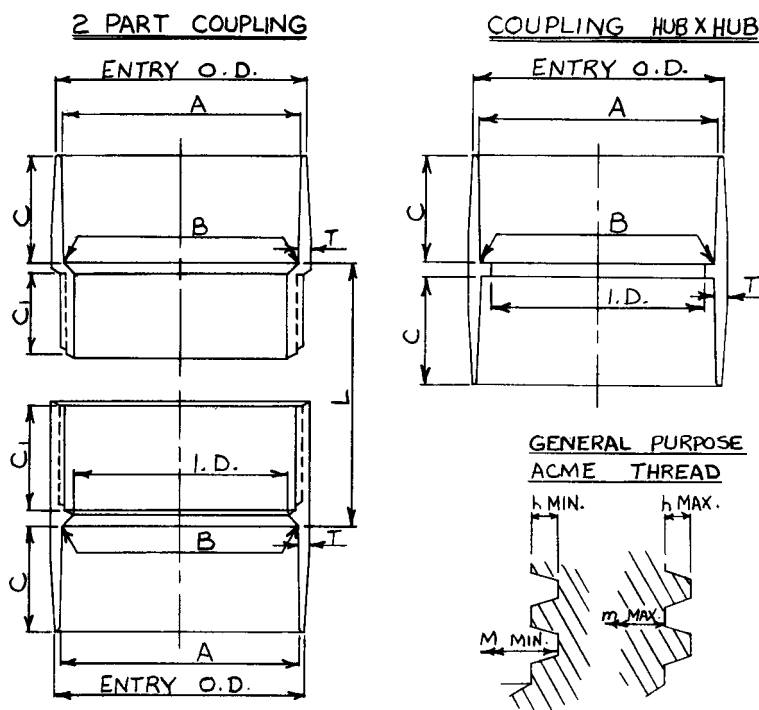
7.5 Impact Classification (see Test Methods **D2444**)—Determine the impact classification in accordance with Test Method **D2444**, using Tup B weighing 30 lb and Holder B. Select ten well casing pipe specimens of each size with each specimen 6 ± ½ in. (150 ± 3 mm) in length. Condition the test specimens in a low-temperature environmental chamber maintaining a test temperature of 32 to 35.6°F a minimum of 2 h or in a mixture of ice and water at 32 to 35.6°F for 1 h before testing and test immediately on removal. Test ten specimens in accordance with Test Method **D2444**; nine of the ten specimens shall be above the lower limit of the IC cell. Examine the results for conformance with **6.5**.

7.6 Tup Puncture Resistance Test:

7.6.1 Procedure—Select three pipe specimens and three couplings. Determine whether the specimens are resistant to tup puncture at 30 % deflection by using the apparatus required for Test Method **D2412** and Tup A as defined in Test Method **D2444**. The test method uses a constant-load rate instead of an impact load. The Vee-block base has been enlarged to accommodate larger specimens as seen in Fig. 1. Machine the base so that the two sides of the Vee form an angle of 90 ± 0.01°. Mount Tup A of Test Method **D2444** on a square steel plate as shown in Fig. 2. Attach two Federal D01S dial gages to the

TABLE 3 Thermoplastic Water Well Casing Pipe Couplings Socket Dimensions and Laying Length Dimensions, in. (see Specification D2672)

NOTE 1—See 6.7 for thread dimensions other than ACME 2G screw threads.



S	2	2½	3	3½	4	5	6	8	10	12
A	2.386	2.887	3.514	4.015	4.517	5.584	6.648	8.649	10.796	12.778
A ₁	±0.006	±0.007	±0.008	±0.008	±0.009	±0.010	±0.011	±0.015	±0.015	±0.015
B	2.370	2.869	3.493	3.992	4.491	5.553	6.614	8.613	12.737	12.736
B ₁	±0.006	±0.007	±0.008	±0.008	±0.009	±0.010	±0.011	±0.015	±0.015	±0.015
C	1.500	1.750	2.000	2.250	2.500	3.000	3.500	4.500	5.000	6.000
C ₁	1.000	1.250	1.500	1.750	2.000	2.500	3.000	4.000	4.500	5.500
ID	2.149	2.601	3.166	3.620	4.072	5.033	5.993	7.805	9.728	11.538
T	0.113	0.137	0.167	0.190	0.214	0.265	0.316	0.410	0.511	0.606
T ₁	+0.020	+0.020	+0.020	+0.023	+0.026	+0.032	+0.038	+0.049	+0.061	+0.073
h	0.083	0.100	0.100	0.125	0.125	0.166	0.200	0.250	0.333	0.375
M	2.465	2.982	3.606	4.131	4.630	5.735	6.830	8.878	11.086	13.127
m	2.289	2.772	3.396	3.871	4.370	5.393	6.420	8.368	10.410	12.367
L	1.500	1.750	2.000	2.250	2.500	3.000	3.500	4.500	5.000	6.000
OD	2.612	3.161	3.848	4.395	4.945	6.114	7.280	9.469	11.818	13.900

- S = nominal pipe size
A = socket entrance diameter
A₁ = tolerance on diameter
B = socket bottom diameter
B₁ = tolerance on diameter
C = socket depth
C₁ = thread length
ID = bore diameter
T = minimum wall thickness
T₁ = tolerance on wall thickness
h = thread height—for ACME 2G screw thread (Note)
M = major diameter of internal thread—for ACME 2G screw thread (Note)
m = minor diameter of external thread—for ACME 2G screw thread (Note)
L = lay length
OD = outside diameter at entry of hub

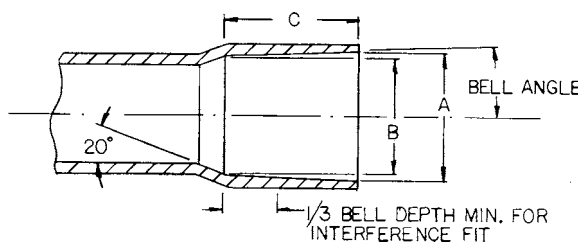
square steel plate 180° apart as seen in Fig. 3 and Fig. 4. Measure the specimens to determine the point of minimum wall thickness. Place the pipe or coupling specimen of 6 ± ¼ in. (150 ± 3 mm) in length in the universal load machine with the minimum wall of the specimen positioned directly under the nose of the tup. Place spacers between the dial gage stems

and the base so that the deflection of the tup versus load can be measured. The speed of testing shall be 0.5 ± 0.02 in. (12.5 ± 0.5 mm)/min. Continue the test until the diameter is deflected 30 % of its original diameter (puncture resistance). Examine the test results for each specimen of pipe and coupling for conformance to Section 6.

TABLE 4 Metric Equivalents for Table 3, mm

S	2	2½	3	3½	4	5	6	8	10	12½
A	60.60	73.32	89.26	101.98	114.74	141.84	168.86	219.68	273.71	324.56
A ₁	±0.16	±0.18	±0.20	±0.20	±0.22	±0.26	±0.28	±0.38	±0.38	±0.38
B	60.20	72.88	88.72	101.40	114.08	141.04	168.00	218.78	272.72	323.50
B ₁	±0.16	±0.18	±0.20	±0.20	±0.22	±0.26	±0.28	±0.38	±0.38	±0.38
C	38	44	51	57	64	76	89	114	127	152
C ₁	25	32	38	44	51	64	76	102	114	140
ID	54.58	66.06	80.42	91.94	103.42	127.84	152.22	198.24	247.10	293.06
T	2.88	3.48	4.24	4.82	5.44	6.74	8.02	10.42	12.98	15.40
T ₁	+0.50	+0.50	+0.50	+0.58	+0.66	+0.82	+0.96	+1.24	+1.54	+1.86
h	2.10	2.54	2.54	3.18	3.18	4.22	5.08	6.34	8.46	9.52
M	62.62	75.74	91.60	104.92	117.60	145.66	173.48	225.50	281.58	333.42
m	58.14	70.40	86.26	98.32	111.00	136.98	163.06	212.54	264.40	314.12
L	38	44	51	57	64	76	89	114	127	152
OD	66.34	80.28	97.74	111.64	125.60	155.30	184.92	240.52	300.18	355.34

TABLE 5 Tapered Sockets for Bell-End Pipe, in.⁴



Nominal Pipe Size	A Socket Entrance Diameter			B Socket Bottom Diameter			C Socket Length, min
	Diameter	Tolerance on Diameter	Max Out-of-Round	Diameter	Tolerance on Diameter	Max Out-of-Round	
2	2.386	±0.006	±0.012	2.363	±0.006	±0.012	3.000
2½	2.887	±0.007	±0.015	2.861	±0.007	±0.015	3.500
3	3.514	±0.008	±0.015	3.484	±0.008	±0.015	4.000
3½	4.015	±0.008	±0.015	3.984	±0.008	±0.015	4.500
4	4.517	±0.009	±0.015	4.482	±0.009	±0.015	5.000
4½	4.968	±0.009	±0.030	4.932	±0.009	±0.030	5.500
5	5.584	±0.010	±0.030	5.543	±0.010	±0.030	6.000
6	6.648	±0.011	±0.030	6.603	±0.011	±0.030	6.500
6¼	6.922	±0.011	±0.030	6.878	±0.011	±0.030	7.000
8	8.649	±0.015	±0.045	8.598	±0.015	±0.045	7.000
10	10.776	±0.015	±0.050	10.722	±0.015	±0.050	7.500
12	12.778	±0.015	±0.060	12.721	±0.015	±0.060	8.000
14	14.035	±0.015	±0.060	13.970	±0.015	±0.060	8.000
16	16.045	±0.015	±0.060	15.970	±0.015	±0.060	8.000

⁴Minimum dimensions have zero negative tolerance. The sketches and designs of fittings are illustrative only.

TABLE 6 Minimum Pipe Stiffness at 5 % Deflection, lbf/(in.-in.) (kN/(m-m))

NOTE 1—The PS values are computed on the basis of minimum pipe wall thickness with the following material moduli: SR, 300 000 psi (2.07 GPa); ABS, 250 000 and 350 000 psi (1.72 to 2.41 GPa); and PVC, 400 000 psi (2.76 GPa).

	SDR 13.5	SDR 17	SDR 21	SDR 26	SDR 32.5	SDR 41
SR	684 (4720)	339 (2340)	168 (1160)	84 (580)	...	...
ABS 250 000	570 (3935)	273 (1942)	140 (964)	70 (485)	...	...
ABS 350 000	798 (5510)	395 (2720)	196 (1350)	98 (677)	...	...
PVC	912 (6290)	452 (3120)	224 (1550)	112 (774)	56	28

NOTE 7—The tup puncture test for point load is derived from Test Methods D2412 and D2444, combined to achieve a meaningful design parameter for well casing pipe used in water well construction. There are many possibilities for a point load to be exerted on the well casing pipe. Perhaps the most significant of these is the stringing of a well casing pipe through a boulder field. The sides of the well hole are seldom smooth surfaces, but rather pieces of rock are embedded in the surrounding soil layers. When these rock particles come in contact with the well casing pipe, a point loading situation can develop. Natural earth movements can

impose high stresses over a small area of well casing pipe surface. This type of localized load is an entirely different situation from a uniform load.

7.7 Threads—Gage the threads using gages specified in accordance with recommended gages and gaging practice for external and internal threads as specified in the following standards:

ANSI B1.5 1973

TABLE 7 Minimum Pipe Stiffness for SCH 40 and SCH 80 Well Casing Pipe, PSI (kN/(m²))^A

Nominal Pipe Size, in.	SCH40	SCH80	SCH40	SCH80	SCH40	SCH80
	ABS 250 000	ABS 250 000	ABS 350 000	ABS 350 000	PVC	PVC
2	373 (2571)	1155 (7963)	543 (3743)	1680 (11582)	600 (4136)	1920 (13236)
2½	490 (3378)	1340 (9238)	630 (4343)	1960 (13512)	800 (5515)	2240 (15443)
3	318 (2192)	921 (6349)	464 (3199)	1330 (9169)	510 (3516)	1520 (10479)
3½	240 (1655)	720 (4964)	350 (2413)	1033 (7122)	400 (2758)	1180 (8135)
4	192 (1324)	593 (4088)	284 (1958)	823 (5674)	310 (2137)	940 (6480)
5	128 (882)	422 (2909)	182 (1255)	613 (4226)	208 (1434)	702 (4840)
6	96 (662)	329 (2268)	137 (944)	553 (3812)	150 (1034)	632 (4357)
8	65 (448)	260 (1792)	91 (627)	378 (2606)	100 (689)	432 (2978)
10	48 (331)	222 (1530)	68 (469)	326 (2247)	78 (538)	372 (2565)
12	49 (338)	206 (1420)	58 (400)	301 (2075)	63 (434)	344 (2372)
14	...	...	...	...	59 (407)	336 (2316)
16	...	...	...	...	59 (407)	324 (2234)

^AReference **D1527** for ABS and **D1785** for PVC.

TABLE 8 Impact Classification (IC) Cell Classification (see Test Methods **D2444)**

Nominal Pipe Size, in.	IC-0	IC-1, m·kg(ft·lb)	IC-2, m·kg(ft·lb)	IC-3, min, m·kg(ft·lb)
2	Ns ^A	9.7–12.4(70–90)	12.4–15.2(90–110)	>15.2(110)
2½	Ns	11.0–13.8(80–100)	13.8–18.0(100–130)	>18.0(130)
3	Ns	16.6–19.4(120–140)	19.4–24.9(140–180)	>24.9(180)
3½ †	Ns	18.0–22.1(130–160)	22.1–27.7(160–200)	>27.7(200)
4	Ns	22.1–27.7(160–200)	27.7–33.2(200–240)	>33.2(240)
5	Ns	24.9–30.4(180–220)	30.4–36.0(220–260)	>36.0(260)
6	Ns	27.7–36.0(200–260)	36.0–41.5(260–300)	>41.5(300)
8	Ns	36.0–41.5(260–300)	>41.5(300)	>41.5(300)
10	Ns	>41.5(300)	>41.5(300)	>41.5(300)
12, 14, 16	Ns	>41.5(300)	>41.5(300)	>41.5(300)

^ANs—Not specified.

† Value was corrected May 2006.

ANSI **B1.8** 1973

ANSI **B1.9** 1973

(Not Flush Threaded)

Screw-Threads, Standards for Federal Service 1957 Part III, Handbook H28

7.7.1 Machining flush joint threads directly into the wall of the pipe may cause difficulty in measuring the thread dimensions when the pipe is removed from the threading device. The inherent out-of-round condition of the pipe will cause the thread dimensions to conform to the irregularities of the pipe. Measurements must be taken at many points and averaged. Alternatively gages of metal or other rigid material may be used when gage dimensions or methods are available. Gages should be polished and free of all lubricants when used. The male gage should be fitted with an “O” ring of the same material, durometer, and dimensions as that specified for the manufactured product.

7.8 *Threaded Joints*—Assemble two specimens of well casing pipe, 6 ± ⅛ in. (150 ± 3 mm), together with a male and female two-piece threaded well casing pipe coupling. Solvent cement the male and female well casing pipe coupling to each specimen of well casing pipe and allow to stand for 24 h at room temperature. Apply an approved thread lubricant, specifically intended for use with the designated plastic material, to the threads of the male and female two-piece well casing pipe coupling and assemble. Subject the specimen to an internal pressure of 25 psi (170 kPa) with water as a medium, for 1 h. Should the threads be an integral part of the casing, the assembling of the coupling to the pipe shall be omitted. Examine the well casing pipe coupling joint for leakage to determine conformance to the requirements of **6.8**.

7.8.1 *Flush Threaded Joints*—Assemble the specimens of well casing, one threaded female and one threaded male with an “O” ring. No adhesives, solvents, or sealants may be used. Water only may be used, if necessary, to ensure a smooth closure. The joint should then be torqued to the maximum value to be specified for that joint pattern. Allow the joint to stand for 24 h at room temperature. Subject the specimen to an internal pressure of 25 psi (170 kPa) with water as a medium, for 1 h. Examine the well casing pipe joint for leakage to determine conformance to the requirements of **6.8**.

8. Retest and Rejection

8.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) may be conducted again in accordance with an agreement between the purchaser and the seller. In retesting, the product requirements of this specification shall be met, and the test methods designated in the specification shall be followed. If, upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

9. Product Marking

9.1 *Quality of Product Marking*—The product marking shall be applied to the pipe in such a manner that it remains legible (easily read) after installation and inspection.

9.2 Content of Product Marking:

9.2.1 *Well Casing Pipe*—The well casing pipe shall be marked at least every 5 ft (1.5 m) in letters not less than ⅜ in. (5 mm) high in a contrasting color with the following information:

9.2.1.1 Nominal well casing pipe size (for example, 2 in.),

1" x 12" x 18" 2-REQUIRED 122.4 LBS.
 3/4" x 16" x 20" 1-REQUIRED 68.0 LBS.
 3/4" TRAPEZOID SECTION 6-REQ'D. 37.4 LBS.

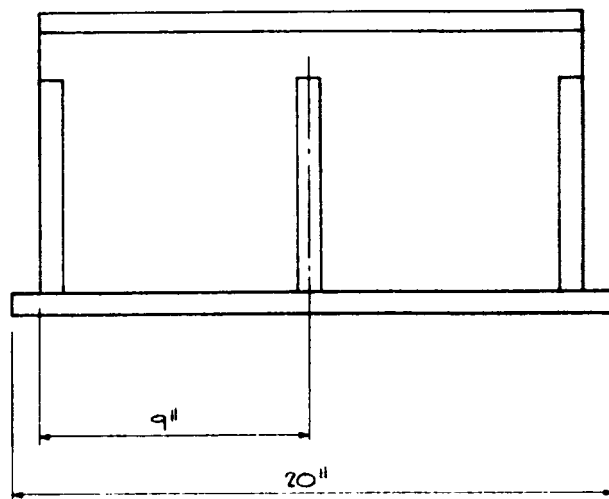
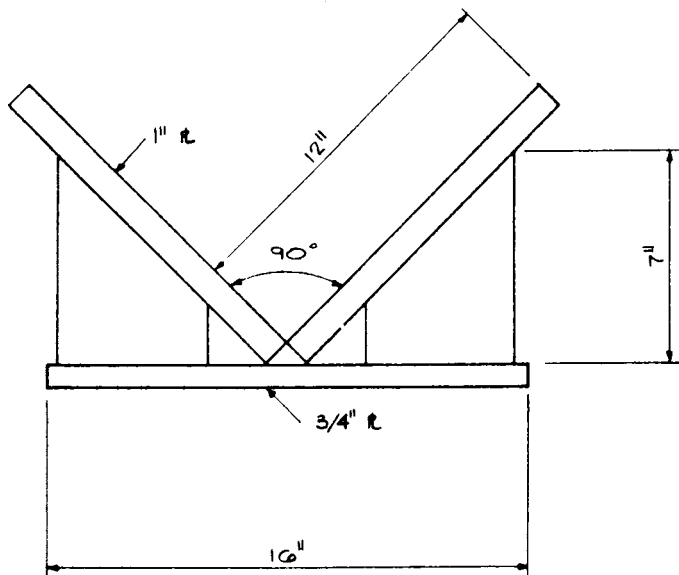
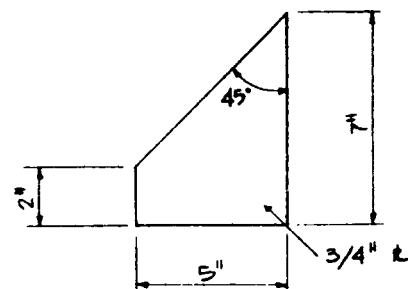


FIG. 1 V-Block Support (No Scale)
 Configuration of Tup A Impact Resistance of Thermoplastic Pipe (Test Method D2444)

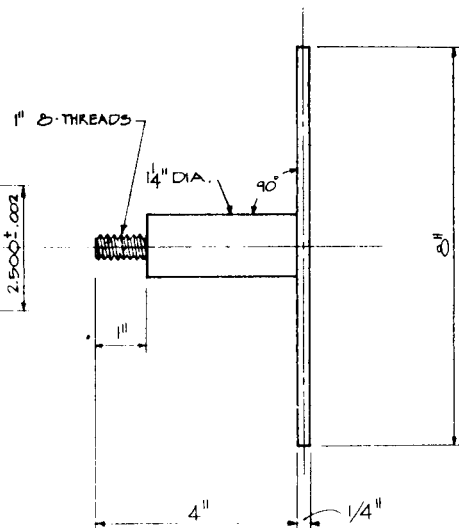
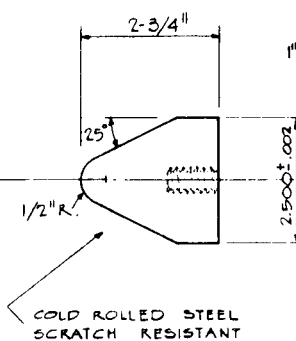
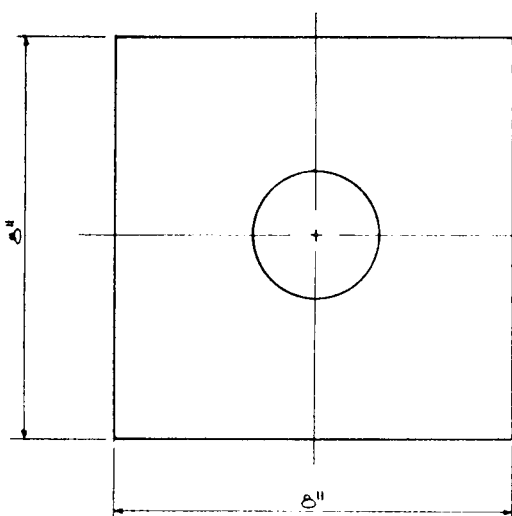


FIG. 2 Tup Test Apparatus (No Scale)

9.2.1.2 Well casing pipe standard dimension ratio, in accordance with designation code given in 3.2 (for example, SDR 17),

9.2.1.3 Type of plastic well casing pipe material (for example, ABS250, ABS350, PVC, or SR),

9.2.1.4 The wording—well casing—followed by the impact classification (for example, IC-3),

9.2.1.5 Designation ASTM F480, with which the well casing pipe complies,

9.2.1.6 Manufacturer's name (or trademark), and

9.2.1.7 Manufacturer's code for resin manufacture, lot number, and date of manufacture.

9.2.1.8 Well casing pipe intended for potable water shall also include the seal or mark of the laboratory making the

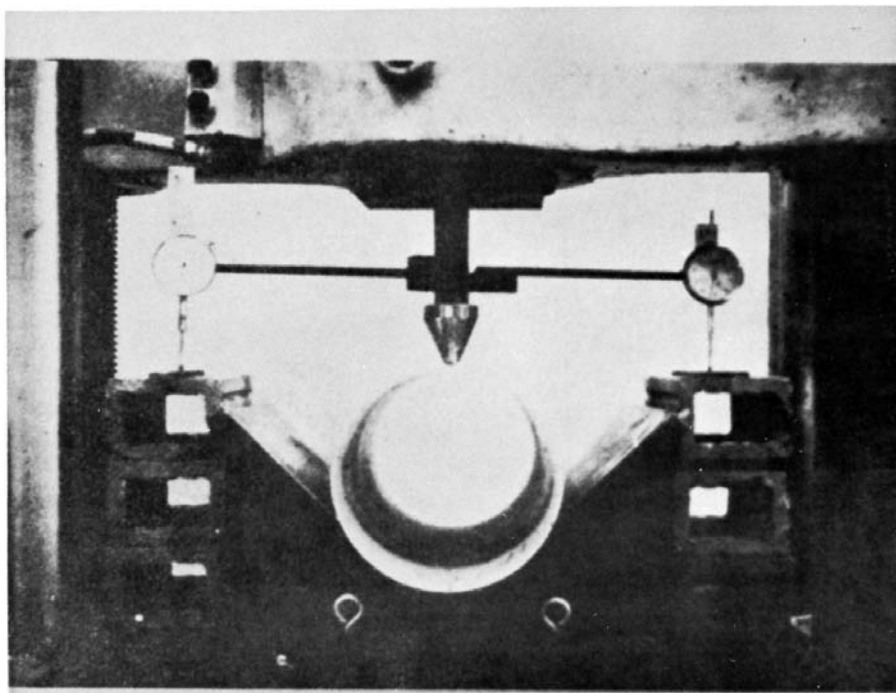


FIG. 3 Tup Test Apparatus

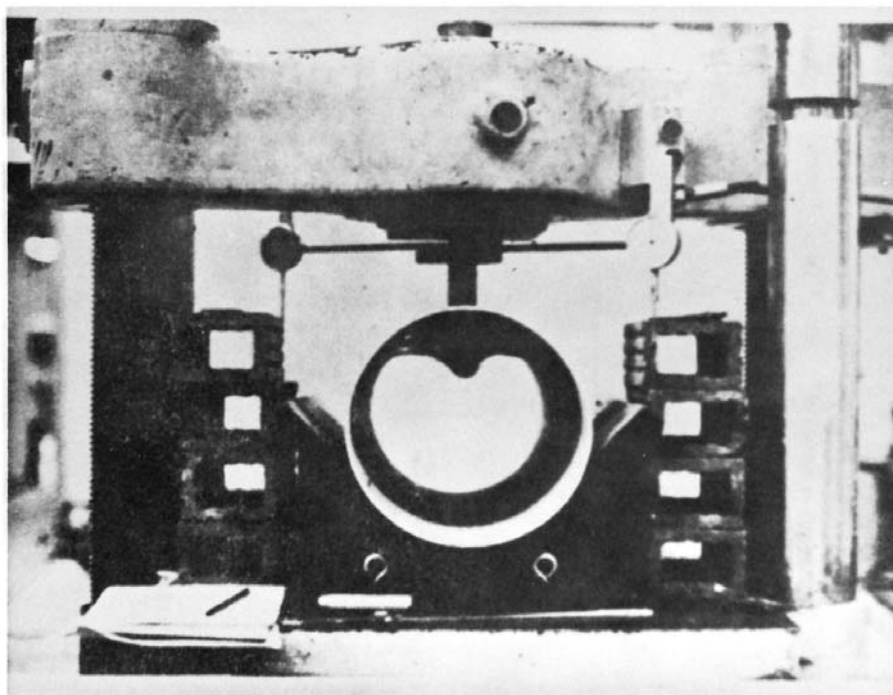


FIG. 4 Example of Specimen During Tup Test

evaluation for this purpose spaced at intervals specified by the laboratory (see Supplementary Requirements S3).

9.2.1.9 Well casing pipe intended for manufacture into screen or casing for ground water monitoring use shall not be marked with any foreign material, for example, ink, unless it can be independently proven that the marking material will not

contaminate the ground water sample or affect the subsequent analysis of the water sample for pollutants.

9.3 *Well Casing Pipe Coupling*—Well casing pipe couplings shall be marked in letters not less than $\frac{3}{16}$ in. (5 mm) high, with the following information:

9.3.1 Nominal well casing pipe coupling size (for example, 2 in.),

9.3.2 Type of plastic well casing pipe coupling material (for example, ABS250, ABS350, PVC, or SR),

9.3.3 ASTM Designation F480, with which the well casing pipe coupling complies, and

9.3.4 Manufacturer's name (or trademark).

9.3.5 Well casing pipe couplings intended for potable water shall also include the seal or mark of the laboratory making the evaluation for this purpose spaced at intervals specified by the laboratory (see Supplementary Requirements S3).

10. Quality Assurance

10.1 When the product is marked with this designation, F480, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

11. Keywords

11.1 couplings; flush thread; ground water; poly(vinyl chloride); PVC; thermoplastic; well-casing; well screen

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to federal/military procurement, not domestic sales or transfers.

S1. *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1-1—In U.S. federal contracts, the contractor is responsible for inspection.

S2. *Packaging and Marking for U.S. Government Procurement*:

S2.1 *Packaging*—Unless otherwise specified in the contract, the material shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

S2.2 *Marking*—Marking for shipment shall be in accordance with **FED-STD-123** for civil agencies and **MIL-STD-129** for military agencies.

NOTE S2-1—The inclusion of U.S. Government procurement requirements shall not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.

POTABLE WATER REQUIREMENT

This requirement applies whenever a Regulatory Authority or user calls for product to be used to convey or to be in contact with potable water.

S3. *Potable Water Requirement*—Products intended for contact with potable water shall be evaluated, tested and certified for conformance with ANSI/**NSF 61** or the health

effects portion of **NSF 14** by an acceptable certifying organization when required by the regulatory authority having jurisdiction.



ANNEXES

(Mandatory Information)

A1. PLASTIC PIPE WELL CASING SPECIALS

A1.1 To fill the needs of the water well industry, plastic pipe having a variety of sizes and wall thicknesses have been used as well casing over the past 20 years. Some of these casings were standard products, for example, Schedule 40 and 80 Iron Pipe Size (IPS) OD pipe and Plastic Irrigation Pipe (PIP) OD SDR pipe. Other products were made to special outside diameters and wall thicknesses expressly to fill the needs of various well drillers. Because the tables in this specification include only IPS-OD SDR pipe and because many of these other products have a long service history and fulfill special needs, this listing of Well Casing specials is offered in **Table A1.1** and **Table A1.2**. These well casings can be tested to verify that they meet the quality requirements in this specification by using the minimum Pipe Stiffness (PS) values in these tables and the other quality control tests in the specification.

A1.2 Other special sizes are allowed within this specification, however the material must meet the requirements of **5**. The pipe, couplings, bell-ends, or combination thereof, shall comply with the manufacturer's dimensional specifications and shall meet the calculated minimum pipe stiffness for the design/material used. For those sizes designated with an impact class, the product shall meet the requirements for the nearest sized product/material given in this specification.

TABLE A1.2 SR Well Casing Specials, in.

Nominal Size	Outside Diameter	Minimum Wall	Minimum PS
4	4.500	0.175	87
	4.500	0.200	138
	4.500	0.250	285
4½	4.886	0.200	105
	4.886	0.230	165
5	5.300	0.175	53
	5.300	0.200	79
	5.300	0.250	162
	5.300	0.320	366
5½	5.563	0.225	99
6	6.275	0.175	32
	6.275	0.200	47
	6.275	0.250	96
	6.275	0.320	216
6¾	6.625	0.250	80
	6.625	0.320	177
7	7.000	0.250	68
8¾	8.625	0.250	36

TABLE A1.1 PVC Well Casing Specials Referencing Specifications, in.

Reference Standard	Nominal Size	Outside Diameter	SDR 41			SDR 32.5		
			Minimum Wall	Minimum PS		Minimum Wall	Minimum PS	
ASAE	6	6.140	0.150	28		0.189	56	
S376	8	8.160	0.199	28		0.251	56	
and	10	10.200	0.249	28		0.314	56	
SCS	12	12.240	0.299	28		0.377	56	
430-DD	15	15.300	0.373	28		0.471	56	

										Impact Class, m·kg (ft·lb)		
Nominal Size	Outside Diameter	Tolerance on Outside Diameter	Maximum Out-of-Roundness	Minimum Wall	Minimum PS	SDR ^A	DR ^A	Schedule ^A		IC-1	IC-2	IC-3
Miscellaneous	4½	4.950	±0.010	0.045	0.190	112	26	...	...	23.5–29.0 (170–210)	29.1–34.6 (211–250)	>34.6 (>250) ^B
	...	4.950	±0.010	0.100	0.236	224	21	...	...	23.5–29.0 (170–210)	29.1–34.6 (211–250)	>34.6 (>250) ^B
	...	4.950	±0.010	0.045	0.248	268	...	...	40	23.5–29.0 (170–210)	29.1–34.6 (211–250)	>34.6 (>250) ^B
	...	4.950	±0.010	0.045	0.291	452	17	...	...	23.5–29.0 (170–210)	29.1–34.6 (211–250)	>34.6 (>250) ^B
	5	5.563	±0.010	0.100	0.190	78	...	29	...	24.9–30.4 (180–220)	30.4–36.0 (220–260)	>36.0 (>260) ^B
	6	6.625	±0.011	0.100	0.190	60	...	35	...	27.7–36.0 (200–260)	36.0–41.5 (260–300)	>41.5 (>300) ^B
	6¾	6.900	±0.011	0.100	0.250	95	...	27.6	...	28.8–36.6 (208–265)	36.6–41.5 (265–300)	>41.5 (>300) ^B
	...	6.900	±0.011	0.075	0.329	224	21	...	...	28.8–36.6 (208–265)	36.6–41.5 (265–300)	>41.5 (>300) ^B
	...	6.900	±0.011	0.075	0.406	452	17	...	...	28.8–36.6 (208–265)	36.6–41.5 (265–300)	>41.5 (>300) ^B
	7	7.000	±0.013	0.080	0.300	164	...	23	...	31.4–39.3 (227–284)	39.6–41.5 (268–300)	>41.5 (>300) ^B
	15	15.300	±0.020	0.150	0.410	38	...	37	...	NA ^C	NA	NA
	16	16.000	±0.020	0.150	0.429	38	...	37	...	NA	NA	NA

^ADimension ratios meeting the definition given in 6.2.1 are designated SDR, others as DR or Schedule 40.

^BThe test value for confirming this IC shall be at least 0.1 mg·kg (1 ft·lb) greater than the value indicated.

^CNot applicable.

A2. FLUSH THREAD DESIGN DATA FOR GROUND WATER MONITORING CASING AND SCREEN

A2.1 *Rationale*—The publication of the major revision of this specification in 1988 resulted in approaches to the responsible Subcommittee F17.61, from manufacturers of well screen and casing used primarily for ground water monitoring. The resulting task group has proposed several changes to the specification that address the needs of the ground water monitoring well construction industry. The needs of the ground water monitoring industry were surveyed through Subcommittee D18.21. This survey concluded that there was need for alternate thread patterns and more extensive testing than was originally included in F480 – 88. The basic specification is modified to more closely reflect the needs of the industry defined by the task group and the industry survey as follows:

A2.1.1 Bias, by the provision of a single flush thread design, is removed .

A2.1.2 All flush thread design data is now included in the annex (Fig. A2.1).

A2.1.3 A new standard is being written to specifically address the needs of the ground water monitoring industry for the application of thermoplastic well casing pipe. This new standard will define design and testing criteria in performance terms for the application of thermoplastic well casing pipe in ground water monitoring.

A2.2 Tables A2.1-A2.12 provide basic dimensional information for flush thread forms, (single entry with “O” ring). The performance of these designs will equal or better that specified in Section 6 of this specification. Pipe sizes larger than 12 in. have been eliminated from the tables as they are not used for ground water monitoring wells. Tolerances are included and data in SI units are added.

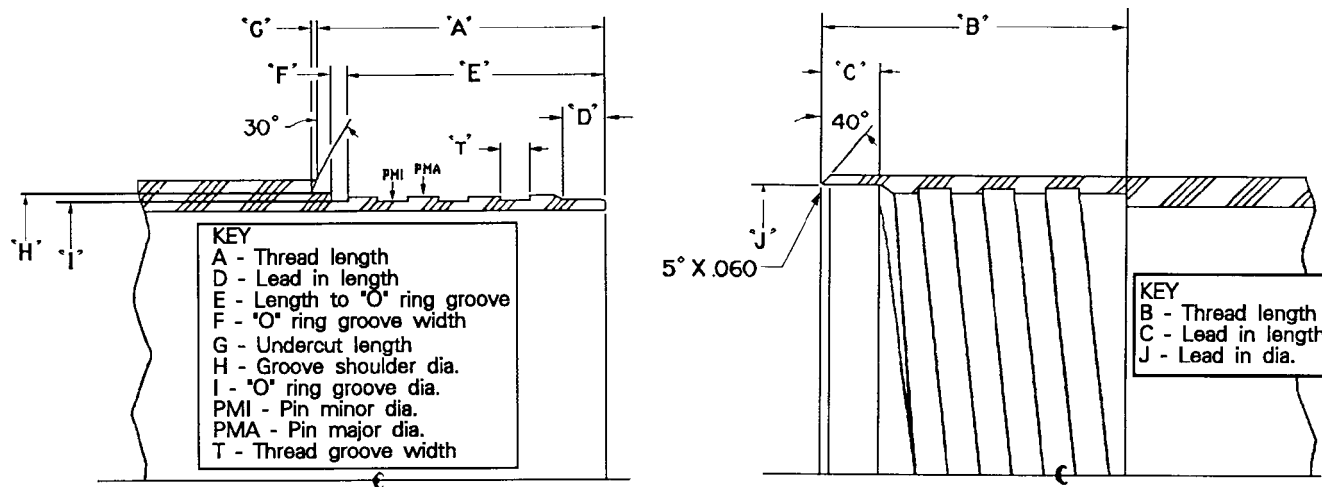


FIG. A2.1 Square Flush Thread Design

TABLE A2.1 Flush Thread Design Data (Nominal 2 Threads/in.)^A (continued in Table A2.2)

NOTE 1— For Tables A2.1-A2.4, designs incorporating alternate “O” rings and compensating dimensional changes are currently available as follows, tolerances as in the main tables:

ALTERNATE “O” RING FLUSH THREAD DESIGN DATA (Nominal 2 threads/in.)																
Schedule		Size		“O” Ring “F”			“O” Ring I			“O” Number						
40		4		0.075			4.207			045						
40		4½		0.075			4.467			047						
40		5		0.075			5.248			049						
40		6		0.075			6.302			050						
80		4		0.075			4.133			045						
80		5		0.075			5.073			047						
80		6		0.075			6.155			050						

Size S40	TPI	Thread Groove Width“ T”	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread “A”	Tolerance	Thread “B”	Tolerance
2	2	0.255	±0.003	2.239	±0.003	2.155	±0.003	2.249	±0.003	2.165	±0.003	1.500	±0.003	1.535	±0.003
2½	2	0.255	±0.003	2.729	±0.003	2.645	±0.003	2.739	±0.003	2.655	±0.003	2.375	±0.003	2.415	±0.003
3	2	0.255	±0.003	3.320	±0.003	3.236	±0.003	3.330	±0.003	3.246	±0.003	2.375	±0.003	2.420	±0.003
4	2	0.255	±0.003	4.300	±0.003	4.216	±0.003	4.310	±0.003	4.226	±0.003	2.500	±0.003	2.555	±0.003
4½	2	0.255	±0.003	4.739	±0.003	4.655	±0.003	4.749	±0.003	4.665	±0.003	2.500	±0.003	2.552	±0.003
5	2	0.255	±0.003	5.348	±0.003	5.248	±0.003	5.362	±0.003	5.262	±0.003	2.750	±0.003	2.802	±0.003
6	2	0.255	±0.003	6.393	±0.003	6.283	±0.003	6.407	±0.003	6.297	±0.002	3.000	±0.003	3.052	±0.003
8	2	0.255	±0.003	8.346	±0.003	8.226	±0.003	8.360	±0.003	8.240	±0.003	4.000	±0.003	4.070	±0.003
10	2	0.255	±0.003	10.447	±0.003	10.307	±0.003	10.463	±0.003	10.323	±0.003	4.375	±0.003	4.445	±0.003
12	2	0.255	±0.003	12.420	±0.003	12.250	±0.003	12.438	±0.003	12.268	±0.003	4.500	±0.003	4.580	±0.003

Size S40	Start “C”	Tolerance	Start “D”	Tolerance	Length “E”	Tolerance	“O” Ring Width “F”	Tolerance	Length “G”	Tolerance	Diameter “H”	Tolerance	“O” Ring Diameter “I”	Tolerance	Diameter “J”	Tolerance	“O” Ring Number
2	0.500	±0.010	0.375	±0.010	1.350	±0.010	0.075	±0.003	0.035	±0.005	2.252	±0.005	2.169	±0.002	2.285	±0.002	032
2½	0.500	±0.010	0.375	±0.010	2.225	±0.010	0.075	±0.003	0.040	±0.005	2.745	±0.005	2.645	±0.002	2.765	±0.002	036
3	0.500	±0.010	0.375	±0.010	2.225	±0.010	0.075	±0.003	0.045	±0.005	3.350	±0.005	3.245	±0.002	3.365	±0.002	041
4	0.500	±0.010	0.375	±0.010	2.350	±0.010	0.110	±0.003	0.055	±0.005	4.315	±0.005	4.184	±0.002	4.330	±0.002	151
4½	0.500	±0.010	0.375	±0.010	2.300	±0.010	0.110	±0.003	0.052	±0.005	4.770	±0.005	4.631	±0.002	4.795	±0.002	155
5	0.500	±0.010	0.375	±0.010	2.550	±0.010	0.110	±0.003	0.052	±0.005	5.380	±0.005	5.265	±0.002	5.435	±0.002	156
6	0.750	±0.010	0.500	±0.010	2.750	±0.010	0.110	±0.003	0.052	±0.005	6.445	±0.005	6.305	±0.002	6.465	±0.002	158
8	0.750	±0.010	0.500	±0.010	3.750	±0.010	0.110	±0.003	0.070	±0.005	8.385	±0.005	8.235	±0.002	8.405	±0.002	168
10	0.750	±0.010	0.750	±0.010	4.125	±0.010	0.150	±0.003	0.070	±0.005	10.510	±0.005	10.315	±0.002	10.535	±0.002	272
12 ^A	0.750	±0.010	0.750	±0.010	4.250	±0.010	0.150	±0.003	0.080	±0.005	12.470	±0.005	12.260	±0.002	12.485	±0.002	277

^ADimensions in inches. Use illustrations of thread patterns and keys as shown in Fig. A2.1.

TABLE A2.2 Flush Thread Design Data (Nominal 2 Threads/in.)^A (continued in Table A2.3)

Size S80	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread " A"	Tolerance	Thread " B"	Tolerance		
1/2	4	0.136	±0.003	0.717	±0.003	0.663	±0.003	0.723	±0.003	0.669	±0.003	0.825	±0.003	0.825	±0.003		
3/4	4	0.136	±0.003	0.920	±0.003	0.866	±0.003	0.926	±0.003	0.812	±0.003	1.125	±0.003	1.125	±0.003		
1	4	0.136	±0.003	1.159	±0.003	1.105	±0.003	1.167	±0.003	1.113	±0.003	1.125	±0.003	1.125	±0.003		
1 1/4	2	0.255	±0.003	1.507	±0.003	1.423	±0.003	1.575	±0.003	1.431	±0.003	1.500	±0.003	1.500	±0.003		
1 1/2	2	0.255	±0.003	1.737	±0.003	1.653	±0.003	1.747	±0.003	1.663	±0.003	1.500	±0.003	1.500	±0.003		
2	2	0.255	±0.003	2.164	±0.003	2.085	±0.003	2.179	±0.003	2.095	±0.003	2.000	±0.003	2.050	±0.003		
2 1/2	2	0.255	±0.003	2.644	±0.003	2.544	±0.003	2.654	±0.003	2.554	±0.003	2.375	±0.003	2.430	±0.003		
3	2	0.255	±0.003	3.250	±0.003	3.140	±0.003	3.260	±0.003	3.150	±0.003	2.375	±0.003	2.444	±0.003		
4	2	0.255	±0.003	4.213	±0.003	4.103	±0.003	4.223	±0.003	4.113	±0.003	2.500	±0.003	2.565	±0.003		
4 1/2																	
5	2	0.255	±0.003	5.183	±0.003	5.073	±0.003	5.193	±0.003	5.083	±0.003	2.750	±0.003	2.845	±0.003		
6	2	0.255	±0.003	6.255	±0.003	6.120	±0.003	6.265	±0.003	6.130	±0.003	3.000	±0.003	3.095	±0.003		
8	2	0.255	±0.003	8.193	±0.003	8.043	±0.003	8.207	±0.003	8.057	±0.003	4.000	±0.003	4.115	±0.003		
10	2	0.255	±0.003	10.250	±0.003	10.050	±0.003	10.264	±0.003	10.064	±0.003	4.375	±0.003	4.500	±0.003		
12	2	0.255	±0.003	12.175	±0.003	11.935	±0.003	12.191	±0.003	11.951	±0.003	4.500	±0.003	4.650	±0.003		
NOT APPLICABLE																	
Size S80	Start "C"	Tolerance	Start " D"	Tolerance	Length "E"	Tolerance	"O" Ring Width "F"	Tolerance	Length "G"	Tolerance	Diameter " H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter " J"	Tolerance	"O" Ring Number
1/2	0.200	±0.010	0.200	±0.010	...	...	...	...	0.020	...	...	...	0.660	±0.003	...	...	014
3/4	0.200	±0.010	0.200	±0.010	...	...	...	...	0.020	...	...	...	0.863	±0.003	...	...	016
1	0.200	±0.010	0.200	±0.010	...	...	...	...	0.020	...	...	...	1.102	±0.003	...	...	020
1 1/4	0.250	±0.010	0.250	±0.010	...	...	...	...	0.020	...	...	...	1.420	±0.003	...	...	028
1 1/2	0.250	±0.010	0.250	±0.010	...	...	...	...	0.020	...	...	...	1.650	±0.003	...	...	030
2	0.500	±0.010	0.375	±0.010	1.850	±0.010	0.075	±0.003	0.050	±0.005	2.194	±0.005	2.105	±0.002	2.225	±0.002	032
2 1/2	0.500	±0.010	0.375	±0.010	2.225	±0.010	0.075	±0.003	0.055	±0.005	2.685	±0.005	2.570	±0.002	2.700	±0.002	036
3	0.500	±0.010	0.375	±0.010	2.225	±0.010	0.075	±0.003	0.065	±0.005	3.275	±0.005	3.150	±0.002	3.282	±0.002	041
4	0.500	±0.010	0.375	±0.010	2.350	±0.010	0.120	±0.003	0.065	±0.005	4.281	±0.005	4.113	±0.002	4.296	±0.002	155
4 1/2																	
5	0.650	±0.010	0.500	±0.010	2.550	±0.010	0.150	±0.003	0.095	±0.005	5.225	±0.005	5.070	±0.002	5.298	±0.002	242
6	0.750	±0.010	0.750	±0.010	2.750	±0.010	0.150	±0.003	0.095	±0.005	6.295	±0.005	6.120	±0.002	6.316	±0.002	251
8	0.750	±0.010	0.750	±0.010	3.750	±0.010	0.150	±0.003	0.115	±0.005	8.229	±0.005	8.048	±0.002	8.244	±0.002	262
10	0.750	±0.010	0.750	±0.010	4.125	±0.010	0.150	±0.003	0.125	±0.005	10.295	±0.005	10.110	±0.002	10.310	±0.002	270
12 ^A	0.750	±0.010	0.750	±0.010	4.250	±0.010	0.150	±0.003	0.150	±0.005	12.220	±0.005	12.035	±0.002	12.235	±0.002	276

^ADimensions in inches. Use illustrations of thread patterns and keys as shown in Fig. A2.1.

TABLE A2.3 Flush Thread Design Data (Nominal 2 Threads/in.) SI units^A (continued in Table A2.4)

Size S40	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread "A"	Tolerance	Thread "B"	Tolerance	Start "C"
2	2	6.48	±0.08	56.87	±0.08	54.74	±0.08	57.12	±0.08	54.99	±0.08	38.1	±0.08	38.99	±0.08	12.70
2 1/2	2	6.48	±0.08	69.32	±0.08	67.18	±0.08	69.57	±0.08	67.44	±0.08	60.33	±0.08	61.34	±0.08	12.70
3	2	6.48	±0.08	84.33	±0.08	82.19	±0.08	84.58	±0.08	82.47	±0.08	60.33	±0.08	61.47	±0.08	12.70
4	2	6.48	±0.08	109.22	±0.08	107.09	±0.08	109.47	±0.08	107.34	±0.08	63.50	±0.08	64.90	±0.08	12.70
4 1/2	2	6.48	±0.08	120.37	±0.08	118.24	±0.08	120.62	±0.08	118.49	±0.08	63.50	±0.08	64.82	±0.08	12.70
5	2	6.48	±0.08	135.84	±0.08	133.30	±0.08	136.19	±0.08	133.65	±0.08	69.85	±0.08	71.17	±0.08	12.70
6	2	6.48	±0.08	162.38	±0.08	159.59	±0.08	162.74	±0.08	159.94	±0.08	76.20	±0.08	77.52	±0.08	19.05
8	2	6.48	±0.08	211.99	±0.08	208.94	±0.08	212.34	±0.08	209.30	±0.08	101.60	±0.08	103.38	±0.08	19.05
10	2	6.48	±0.08	265.35	±0.08	261.80	±0.08	265.76	±0.08	303.50	±0.08	111.13	±0.08	112.90	±0.08	19.05
12	2	6.48	±0.08	315.47	±0.08	311.15	±0.08	315.93	±0.08	311.61	±0.08	114.30	±0.08	116.33	±0.08	19.05
Size S40	Tolerance	Start "D"	Tolerance	Length "E"	Tolerance	"O" Ring Width "F"	Tolerance	Length "G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter "J"	Tolerance	"O" Ring Number
2	±0.25	9.53	±0.25	34.29	±0.25	1.91	±0.08	0.89	±0.13	57.20	±0.13	55.09	±0.05	58.04	±0.05	032
2 1/2	±0.25	9.53	±0.25	56.52	±0.25	1.91	±0.08	1.02	±0.13	69.72	±0.13	67.18	±0.05	70.23	±0.05	036
3	±0.25	9.53	±0.25	56.52	±0.25	1.91	±0.08	1.14	±0.13	85.09	±0.13	82.42	±0.05	85.47	±0.05	041
4	±0.25	9.53	±0.25	59.69	±0.25	2.79	±0.08	1.40	±0.13	109.60	±0.13	106.27	±0.05	109.98	±0.05	151
4 1/2	±0.25	9.53	±0.25	58.42	±0.25	2.79	±0.08	1.32	±0.13	121.16	±0.13	117.63	±0.05	121.87	±0.05	155
5	±0.25	9.53	±0.25	64.77	±0.25	2.79	±0.08	1.32	±0.13	136.65	±0.13	133.73	±0.05	138.05	±0.05	156
6	±0.25	12.70	±0.25	69.85	±0.25	2.79	±0.08	1.32	±0.13	163.70	±0.13	160.15	±0.05	164.21	±0.05	158
8	±0.25	12.70	±0.25	95.25	±0.25	2.79	±0.08	1.78	±0.13	212.98	±0.13	209.17	±0.05	213.49	±0.05	168
10	±0.25	19.05	±0.25	104.78	±0.25	3.81	±0.08	1.78	±0.13	266.95	±0.13	262.00	±0.05	267.59	±0.05	272
12 ^A	±0.25	19.05	±0.25	107.95	±0.25	3.81	±0.08	2.03	±0.13	316.74	±0.13	311.40	±0.05	317.12	±0.05	277

^ADimensions in millimetres. Use illustrations of thread patterns and keys as shown in Fig. A2.1.

TABLE A2.4 Flush Thread Design Data (Nominal 2 Threads/in.) SI units^A

Size S80	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread "A"	Tolerance	Thread "B"	Tolerance	Start "C"
1/2	4	3.45	±0.08	18.21	±0.08	16.84	±0.08	18.42	±0.08	16.99	±0.08	20.96	±0.08	20.96	±0.08	5.08
3/4	4	3.45	±0.08	23.37	±0.08	22.00	±0.08	23.52	±0.08	20.62	±0.08	28.58	±0.08	28.58	±0.08	5.08
1	4	3.45	±0.08	29.44	±0.08	28.07	±0.08	29.64	±0.08	28.27	±0.08	28.58	±0.08	28.58	±0.08	5.08
1 1/4	2	6.48	±0.08	38.28	±0.08	36.14	±0.08	40.00	±0.08	36.35	±0.08	38.10	±0.08	38.10	±0.08	6.35
1 1/2	2	6.48	±0.08	44.12	±0.08	41.99	±0.08	44.37	±0.08	42.24	±0.08	38.10	±0.08	38.10	±0.08	6.35
2	2	6.48	±0.08	54.97	±0.08	52.96	±0.08	55.35	±0.08	53.21	±0.08	50.80	±0.08	52.07	±0.08	12.70
2 1/2	2	6.48	±0.08	67.16	±0.08	64.62	±0.08	67.41	±0.08	64.87	±0.08	60.33	±0.08	61.72	±0.08	12.70
3	2	6.48	±0.08	82.55	±0.08	79.76	±0.08	82.80	±0.08	80.01	±0.08	60.33	±0.08	62.08	±0.08	12.70
4	2	6.48	±0.08	107.01	±0.08	104.22	±0.08	107.26	±0.08	104.47	±0.08	63.50	±0.08	65.15	±0.08	12.70
4 1/2								NOT APPLICABLE								
5	2	6.48	±0.08	131.65	±0.08	128.85	±0.08	131.90	±0.08	129.11	±0.08	69.85	±0.08	72.26	±0.08	16.51
6	2	6.48	±0.08	158.88	±0.08	155.45	±0.08	159.13	±0.08	155.70	±0.08	76.20	±0.08	78.61	±0.08	19.05
8	2	6.48	±0.08	208.10	±0.08	204.29	±0.08	208.46	±0.08	204.65	±0.08	101.60	±0.08	104.52	±0.08	19.05
10	2	6.48	±0.08	260.35	±0.08	255.27	±0.08	260.71	±0.08	255.63	±0.08	111.13	±0.08	114.30	±0.08	19.05
12	2	6.48	±0.08	309.25	±0.08	303.15	±0.08	309.65	±0.08	305.56	±0.08	114.30	±0.08	118.11	±0.08	19.05
Size S80	Tolerance	Start "D"	Tolerance	Length "E"	Tolerance	"O" Ring Width "F"	Tolerance	Length "G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter "J"	Tolerance	"O" Ring Number
1/2	±0.25	5.08	±0.25	...	...	...	...	0.51	...	...	...	16.76	±0.08	...	...	014
3/4	±0.25	5.08	±0.25	...	...	...	...	0.51	...	...	...	21.92	±0.08	...	...	016
1	±0.25	5.08	±0.25	...	...	...	...	0.51	...	...	...	27.99	±0.08	...	...	020
1 1/4	±0.25	6.35	±0.25	...	...	...	...	0.51	...	...	...	36.07	±0.08	...	...	028
1 1/2	±0.25	6.35	±0.25	...	...	...	...	0.51	...	...	...	41.91	±0.08	...	...	030
2	±0.25	12.70	±0.25	46.99	±0.25	1.91	±0.08	1.27	±0.13	55.73	±0.13	53.47	±0.05	56.52	±0.05	032
2 1/2	±0.25	12.70	±0.25	56.52	±0.25	1.91	±0.08	1.40	±0.13	68.20	±0.13	65.28	±0.05	68.58	±0.05	036
3	±0.25	12.70	±0.25	56.52	±0.25	1.91	±0.08	1.65	±0.13	83.19	±0.13	80.01	±0.05	83.36	±0.05	041
4	±0.25	12.70	±0.25	59.69	±0.25	3.05	±0.08	1.65	±0.13	108.74	±0.13	104.47	±0.05	109.12	±0.05	155
4 1/2								NOT APPLICABLE								
5	±0.25	16.51	±0.25	64.77	±0.25	3.81	±0.08	2.41	±0.13	132.72	±0.13	128.78	±0.05	134.57	±0.05	242
6	±0.25	19.05	±0.25	69.85	±0.25	3.81	±0.08	2.41	±0.13	159.89	±0.13	155.45	±0.05	160.43	±0.05	251
8	±0.25	19.05	±0.25	95.25	±0.25	3.81	±0.08	2.92	±0.13	209.02	±0.13	204.42	±0.05	209.40	±0.05	262
10	±0.25	19.05	±0.25	104.78	±0.25	3.81	±0.08	3.18	±0.13	261.49	±0.13	256.79	±0.05	261.87	±0.05	270
12 ^A	±0.25	19.05	±0.25	107.95	±0.25	3.81	±0.08	3.81	±0.13	310.39	±0.13	305.69	±0.05	310.77	±0.05	276

^ADimensions in millimetres. Use illustrations of thread patterns and keys as shown in Fig. A2.1.

TABLE A2.5 Flush Thread Design Data (Nominal 4 Threads/in.)^A (continued in Table A2.6)

Size S40	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread "A"	Tolerance	Thread "B"	Tolerance	Start "C"
1	8	0.070	+0.004 -0.002	1.200	±0.003	1.150	±0.003	1.210	±0.003	1.160	±0.003	1.000	+0.000 -0.010	1.000	+0.010 -0.000	0.200
1¼	8	0.070	+0.004 -0.002	1.530	±0.003	1.470	±0.003	1.545	±0.003	1.485	±0.003	1.250	+0.000 -0.010	1.250	+0.010 -0.000	0.250
1½	4	0.130	+0.000 -0.002	1.775	+0.000 -0.003	1.715	+0.000 -0.003	1.790	+0.003 -0.000	1.730	+0.003 -0.000	1.625	+0.000 -0.002	1.625	+0.002 -0.000	0.250
2	4	0.130	+0.000 -0.002	2.243	+0.000 -0.005	2.187	+0.000 -0.005	2.255	+0.005 -0.000	2.200	+0.005 -0.000	1.690	+0.000 -0.002	1.690	+0.002 -0.000	0.375
2½	4	0.130	+0.000 -0.002	2.722	+0.000 -0.005	2.622	+0.000 -0.005	2.737	+0.005 -0.000	2.637	+0.005 -0.000	2.375	+0.000 -0.005	2.375	+0.005 -0.000	0.580
3	4	0.130	+0.000 -0.002	3.310	+0.000 -0.005	3.220	+0.000 -0.005	3.330	+0.005 -0.000	3.240	+0.005 -0.000	2.375	+0.000 -0.005	2.375	+0.005 -0.000	0.588
4	4	0.130	+0.000 -0.002	4.312	+0.000 -0.005	4.181	+0.000 -0.005	4.332	+0.005 -0.000	4.208	+0.005 -0.000	2.500	+0.000 -0.002	2.500	+0.002 -0.000	0.625
4½	4	0.130	+0.000 -0.002	4.711	+0.000 -0.005	4.580	+0.000 -0.005	4.731	+0.005 -0.000	4.600	+0.005 -0.000	2.500	+0.000 -0.005	2.500	+0.005 -0.000	0.625
5	4	0.130	+0.000 -0.002	5.341	+0.000 -0.005	5.249	+0.000 -0.005	5.361	+0.005 -0.000	5.269	+0.005 -0.000	2.955	+0.000 -0.005	2.955	+0.005 -0.000	0.641
6	3	0.165	+0.000 -0.002	6.357	+0.000 -0.005	6.227	+0.000 -0.005	6.392	+0.005 -0.000	6.262	+0.005 -0.000	3.000	+0.000 -0.010	3.000	+0.010 -0.000	0.625
Size S40	Tolerance	Start "D"	Tolerance	Length "E"	Tolerance	"O" Ring Width "F"	Tolerance	Length "G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter "J"	Tolerance	"O" Ring
1	±0.005	0.187	±0.005	0.880	±0.005	0.070	±0.003	NA ^B	NA	NA	NA	1.140	±0.003	1.220	±0.001	018
1¼	±0.005	0.187	±0.005	1.130	±0.005	0.070	±0.003	NA	NA	NA	NA	1.465	±0.003	1.565	±0.001	024
1½	±0.005	0.250	±0.005	1.482	±0.005	0.070	±0.003	NA	NA	NA	NA	1.716	±0.003	1.815	+0.002 -0.000	026
2	±0.005	0.250	±0.005	1.505	±0.005	0.080	±0.003	0.030	+0.000 -0.005	NA	NA	2.172	±0.001	2.280	+0.002 -0.000	032
2½	±0.005	0.437	±0.005	2.125	±0.005	0.125	±0.003	0.044	+0.000 -0.005	NA	NA	2.590	±0.001	2.757	+0.002 -0.000	145
3	±0.005	0.437	±0.005	2.125	±0.005	0.125	±0.003	0.055	+0.000 -0.005	NA	NA	3.195	±0.001	3.350	+0.002 -0.000	140
4	±0.005	0.437	±0.005	2.250	±0.005	0.125	±0.003	0.050	+0.000 -0.005	NA	NA	4.199	±0.001	4.350	+0.002 -0.000	151
4½	±0.005	0.437	±0.005	2.250	±0.005	0.125	±0.003	0.069	+0.000 -0.005	NA	NA	4.590	±0.001	4.750	+0.002 -0.000	153
5	±0.005	0.466	±0.005	2.700	±0.005	0.125	±0.003	0.064	+0.000 -0.005	NA	NA	5.214	±0.001	5.380	+0.002 -0.000	158
6 ^A	±0.005	0.500	±0.005	2.750	±0.005	0.125	±0.003	NA	NA	NA	NA	6.230	±0.002	6.415	+0.004 -0.000	163

^ADimensions in inches. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

TABLE A2.6 Flush Thread Design Data (Nominal 4 Threads/in.)^A (continued in Table A2.7)

Size S80	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread "A"	Tolerance	Thread "B"	Tolerance	Start "C"
1/2	8	0.070	+0.004 -0.002	0.715	+0.000 -0.003	0.655	+0.000 -0.003	0.725	+0.003 -0.000	0.665	+0.003 -0.000	0.800	+0.000 -0.003	0.800	+0.002 -0.000	0.250
3/4	8	0.070	+0.004 -0.002	0.918	±0.002	0.857	±0.002	0.933	±0.002	0.870	±0.002	1.000	+0.000 -0.010	1.000	+0.010 -0.000	0.250
1	8	0.070	+0.004 -0.002	1.200	±0.003	1.150	±0.003	1.210	±0.003	1.160	±0.003	1.000	+0.000 -0.010	1.000	+0.010 -0.000	0.200
1 1/4	8	0.070	+0.004 -0.002	1.530	±0.003	1.470	±0.003	1.545	±0.003	1.485	±0.003	1.250	+0.000 -0.010	1.250	+0.010 -0.000	0.250
1 1/2	4	0.130	+0.000 -0.002	1.775	+0.000 -0.003	1.715	+0.000 -0.003	1.790	+0.003 -0.000	1.730	+0.003 -0.000	1.625	+0.000 -0.002	1.625	+0.002 -0.000	0.250
2	4	0.130	+0.000 -0.002	2.243	+0.000 -0.005	2.187	+0.000 -0.005	2.255	+0.005 -0.000	2.200	+0.005 -0.000	1.690	+0.000 -0.002	1.690	+0.002 -0.000	0.375
2 1/2	4	0.130	+0.000 -0.002	2.722	+0.000 -0.005	2.622	+0.000 -0.005	2.737	+0.005 -0.000	2.637	+0.005 -0.000	2.375	+0.000 -0.005	2.375	+0.005 -0.000	0.580
3	4	0.130	+0.000 -0.002	3.310	+0.000 -0.005	3.220	+0.000 -0.005	3.330	+0.005 -0.000	3.240	+0.005 -0.000	2.375	+0.000 -0.005	2.375	+0.005 -0.000	0.588
4	4	0.130	+0.000 -0.002	4.312	+0.000 -0.005	4.181	+0.000 -0.005	4.332	+0.005 -0.000	4.208	+0.005 -0.000	2.500	+0.000 -0.002	2.500	+0.002 -0.000	0.625
4 1/2	NOT APPLICABLE															
5	4	0.130	+0.000 -0.002	5.341	+0.000 -0.005	5.249	+0.000 -0.005	5.361	+0.005 -0.000	5.269	+0.005 -0.000	2.955	+0.000 -0.005	2.955	+0.005 -0.000	0.641
6	3	0.163	+0.010 -0.002	6.357	+0.000 -0.005	6.227	+0.000 -0.005	6.392	+0.005 -0.000	6.262	+0.005 -0.000	3.000	+0.000 -0.010	3.000	+0.010 -0.000	0.625
Size S80	Tolerance	Start "D"	Tolerance	Length "E"	Tolerance	"O" Ring Width "F"	Tolerance	Length "G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter "J"	Tolerance	"O" Ring
1/2	±0.005	0.187	±0.005	0.685	±0.005	0.070	±0.003	NA ^B	NA	NA	NA	0.647	±0.002	0.725	±0.002 -0.000	013
3/4	±0.005	0.187	±0.005	0.895	±0.005	0.070	±0.003	NA	NA	NA	NA	0.852	±0.002	0.945	±0.001	016
1	±0.005	0.187	±0.005	0.880	±0.005	0.070	±0.003	NA	NA	NA	NA	1.140	±0.003	1.220	±0.001	018
1 1/4	±0.005	0.187	±0.005	1.130	±0.005	0.070	±0.003	NA	NA	NA	NA	1.465	±0.003	1.565	±0.001	024
1 1/2	±0.005	0.250	±0.005	1.482	±0.005	0.070	±0.003	NA	NA	NA	NA	1.716	±0.003	1.815	+0.002 -0.000	026
2	±0.005	0.250	±0.005	1.505	±0.005	0.080	±0.003	0.030	+0.000 -0.005	NA	NA	2.172	±0.001	2.280	+0.002 -0.000	032
2 1/2	±0.005	0.437	±0.005	2.125	±0.005	0.125	±0.003	0.044	+0.000 -0.005	NA	NA	2.590	±0.001	2.757	+0.002 -0.000	145
3	±0.005	0.437	±0.005	2.125	±0.005	0.125	±0.003	0.055	+0.000 -0.005	NA	NA	3.195	±0.001	3.350	+0.002 -0.000	140
4	±0.005	0.437	±0.005	2.250	±0.005	0.125	±0.003	0.050	+0.000 -0.005	NA	NA	4.199	±0.001	4.350	+0.002 -0.000	151
4 1/2	NOT APPLICABLE															
5	±0.005	0.466	±0.005	2.700	±0.005	0.125	±0.003	0.064	+0.000 -0.005	NA	NA	5.214	±0.001	5.380	+0.002 -0.000	158
6 ^A	±0.005	0.500	±0.005	2.750	±0.005	0.125	±0.003	NA	NA	NA	NA	6.230	±0.002	6.415	+0.004 -0.000	163

^ADimensions in inches. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

TABLE A2.7 Flush Thread Design Data (Nominal 4 Threads/in.) SI units^A (continued in Table A2.8)

Size S40	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread "A"	Tolerance	Thread "B"	Tolerance	Start "C"
1	8	1.79	+0.10 -0.05	30.48	±0.08	29.21	±0.08	30.73	±0.08	29.46	±0.08	25.40	+0.00 -0.25	25.40	+0.25 -0.00	5.08
1¼	8	1.79	+0.10 -0.05	38.86	±0.08	37.34	±0.08	39.24	±0.08	37.72	±0.08	31.75	+0.00 -0.25	31.75	+0.25 -0.00	6.35
1½	4	3.30	+0.00 -0.05	45.09	+0.00 -0.08	43.56	+0.00 -0.08	45.47	+0.08 -0.00	43.94	+0.08 -0.00	41.28	+0.00 -0.05	41.28	+0.05 -0.00	6.35
2	4	3.30	+0.00 -0.05	56.97	+0.00 -0.13	55.55	+0.00 -0.13	57.28	+0.13 -0.00	55.88	+0.13 -0.00	41.91	+0.00 -0.05	41.91	+0.05 -0.00	9.53
2½	4	3.30	+0.00 -0.05	69.14	+0.00 -0.13	66.60	+0.00 -0.13	69.52	+0.13 -0.00	66.98	+0.13 -0.00	60.33	+0.00 -0.13	60.33	+0.13 -0.00	14.73
3	4	3.30	+0.00 -0.05	84.07	+0.00 -0.13	81.79	+0.00 -0.13	84.58	+0.13 -0.00	82.30	+0.13 -0.00	60.33	+0.00 -0.13	60.33	+0.13 -0.00	14.95
4	4	3.30	+0.00 -0.05	109.52	+0.00 -0.13	106.20	+0.00 -0.13	110.03	+0.13 -0.00	106.88	+0.13 -0.00	63.50	+0.00 -0.13	63.50	+0.13 -0.00	15.89
4½	4	3.30	+0.00 -0.05	119.66	+0.00 -0.13	116.33	+0.00 -0.13	120.17	+0.13 -0.00	116.84	+0.13 -0.00	63.50	+0.00 -0.13	63.50	+0.13 -0.00	15.89
5	4	3.30	+0.00 -0.05	136.66	+0.00 -0.13	133.33	+0.00 -0.13	136.17	+0.13 -0.00	133.83	+0.13 -0.00	75.06	+0.00 -0.13	75.06	+0.13 -0.00	16.28
6	3	4.19	+0.00 -0.05	161.47	+0.00 -0.13	158.17	+0.00 -0.13	162.36	+0.13 -0.00	159.06	+0.13 -0.00	76.20	+0.00 -0.25	76.20	+0.25 -0.00	15.89
Size S40	Tolerance	Start "D"	Tolerance	Length "E"	Tolerance	"O" Ring Width "F"	Tolerance	Length "G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter "J"	Tolerance	"O" Number
1	±0.13	4.75	±0.13	22.35	±0.13	1.78	±0.08	NA ^B	NA	NA	NA	28.96	±0.08	30.99	±0.03	018
1¼	±0.13	4.75	±0.13	28.70	±0.13	1.78	±0.08	NA	NA	NA	NA	37.21	±0.08	39.75	±0.03	024
1½	±0.13	6.35	±0.13	37.64	±0.13	1.78	±0.08	NA	NA	NA	NA	43.59	±0.08	46.10	+0.05 -0.00	026
2	±0.13	6.35	±0.13	38.23	±0.13	2.03	±0.08	0.76	+0.00 -0.13	NA	NA	55.17	±0.03	57.91	+0.05 -0.00	032
2½	±0.13	11.10	±0.13	53.98	±0.13	3.18	±0.08	1.12	+0.00 -0.13	NA	NA	65.79	±0.03	70.03	+0.05 -0.00	145
3	±0.13	11.10	±0.13	53.98	±0.13	3.18	±0.08	1.40	+0.00 -0.13	NA	NA	81.15	±0.03	85.09	+0.05 -0.00	140
4	±0.13	11.10	±0.13	57.15	±0.13	3.18	±0.08	1.27	+0.00 -0.13	NA	NA	106.65	±0.03	110.49	+0.05 -0.00	151
4½	±0.13	11.10	±0.13	57.15	±0.13	3.18	±0.08	1.75	+0.00 -0.13	NA	NA	116.59	±0.03	120.65	+0.05 -0.00	153
5	±0.13	11.84	±0.13	68.58	±0.13	3.18	±0.08	1.63	+0.00 -0.13	NA	NA	132.44	±0.03	136.65	+0.05 -0.00	158
6 ^A	±0.13	12.7	±0.13	69.85	±0.13	3.18	±0.08	NA	NA	NA	NA	158.24	±0.05	162.94	+0.10 -0.00	163

^ADimensions in millimetres. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

TABLE A2.8 Flush Thread Design Data (Nominal 4 Threads/in.) SI units^A

Size S80	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread "A"	Tolerance	Thread "B"	Tolerance	Start "C"
½	8	1.79	+0.10 -0.05	18.16	±0.00 -0.08	16.64	+0.00 -0.08	18.42	+0.08 -0.00	16.89	+0.08 -0.00	20.32	+0.00 -0.08	20.32	+0.05 -0.00	6.35
¾	8	1.79	+0.10 -0.05	23.32	±0.05	21.77	±0.05	23.70	±0.05	22.10	±0.05	25.40	+0.00 -0.25	25.40	+0.25 -0.00	6.35
1	8	1.79	+0.10 -0.05	30.48	±0.08	29.21	±0.08	30.73	±0.08	29.46	±0.08	25.40	+0.00 -0.25	25.40	+0.25 -0.00	5.08
1¼	8	1.79	+0.10 -0.05	38.86	±0.08	37.34	±0.08	39.24	±0.08	37.72	±0.08	31.75	+0.00 -0.25	31.75	+0.25 -0.00	6.35
1½	4	3.30	+0.00 -0.05	45.09	+0.00 -0.08	43.56	+0.00 -0.08	45.47	+0.08 -0.00	43.94	+0.08 -0.00	41.28	+0.00 -0.05	41.28	+0.05 -0.00	6.35
2	4	3.30	+0.00 -0.05	56.97	+0.00 -0.13	55.55	+0.00 -0.13	57.28	+0.13 -0.00	55.88	+0.13 -0.00	41.91	+0.00 -0.05	41.91	+0.05 -0.00	9.53
2½	4	3.30	+0.00 -0.05	69.14	+0.00 -0.13	66.60	+0.00 -0.13	69.52	+0.13 -0.00	66.98	+0.13 -0.00	60.33	+0.00 -0.13	60.33	+0.13 -0.00	14.73
3	4	3.30	+0.00 -0.05	84.07	+0.00 -0.13	81.79	+0.00 -0.13	84.58	+0.13 -0.00	82.30	+0.13 -0.00	60.33	+0.00 -0.13	60.33	+0.13 -0.00	14.95
4	4	3.30	+0.00 -0.05	109.52	+0.00 -0.13	106.20	+0.00 -0.13	110.03	+0.13 -0.00	106.88	+0.13 -0.00	63.50	+0.00 -0.13	63.50	+0.13 -0.00	15.89
4	4	3.30	+0.00 -0.05	119.66	+0.00 -0.13	116.33	+0.00 -0.13	120.17	+0.13 -0.00	116.84	+0.13 -0.00	63.50	+0.00 -0.13	63.50	+0.13 -0.00	15.89
5	4	3.30	+0.00 -0.05	136.66	+0.00 -0.13	133.33	+0.00 -0.13	136.17	+0.13 -0.00	133.83	+0.13 -0.00	75.06	+0.00 -0.13	75.06	+0.13 -0.00	16.28
6	3	4.19	+0.00 -0.05	161.47	+0.00 -0.13	158.17	+0.00 -0.13	162.36	+0.13 -0.00	159.06	+0.13 -0.00	76.20	+0.00 -0.25	76.20	+0.25 -0.00	15.89
Size S80	Tolerance	Start "D"	Tolerance	Length "E"	Tolerance	"O" Ring Width "F"	Tolerance	Length "G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter "J"	Tolerance	"O" Number
½	±0.13	4.75	±0.13	17.40	±0.13	1.78	±0.08	NA ^B	NA	NA	NA	16.44	±0.05	18.42	+0.05 -0.00	013
¾	±0.13	4.75	±0.13	22.73	±0.13	1.78	±0.08	NA	NA	NA	NA	21.64	±0.05	24.00	±0.03	016
1	±0.13	4.75	±0.13	22.35	±0.13	1.78	±0.08	NA	NA	NA	NA	28.96	±0.08	30.99	±0.03	018
1¼	±0.13	4.75	±0.13	28.70	±0.13	1.78	±0.08	NA	NA	NA	NA	37.21	±0.08	39.75	±0.03	024
1½	±0.13	6.35	±0.13	37.64	±0.13	1.78	±0.08	NA	NA	NA	NA	43.59	±0.08	46.10	+0.05 -0.00	026
2	±0.13	6.35	±0.13	38.23	±0.13	2.03	±0.08	0.76	+0.00 -0.13	NA	NA	55.17	±0.03	57.91	+0.05 -0.00	032
2½	±0.13	11.10	±0.13	53.98	±0.13	3.18	±0.08	1.12	+0.00 -0.13	NA	NA	65.79	±0.03	70.03	+0.05 -0.00	145
3	±0.13	11.10	±0.13	53.98	±0.13	3.18	±0.08	1.40	+0.00 -0.13	NA	NA	81.15	±0.03	85.09	+0.05 -0.00	140
4	±0.13	11.10	±0.13	57.15	±0.13	3.18	±0.08	1.27	+0.00 -0.13	NA	NA	106.65	±0.03	110.49	+0.05 -0.00	151
4½	NOT APPLICABLE															
5	±0.13	11.84	±0.13	68.58	±0.13	3.18	±0.08	1.63	+0.00 -0.13	NA	NA	132.44	±0.03	136.65	+0.05 -0.00	158
6 ^A	±0.13	12.70	±0.13	69.85	±0.13	3.18	±0.08	NA	NA	NA	NA	158.24	±0.05	162.94	+0.10 -0.00	163

^ADimensions in millimetres. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

TABLE A2.9 Flush Thread Design Data (Nominal 8 Threads/in.)^A (continued in Table A2.10)

Size S40	TPI	Thread Groove Width "T"	Toler- ance	Pin Major Diameter	Toler- ance	Pin Minor Diameter	Toler- ance	Box Major Diameter	Toler- ance	Box Minor Diameter	Toler- ance	Thread " A"	Toler- ance	Thread " B"	Toler- ance		
1/2	8	0.082	+0.005 -0.003	0.750	±0.002	0.690	±0.002	0.760	±0.002	0.700	±0.002	1.000	±0.002	1.050	±0.002		
3/4	8	0.082	+0.005 -0.003	0.950	±0.002	0.890	±0.002	0.965	±0.002	0.905	±0.002	1.000	±0.002	1.050	±0.002		
1	8	0.082	+0.005 -0.003	1.200	±0.002	1.105	±0.002	1.215	±0.002	1.124	±0.002	1.000	±0.002	1.050	±0.002		
1 1/4	8	0.082	+0.005 -0.003	1.545	±0.002	1.570	±0.002	1.570	±0.002	1.475	±0.002	1.000	±0.002	1.050	±0.002		
1 1/2	8	0.082	+0.005 -0.003	1.770	±0.002	1.670	±0.002	1.785	±0.002	1.685	±0.002	1.125	±0.002	1.175	±0.002		
2	8	0.082	+0.005 -0.003	2.250	±0.002	2.160	±0.002	2.272	±0.002	2.182	±0.002	1.250	±0.002	1.300	±0.002		
2 1/2	8	0.082	+0.005 -0.003	2.722	±0.002	2.600	±0.002	2.730	±0.002	2.615	±0.002	1.250	±0.002	1.300	±0.002		
3	8	0.082	+0.005 -0.003	3.306	±0.002	3.182	±0.002	3.325	±0.002	3.204	±0.002	1.500	±0.002	1.550	±0.002		
4	8	0.082	+0.005 -0.003	4.306	±0.002	4.186	±0.002	4.325	±0.002	4.208	±0.002	1.875	±0.002	1.925	±0.002		
4 1/2	8	0.082	+0.005 -0.003	4.730	±0.002	4.605	±0.002	4.750	±0.002	4.628	±0.002	1.875	±0.002	1.925	±0.002		
5	8	0.082	+0.005 -0.003	5.310	±0.002	5.190	±0.002	5.340	±0.002	5.220	±0.002	2.250	±0.002	2.300	±0.002		
6	8	0.082	+0.005 -0.003	6.360	±0.002	6.235	±0.002	6.385	±0.002	6.265	±0.002	2.500	±0.002	2.550	±0.002		
8	4	0.130	+0.005 -0.003	8.346	±0.002	8.224	±0.002	8.362	±0.002	8.242	±0.002	4.075	±0.002	4.150	±0.002		
10	4	0.130	+0.005 -0.003	10.447	±0.002	10.307	±0.002	10.465	±0.002	10.325	±0.002	4.375	±0.002	4.450	±0.002		
12	4	0.130	+0.005 -0.003	12.420	±0.002	12.250	±0.002	12.440	±0.002	12.268	±0.002	4.555	±0.002	4.630	±0.002		
Size S40	Start "C"	Toler- ance	Start " D"	Toler- ance	Length " E"	Toler- ance	"O" Ring Width "F"	Toler- ance	Length " G"	Toler- ance	Diameter "H"	Toler- ance	"O" Ring Diameter "I"	Toler- ance	Diameter " J"	Toler- ance	"O" Number
1/2	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA ^B	NA	0.750	±0.002	NA	NA	0.760	±0.002	016
3/4	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA	NA	0.950	±0.002	0.870	±0.002	0.965	±0.002	019
1	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA	NA	1.200	±0.002	1.110	±0.002	1.215	±0.002	024
1 1/4	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA	NA	1.545	±0.002	1.455	±0.002	1.570	±0.002	028
1 1/2	0.250	±0.002	0.250	±0.002	0.830	±0.002	0.095	±0.002	NA	NA	1.770	±0.002	1.685	±0.002	1.795	±0.002	030
2	0.500	±0.002	0.250	±0.002	0.955	±0.002	0.095	±0.002	NA	NA	2.250	±0.002	2.165	±0.002	2.272	±0.002	033
2 1/2	0.250	±0.002	0.250	±0.002	0.955	±0.002	0.095	±0.002	NA	NA	2.722	±0.002	2.630	±0.002	2.730	±0.002	037
3	0.250	±0.002	0.250	±0.002	1.205	±0.002	0.095	±0.002	NA	NA	3.306	±0.002	3.220	±0.002	3.325	±0.002	041
4	0.500	±0.002	0.250	±0.002	1.580	±0.002	0.095	±0.002	NA	NA	4.306	±0.002	4.228	±0.002	4.325	±0.002	045
4 1/2	0.250	±0.002	0.250	±0.002	1.580	±0.002	0.095	±0.002	NA	NA	4.730	±0.002	4.640	±0.002	4.750	±0.002	045
5	0.250	±0.002	0.250	±0.002	1.955	±0.002	0.095	±0.002	NA	NA	5.310	±0.002	5.250	±0.002	5.340	±0.002	046
6	0.250	±0.002	0.250	±0.002	1.805	±0.002	0.095	±0.002	NA	NA	6.360	±0.002	6.290	±0.002	6.385	±0.002	050
8	0.750	±0.002	0.500	±0.002	3.900	±0.002	0.110	±0.002	NA	NA	8.346	±0.002	8.235	±0.002	8.362	±0.002	168
10	0.750	±0.002	0.500	±0.002	4.200	±0.002	0.130	±0.002	NA	NA	10.447	±0.002	10.315	±0.002	10.465	±0.002	272
12 ^A	0.750	±0.002	0.500	±0.002	4.380	±0.002	0.130	±0.002	NA	NA	12.420	±0.002	12.260	±0.002	12.440	±0.002	277

^ADimensions in inches. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

TABLE A2.10 Square Flush Thread Design Data (Nominal 8 Threads/in.)^A (continued in Table A2.11)

Size S80	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread " A"	Tolerance	Thread " B"	Tolerance			
1/2	8	0.082	+0.005 -0.003	0.750	±0.002	0.650	±0.002	0.775	±0.002	0.675	±0.002	1.000	±0.002	1.050	±0.002			
3/4	8	0.082	+0.005 -0.003	0.947	±0.002	0.827	±0.002	0.965	±0.002	0.845	±0.002	1.000	±0.002	1.050	±0.002			
1	8	0.082	+0.005 -0.003	1.200	±0.002	1.075	±0.002	1.215	±0.002	1.092	±0.002	1.000	±0.002	1.050	±0.002			
1 1/4	8	0.082	+0.005 -0.003	1.545	±0.002	1.425	±0.002	1.565	±0.002	1.445	±0.002	1.000	±0.002	1.050	±0.002			
1 1/2	8	0.082	+0.005 -0.003	1.745	±0.002	1.625	±0.002	1.765	±0.002	1.645	±0.002	1.125	±0.002	1.175	±0.002			
2	8	0.082	+0.005 -0.003	2.188	±0.002	2.066	±0.002	2.200	±0.002	2.080	±0.002	1.250	±0.002	1.300	±0.002			
2 1/2	8	0.082	+0.005 -0.003	2.626	±0.002	2.502	±0.002	2.645	±0.002	2.522	±0.002	1.250	±0.002	1.300	±0.002			
3	8	0.082	+0.005 -0.003	3.238	±0.002	3.115	±0.002	3.245	±0.002	3.122	±0.002	1.500	±0.002	1.550	±0.002			
4	8	0.082	+0.005 -0.003	4.206	±0.002	4.084	±0.002	4.225	±0.002	4.100	±0.002	1.875	±0.002	1.925	±0.002			
4 1/2	8	0.082	+0.005 -0.003	5.230	±0.002	5.105	NOT APPLICABLE				5.255	±0.002	5.135	±0.002	2.250	±0.002	2.300	±0.002
5	8	0.082	+0.005 -0.003	6.184	±0.002	6.060	±0.002	6.215	±0.002	6.095	±0.002	2.500	±0.002	2.550	±0.002			
6	8	0.082	+0.005 -0.003	8.193	±0.002	8.043	±0.002	8.057	±0.002	8.207	±0.002	4.075	±0.002	4.150	±0.002			
8	4	0.130	+0.005 -0.003	10.250	±0.002	10.048	±0.002	10.265	±0.002	10.066	±0.002	4.475	±0.002	4.550	±0.002			
10	4	0.130	+0.005 -0.003	12.175	±0.002	11.935	±0.002	12.190	±0.002	11.950	±0.002	4.575	±0.002	4.650	±0.002			
12	4	0.130	+0.005 -0.003															
Size S80	Start "C"	Tolerance	Start " D"	Tolerance	Length " E"	Tolerance	"O" Ring Width "F"	Tolerance	Length " G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter " J"	Tolerance	"O" Number	
1/2	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA ^B	NA	0.750	±0.002	0.648	NA	0.775	±0.002	016	
3/4	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA	NA	0.947	±0.002	0.820	±0.002	0.965	±0.002	019	
1	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA	NA	1.200	±0.002	1.070	±0.002	1.215	±0.002	024	
1 1/4	0.250	±0.002	0.250	±0.002	0.705	±0.002	0.095	±0.002	NA	NA	1.545	±0.002	1.420	±0.002	1.565	±0.002	028	
1 1/2	0.250	±0.002	0.250	±0.002	0.830	±0.002	0.095	±0.002	NA	NA	1.745	±0.002	1.625	±0.002	1.765	±0.002	030	
2	0.500	±0.002	0.250	±0.002	0.955	±0.002	0.095	±0.002	NA	NA	2.188	±0.002	2.060	±0.002	2.200	±0.002	033	
2 1/2	0.250	±0.002	0.250	±0.002	0.955	±0.002	0.095	±0.002	NA	NA	2.626	±0.002	2.500	±0.002	2.645	±0.002	037	
3	0.250	±0.002	0.250	±0.002	1.205	±0.002	0.095	±0.002	NA	NA	3.238	±0.002	3.110	±0.002	3.245	±0.002	041	
4	0.500	±0.002	0.250	±0.002	1.580	±0.002	0.095	±0.002	NA	NA	4.206	±0.002	4.080	±0.002	4.225	±0.002	045	
4 1/2	0.250	±0.002	0.250	±0.002	1.955	±0.002	0.095	±0.002	NOT APPLICABLE									
5	0.250	±0.002	0.250	±0.002	2.205	±0.002	0.095	±0.002	NA	NA	5.230	±0.002	5.100	±0.002	5.255	±0.002	046	
6	0.250	±0.002	0.250	±0.002	2.205	±0.002	0.095	±0.002	NA	NA	6.184	±0.002	6.060	±0.002	6.215	±0.002	050	
8	0.750	±0.002	0.500	±0.002	3.900	±0.002	0.130	±0.002	NA	NA	8.193	±0.002	8.050	±0.002	8.057	±0.002	262	
10	0.750	±0.002	0.500	±0.002	4.300	±0.002	0.130	±0.002	NA	NA	10.250	±0.002	10.110	±0.002	10.260	±0.002	270	
12 ^A	0.750	±0.002	0.500	±0.002	4.400	±0.002	0.130	±0.002	NA	NA	12.175	±0.002	12.035	±0.002	12.190	±0.002	276	

^ADimensions in inches. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

TABLE A2.11 Flush Thread Design Data (Nominal 8 Threads/in.) SI units^A (continued in Table A2.12)

Size S40	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread " A"	Tolerance	Thread " B"	Tolerance		
1/2	8	2.08	+0.13 -0.08	19.05	±0.05	17.53	±0.05	19.30	±0.05	17.78	±0.05	25.40	±0.05	26.67	±0.05		
3/4	8	2.08	+0.13 -0.08	24.13	±0.05	22.61	±0.05	24.51	±0.05	22.99	±0.05	25.40	±0.05	26.67	±0.05		
1	8	2.08	+0.13 -0.08	30.48	±0.05	28.07	±0.05	30.86	±0.05	28.55	±0.05	25.40	±0.05	26.67	±0.05		
1¼	8	2.08	+0.13 -0.08	39.74	±0.05	36.71	±0.05	39.88	±0.05	37.47	±0.05	25.40	±0.05	26.67	±0.05		
1½	8	2.08	+0.13 -0.08	44.96	±0.05	42.42	±0.05	45.34	±0.05	42.80	±0.05	28.58	±0.05	29.85	±0.05		
2	8	2.08	+0.13 -0.08	57.28	±0.05	54.81	±0.05	57.71	±0.05	55.42	±0.05	31.75	±0.05	33.02	±0.05		
2½	8	2.08	+0.13 -0.08	69.14	±0.05	66.05	±0.05	69.34	±0.05	66.42	±0.05	31.75	±0.05	33.02	±0.05		
3	8	2.08	+0.13 -0.08	83.97	±0.05	80.83	±0.05	84.46	±0.05	81.38	±0.05	38.10	±0.05	39.37	±0.05		
4	8	2.08	+0.13 -0.08	109.37	±0.05	106.34	±0.05	109.86	±0.05	106.88	±0.05	47.63	±0.05	48.90	±0.05		
4½	8	2.08	+0.13 -0.08	120.14	±0.05	116.98	±0.05	120.65	±0.05	117.55	±0.05	47.63	±0.05	48.90	±0.05		
5	8	2.08	+0.13 -0.08	134.87	±0.05	131.83	±0.05	135.64	±0.05	132.59	±0.05	57.15	±0.05	58.42	±0.05		
6	8	2.08	+0.13 -0.08	161.54	±0.05	158.37	±0.05	162.18	±0.05	159.13	±0.05	63.50	±0.05	64.47	±0.05		
8	4	3.30	+0.13 -0.08	211.99	±0.05	208.89	±0.05	212.41	±0.05	209.35	±0.05	103.51	±0.05	105.41	±0.05		
10	4	3.30	+0.13 -0.08	265.35	±0.05	261.80	±0.05	265.81	±0.05	262.26	±0.05	111.13	±0.05	113.03	±0.05		
12	4	3.30	+0.13 -0.08	315.47	±0.05	311.15	±0.05	315.98	±0.05	311.61	±0.05	115.72	±0.05	117.60	±0.05		
Size S40	Start "C"	Tolerance	Start " D"	Tolerance	Length " E"	Tolerance	"O" Ring Width "F"	Tolerance	Length " G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter " J"	Tolerance	"O" Number
1/2	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA ^B	NA	19.05	±0.05	NA	NA	19.30	±0.05	016
3/4	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA	NA	24.13	±0.05	22.10	±0.05	24.51	±0.05	019
1	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA	NA	30.48	±0.05	28.19	±0.05	30.86	±0.05	024
1¼	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA	NA	39.24	±0.05	36.96	±0.05	39.88	±0.05	028
1½	6.35	±0.05	6.35	±0.05	20.40	±0.05	2.41	±0.05	NA	NA	44.96	±0.05	42.80	±0.05	45.34	±0.05	030
2	6.35	±0.05	6.35	±0.05	24.26	±0.05	2.41	±0.05	NA	NA	57.15	±0.05	54.99	±0.05	57.71	±0.05	033
2½	6.35	±0.05	6.35	±0.05	24.26	±0.05	2.41	±0.05	NA	NA	69.27	±0.05	66.80	±0.05	69.34	±0.05	037
3	6.35	±0.05	6.35	±0.05	30.61	±0.05	2.41	±0.05	NA	NA	83.97	±0.05	81.79	±0.05	84.46	±0.05	041
4	6.35	±0.05	6.35	±0.05	40.13	±0.05	2.41	±0.05	NA	NA	109.37	±0.05	107.39	±0.05	109.86	±0.05	045
4½	6.35	±0.05	6.35	±0.05	40.13	±0.05	2.41	±0.05	NA	NA	120.14	±0.05	117.86	±0.05	120.65	±0.05	045
5	6.35	±0.05	6.35	±0.05	49.66	±0.05	2.41	±0.05	NA	NA	134.87	±0.05	133.35	±0.05	135.64	±0.05	046
6	6.35	±0.05	6.35	±0.05	56.01	±0.05	2.41	±0.05	NA	NA	161.54	±0.05	159.77	±0.05	162.18	±0.05	050
8	19.05	±0.05	12.70	±0.05	99.06	±0.05	2.79	±0.05	NA	NA	211.99	±0.05	209.17	±0.05	212.41	±0.05	168
10	19.05	±0.05	12.70	±0.05	106.68	±0.05	3.30	±0.05	NA	NA	265.35	±0.05	262.00	±0.05	265.81	±0.05	272
12 ^A	19.05	±0.05	12.70	±0.05	111.25	±0.05	3.30	±0.05	NA	NA	315.47	±0.05	311.40	±0.05	315.98	±0.05	277

^ADimensions in inches. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

TABLE A2.12 Flush Thread Design Data (Nominal 8 Threads/in.) SI units⁴

Size S80	TPI	Thread Groove Width "T"	Tolerance	Pin Major Diameter	Tolerance	Pin Minor Diameter	Tolerance	Box Major Diameter	Tolerance	Box Minor Diameter	Tolerance	Thread " A"	Tolerance	Thread " B"	Tolerance		
1/2	8	2.08	+0.13 -0.08	19.05	±0.05	16.51	±0.05	19.65	±0.05	17.15	±0.05	25.40	±0.05	26.67	±0.05		
3/4	8	2.08	+0.13 -0.08	24.05	±0.05	21.01	±0.05	24.51	±0.05	21.46	±0.05	25.40	±0.05	26.67	±0.05		
1	8	2.08	+0.13 -0.08	30.48	±0.05	27.31	±0.05	30.86	±0.05	27.74	±0.05	25.40	±0.05	26.67	±0.05		
1 1/4	8	2.08	+0.13 -0.08	39.24	±0.05	36.20	±0.05	39.75	±0.05	36.70	±0.05	25.40	±0.05	26.67	±0.05		
1 1/2	8	2.08	+0.13 -0.08	44.32	±0.05	41.28	±0.05	44.83	±0.05	41.78	±0.05	28.58	±0.05	29.85	±0.05		
2	8	2.08	+0.13 -0.08	55.58	±0.05	52.48	±0.05	55.88	±0.05	52.83	±0.05	31.75	±0.05	33.02	±0.05		
2 1/2	8	2.08	+0.13 -0.08	66.70	±0.05	63.55	±0.05	67.18	±0.05	64.06	±0.05	31.75	±0.05	33.02	±0.05		
3	8	2.08	+0.13 -0.08	82.25	±0.05	79.12	±0.05	82.42	±0.05	79.30	±0.05	38.10	±0.05	39.37	±0.05		
4	8	2.08	+0.13 -0.08	106.63	±0.05	102.82	±0.05	108.08	±0.05	104.14	±0.05	47.63	±0.05	48.90	±0.05		
4 1/2				NOT APPLICABLE													
5	8	2.08	+0.13 -0.08	132.84	±0.05	129.67	±0.05	133.48	±0.05	130.43	±0.05	57.15	±0.05	58.42	±0.05		
6	8	2.08	+0.13 -0.08	157.07	±0.05	153.92	±0.05	157.86	±0.05	154.81	±0.05	63.50	±0.05	64.77	±0.05		
8	4	3.30	+0.13 -0.08	208.10	±0.05	204.29	±0.05	204.65	±0.05	210.06	±0.05	103.51	±0.05	105.41	±0.05		
10	4	3.30	+0.13 -0.08	260.35	±0.05	255.22	±0.05	260.73	±0.05	255.68	±0.05	113.67	±0.05	115.57	±0.05		
12	4	3.30	+0.13 -0.08	309.25	±0.05	303.15	±0.05	309.63	±0.05	303.53	±0.05	116.22	±0.05	118.11	±0.05		
Size S80	Start "C"	Tolerance	Start " D"	Tolerance	Length " E"	Tolerance	"O" Ring Width "F"	Tolerance	Length " G"	Tolerance	Diameter "H"	Tolerance	"O" Ring Diameter "I"	Tolerance	Diameter " J"	Tolerance	"O" Number
1/2	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA ^B	NA	19.05	±0.05	16.46	±0.05	19.69	±0.05	016
3/4	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA	NA	24.05	±0.05	20.83	±0.05	24.51	±0.05	019
1	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA	NA	30.98	±0.05	27.18	±0.05	30.86	±0.05	024
1 1/4	6.35	±0.05	6.35	±0.05	17.91	±0.05	2.41	±0.05	NA	NA	39.24	±0.05	36.07	±0.05	39.75	±0.05	028
1 1/2	6.35	±0.05	6.35	±0.05	21.08	±0.05	2.41	±0.05	NA	NA	44.32	±0.05	41.28	±0.05	44.83	±0.05	030
2	6.35	±0.05	6.35	±0.05	24.26	±0.05	2.41	±0.05	NA	NA	55.88	±0.05	52.32	±0.05	55.88	±0.05	033
2 1/2	6.35	±0.05	6.35	±0.05	24.26	±0.05	2.41	±0.05	NA	NA	66.70	±0.05	63.50	±0.05	67.18	±0.05	037
3	6.35	±0.05	6.35	±0.05	30.61	±0.05	2.41	±0.05	NA	NA	82.55	±0.05	78.99	±0.05	82.42	±0.05	041
4	6.35	±0.05	6.35	±0.05	40.13	±0.05	2.41	±0.05	NA	NA	106.83	±0.05	103.63	±0.05	107.32	±0.05	045
4 1/2					NOT APPLICABLE												
5	6.35	±0.05	6.35	±0.05	49.66	±0.05	2.41	±0.05	NA	NA	132.84	±0.05	129.54	±0.05	132.48	±0.05	046
6	6.35	±0.05	6.35	±0.05	56.01	±0.05	2.41	±0.05	NA	NA	207.87	±0.05	153.92	±0.05	157.86	±0.05	050
8	19.05	±0.05	12.70	±0.05	99.06	±0.05	3.30	±0.05	NA	NA	208.10	±0.05	204.47	±0.05	204.65	±0.05	262
10	19.05	±0.05	12.70	±0.05	109.22	±0.05	3.30	±0.05	NA	NA	260.35	±0.05	256.79	±0.05	260.73	±0.05	270
12 ^A	19.05	±0.05	12.70	±0.05	111.76	±0.05	3.30	±0.05	NA	NA	309.25	±0.05	305.69	±0.05	309.63	±0.05	276

⁴Dimensions in millimetres. Use illustrations of thread patterns and keys as shown in Fig. A2.1.^BNot applicable.

APPENDIXES

(Nonmandatory Information)

X1. STORAGE, HANDLING, AND ASSEMBLY PROCEDURES FOR THERMOPLASTIC WATER WELL CASING PIPE AND COUPLINGS MADE IN STANDARD DIMENSION RATIOS (SDR)

X1.1 *Storage*—Do not store well casing pipe and well casing pipe couplings in direct sunlight for long periods. Store well casing pipe in such a manner as to prevent sagging or bending.

X1.2 *Field Inspection*—Well casing pipe should be carefully inspected for cuts, gouges, deep scratches, damaged ends, and other major imperfections before use. Defective well casing pipe should be rejected.

X1.3 Solvent Cement—Use solvent cements meeting the requirements of the specification for the material used. The solvent cement should provide sufficient open time for making good joints and connections but joints should be completed immediately upon applying solvent cement.

X1.4 Socket Fit—Well casing pipe and well casing pipe couplings are manufactured to close tolerances. Close tolerances are required to ensure satisfactory “interference” fit between well casing pipe and well casing pipe coupling during the solvent cement joining. Use only well casing pipe and well casing pipe coupling combinations that give interference fits. Well casing pipe loose in the socket may not properly bond. The allowable tolerances ensure a forced fit and when solvent is applied will readily mate, this ensuring a chemical fusion equal in strength to well casing pipe and well casing pipe coupling. In the dry joint, the pipe should enter the socket to between one half and two thirds of the socket depth by hand. Attempting to correct a loose fit after assembly by additional cement may result in an unsatisfactory joint.

X1.5 Joining Technique:

X1.5.1 Cutting

Well casing pipe can be easily cut with an ordinary hacksaw or carpenter’s saw. Fine-tooth blades with little or no set should be used for best results. The well casing pipe should be cut square and all burrs removed with a sharp knife, a fine-tooth file, or other suitable device. A miter box is useful to ensure square cut ends. Standard steel pipe or tubing cutters are not recommended for cutting well casing pipe since they might cause excessive heat and pressures that can result in cracked or irregular ends. There are special cutters available with extra-wide rollers and thin cutting wheels which have been designated for cutting plastic pipe.

X1.5.2 Cleaning

Remove burrs and wipe off all dust, dirt, and moisture from surfaces to be cemented. Chemical or mechanical cleaners may be used, but the recommendation of the manufacturer should be followed.

X1.5.3 Primers

Primers should be used where necessary to soften and dissolve the surface of the well casing pipe and coupling to form a continuous bond between the mating surfaces and shall be used when recommended by the solvent cement manufacturer.

X1.5.4 Application of Cement

Using an ordinary brush with a width of one half the pipe diameter, or the brush supplied with the can of solvent cement, first apply a moderate even coating of cement in the well casing pipe coupling covering the well casing pipe joining surfaces only. Heavy or excess applications of cement may become an obstruction inside the well casing pipe. Quickly apply cement to the outside of the well casing pipe. Make sure that the coated distance on the well casing pipe is equal to the depth of the well casing pipe coupling socket.

X1.5.5 Assembly

Make the joint as quickly as possible after application of the cement and before the cement dries. Should the cement dry partially before the joint is made up, reapply cement before assembling. Insert the well casing pipe into the well casing pipe coupling socket, turning the well casing pipe to ensure even distribution of cement. Make sure that the well casing pipe is inserted to the full depth of the well casing pipe coupling socket. Remove excess solvent cement from the exterior of the joint with a clean, dry cloth. Do not attempt to disturb the well casing pipe coupling joint until after the cement has set; damage to the joint and loss of fit may result. Allow sufficient time for the joint to develop good handling strength. Larger diameter water well casing pipe should be assembled by using commercially available plastic pipe joiners to draw the water well casing pipe and coupling together ensuring the proper bottoming of the water well casing pipe with the coupling.

X1.5.6 Handle newly assembled joints carefully until initial set has taken place. Recommended setting time allowed before handling or moving is related to temperature. After initial set, the joints will withstand the stresses of a normal installation. A badly misaligned installation will cause excessive stresses in the joint, pipe, and fittings.

X1.5.7 Cure Time Before Press Testing

Joint strength development is very rapid during the first 48 h. Short cure periods are satisfactory for high-ambient temperatures with low humidity and interference-type fittings. Longer cure periods are necessary for low temperatures, large pipe sizes, loose fits, and relatively high humidity.

X1.5.8 Safety Requirements

Follow Practice **F402**.

X1.6 Well Casing Pipe Coupling:

X1.6.1 Threaded Water Well Casing Pipe Couplings

Molded or formed threads are permitted. Use only approved thread lubricant specifically intended for use with the designated plastic material used.

X1.6.2 Connection to Nonplastic Water Well Screens

When connecting plastic water well casing pipe to nonplastic water well screens, use only approved types of well casing pipe couplings designated for the specific transition intended.

X1.6.3 Thread Tightness

When a threaded joint is made, obtain tightness with a strap wrench not to exceed one full turn.

X1.7 Installation—It is recommended that installation be in accordance with the Manual of Recommended Water Well Construction Standards prepared by the National Water Well Association for the United States Environmental Protection Agency.

X1.8 Thermal Expansion—Allow for thermal expansion and movement in all piping installation by the use of expansion joints when deemed necessary.

X2. CONSIDERATIONS FOR USE OF THERMOPLASTIC WATER WELL CASING PIPE IN SDR RATIOS

X2.1 General—Thermoplastic materials are being used successfully as casing pipe for water wells. They offer many advantages to the user such as non-corrosion, resistance to micro- and macro-biological attack, light weight, competitive price, and approval for potable water use.

X2.2 Collapsing Pressure⁸—Thermoplastic materials have the ability to withstand collapsing pressure under external load. The ability of the thermoplastic material to withstand an external load is influenced by the following:

- (1) The physical properties of the casing material,
- (2) The ratio of diameter to wall thickness referred to as Standard Dimension Ratio (SDR),
- (3) The amount of ovality and eccentricity in the casing pipe, and
- (4) The magnitude and nature of the residual stress present in the casing pipe.

Of these four factors the physical properties of the material and the SDR ratios are used in arriving at the collapsing pressure the material will withstand. The modulus of elasticity of the material is important design information: typical values are 300 000 psi (2.07 GPa) for SR; 250 000 to 350 000 psi (1.72 to 2.41 GPa) for ABS; and 400 000 psi (2.76 GPa) for PVC.

X2.2.1 Many wells are drilled by the use of drilling mud to hold the hole from collapsing while the hole is being drilled. While the casing is being set, either water or drilling mud is allowed to fill the inside of the casing to equalize pressures. After the screen is set, the well is usually brought in with compressed air. Compressed air fed into the well casing reduces the specific gravity of the fluid inside the casing causing the liquid to rise out of the well. The difference in specific gravity between the inside fluid and outside fluid causes a collapsing pressure to be placed upon the casing. The faster the rate at which air is fed into the casing, the greater the difference in specific gravity of the two fluids and the greater the collapsing pressure. Since the drilling mud on the outside of the casing is in a near liquid state, it is possible to calculate the short-term critical collapse pressure of an unsupported thermoplastic water well casing pipe by the following equation:

$$P_c = \frac{2E}{1-\mu^2} \times \frac{1}{\frac{d}{t} \left(\frac{d}{t} - 1 \right)^2} \quad (\text{X2.1})$$

or

$$P_c = \frac{2E}{1-\mu^2} \times \frac{1}{\text{SDR}(\text{SDR} - 1)^2}$$

where:

- P_c = critical collapse pressure, psi,
 E = modulus of elasticity, psi,
 μ = Poisson's ratio,
 d = outside diameter of the well casing pipe, in.,
 t = wall thickness of the well casing pipe, in., and
 SDR = standard dimension ratio.

X2.3 Sample Calculation—Calculate the critical collapse of an unsupported nominal 6-in. SDR17 well casing pipe made from PVC with a modulus of elasticity of 400 000 psi (2.76 GPa) and assume a Poisson's ratio of 0.38.⁹

$$P_c = \frac{2E}{1-\mu^2} \times \frac{1}{\text{SDR}(\text{SDR} - 1)^2} \quad (\text{X2.2})$$

$$P_c = \frac{2 \times 400\,000}{1 - 0.38^2} \times \frac{1}{17(17 - 1)^2}$$

$$P_c = \frac{800\,000}{0.8556} \times \frac{1}{4352}$$

$$P_c = 935016.4 \times 0.0002298$$

$$P_c = 214.85 \text{ psi}$$

X2.4 Displacing the mud around the outside of the well casing pipe with gravel, concrete, or other solid filler will give support to the well casing pipe and resistance to collapse. The reason for this is that as soon as the diameter of the well casing pipe starts to decrease at any point initiating a collapse, the diameter at right angle to this diameter must increase and, since this increase is prevented by the support material on the outside of the well casing pipe, the well casing pipe does not collapse. The ultimate resistance to collapse is obtained when the filler around the well casing pipe firmly holds the well casing pipe from getting out of round. Therefore, it is important that the packing material be carefully selected and the method of packing be performed with care.

X2.5 Depth of Use—The depth at which thermoplastic water well casing can be placed is a design judgment. Thermoplastic water well casing pipe has been placed over 2000 ft (609.6 m) deep, but the water level inside the well casing pipe is less than 100 ft (30.5 m) from the surface.

X2.5.1 For the nominal 6-in. SDR17 well casing pipe used in the sample, calculation indicates a maximum difference of hydrostatic pressure of 215 psi (1483 kPa) or a head of 496 ft (151 m). Thus, a well casing with packing to support the casing and prevent deformation will allow greater depth as long as the pump down or head differential is within the design limits. The restraint offered by the soil to deflection of the well casing pipe makes use at greater depths practical.

X2.5.2 For the 6-in. SDR17 SR well casing pipe used in the sample calculation, a water or fluid level outside the casing that

⁸ Clinedinst, W. O., "A Rational Expression for the Critical Collapsing Pressure of Pipe Under External Pressure," *API Drill and Prod. Practice*, 1939, pp. 383–391.

⁹ McLean, Jasper T., "Determination of Poisson's Ratio," *Proceedings of the 27th Annual Meeting of American Society of Testing and Materials*, Vol 24, 1924, Part II, p. 1012.

is more than 496 ft (151 m) higher than the level inside the casing (215-psi (1483-kPa)) maximum hydrostatic pressure) could result in collapse of the casing if there is no earth or

gravel or concrete packing around it. On the other hand, casing with gravel or concrete packing can operate with almost unlimited head differential.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F480–06b^{e1}) that may impact the use of this standard.

(I) Revised relative humidity tolerance in 7.2.

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