



# Standard Specification for Cold-Expansion Fittings With Metal Compression-Sleeves for Cross-Linked Polyethylene (PEX) Pipe<sup>1</sup>

This standard is issued under the fixed designation F2080; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

<sup>ε1</sup> NOTE—The alignment in Figures 1 and 2 and Tables X1.1 and X1.2 was editorially corrected in June 2014.

## 1. Scope\*

1.1 This specification covers cold-expansion fittings using metal compression-sleeves for use with cross-linked polyethylene (PEX) plastic pipe in  $\frac{3}{8}$ -in.,  $\frac{1}{2}$ -in.,  $\frac{5}{8}$ -in.,  $\frac{3}{4}$ -in., 1-in.,  $1\frac{1}{4}$ -in.,  $1\frac{1}{2}$ -in., and 2 in. nominal diameters, whereby the PEX pipe is cold-expanded before fitting assembly. These cold-expansion fittings and metal compression-sleeves are intended for use in residential and commercial, hot and cold, potable water distribution systems, as well as sealed central heating, including under-floor heating systems, with continuous operation at pressures up to and including 100 psi (690 kPa), and at temperatures up to and including 180°F (82°C).

1.2 Included in this specification are the requirements for materials, workmanship, dimensions, and markings to be used on the fittings and compression-sleeves. Performance requirements are as referenced in Specification F877.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 The following precautionary caveat pertains only to the test method portion, Section 10, 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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

A108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished

A269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A276 Specification for Stainless Steel Bars and Shapes

A312/A312M Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A519 Specification for Seamless Carbon and Alloy Steel Mechanical Tubing

B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines

B62 Specification for Composition Bronze or Ounce Metal Castings

B140/B140M Specification for Copper-Zinc-Lead (Red Brass or Hardware Bronze) Rod, Bar, and Shapes

B283 Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)

B371/B371M Specification for Copper-Zinc-Silicon Alloy Rod

B584 Specification for Copper Alloy Sand Castings for General Applications

B689 Specification for Electroplated Engineering Nickel Coatings

B851 Specification for Automated Controlled Shot Peening of Metallic Articles Prior to Nickel, Autocatalytic Nickel, or Chromium Plating, or as Final Finish

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

F412 Terminology Relating to Plastic Piping Systems

F876 Specification for Crosslinked Polyethylene (PEX) Tubing

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.10 on Fittings. Current edition approved Nov. 1, 2012. Published December 2012. Originally approved in 2001. Last previous edition approved in 2009 as F2080 – 09. DOI: 10.1520/F2080-12.

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

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

## F877 Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems

### 2.2 ASME Standards:

**B1.20.1 Pipe Threads General Purpose (Inch)**<sup>3</sup>

**B16.18 Cast Copper Alloy Solder Joint Pressure Fittings (Inch)**<sup>3</sup>

**B16.22 Wrought Copper Alloy Solder Joint Pressure Fittings (Inch)**<sup>3</sup>

### 2.3 NSF Standards:

**Standard No. 14 for Plastic Piping Components and Related Materials**<sup>4</sup>

**Standard No. 61 for Drinking Water System Components—Health Effects**<sup>4</sup>

### 2.4 MSS Standard:

**SP-104 Wrought Copper Solder Joint Pressure Fittings**<sup>5</sup>

### 2.5 EN Standards:

**EN 12164 Copper and Copper Alloys—Rod for Free Machining Purposes**<sup>6</sup>

**EN 12165 Copper and Copper Alloys—Wrought and Unwrought Forging Stock**<sup>6</sup>

## 3. Terminology

3.1 *Definitions*—Definitions of terms used in this specification are in accordance with Terminology **F412**, and abbreviations are in accordance with Terminology **D1600**, unless otherwise indicated.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *cross-linked polyethylene, n*—plastics prepared by cross-linking (curing) polyethylene compounds (PEX).

3.2.2 *fitting assembly, n*—comprised of a cold-expansion fitting and a metal compression-sleeve, whereby the PEX pipe is cold-expanded before fitting insertion, and the compression-sleeve is pulled over the PEX pipe.

## 4. Classification

4.1 This specification covers one class of metal and plastic cold-expansion fittings with metal compression-sleeves suitable for use with PEX pipe that meets the requirements of Specifications **F876** and **F877**.

## 5. Materials and Manufacture

5.1 *Fittings*—Cold-expansion fittings shall be made from one of the following materials:

5.1.1 *Machined Brass*—Machined brass cold-expansion fittings shall be made from material meeting the requirements of Specification **B16/B16M**, Copper Alloy UNS C36000, or Specification **B140/B140M**, Copper Alloy UNS C31400, or Specification **B371/B371M**, Copper Alloy UNS C69300, or Specification **B283**, Copper Alloy UNS C89844, Copper Alloy UNS No. C27450 or Standard EN 12164, Copper Alloy CW614N.

5.1.2 *Machined Stainless Steel*—Machined stainless steel cold-expansion fittings shall be made from material meeting the requirements of Specification **A312/A312M**, stainless steel alloy 304L or 316L, or Specification **A269**, stainless steel alloy 304L or 316L, or Specification **A276**, stainless steel alloy 304L or 316L.

5.1.3 *Machined Carbon Steel*—Machined carbon steel cold-expansion fittings shall be made from material meeting the requirements of Specification **A108**, Carbon Steel Alloy 1020 or 1025, or Specification **A519**, Carbon Steel Alloy 1020, or 1025 or 1026.

5.1.4 *Forged Brass*—Forged brass cold-expansion fittings shall be made from material meeting the requirements of Specification **B283**, Copper Alloy UNS C37700 or UNS C89844, or Copper Alloy UNS No. C27450, or Copper Alloy UNS C69300 or Standard EN 12165, Copper Alloy CW617N.

5.1.5 *Cast Copper Alloys*—Cast copper alloy cold-expansion fittings shall be made from material meeting the requirements of Specification **B62** copper alloy UNS C83600, or Specification **B584**, copper-alloy UNS C83800, C84400 or C89844.

5.2 *Compression-Sleeves*—Metal compression-sleeves shall be made from one of the following materials:

5.2.1 *Machined Brass*—Machined brass compression-sleeves shall be made from material meeting the requirements of Specification **B16/B16M** copper-alloy UNS C36000, or Standard EN 12168, Copper Alloy CW614N, or Copper Alloy UNS No. C27450, or Standard EN 12165, Copper Alloy CW617N, or Specification **B371/B371M**, Copper Alloy UNS C69300.

5.2.2 *Machined Stainless Steel*—Machined stainless steel compression-sleeves shall be made from material meeting the requirements of Specification **A312/A312M**, stainless steel alloy 304L or 316L, or Specification **A269**, stainless steel alloy 304L or 316L, or Specification **A276**, stainless steel alloy 304L or 316L.

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

<sup>4</sup> Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

<sup>5</sup> Available from Manufacturer's Standardization Society of the Valve and Fittings Industry, 5203 Leesburg Pike, Suite 502, Falls Church, VA 22041.

<sup>6</sup> Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

5.3 *Plating*—Plating of either fitting component with nickel or chrome, or other metal is optional and must fall within the dimensional tolerances of this specification. Plating can not negatively affect the quality of markings or the ability to meet S1.2.

5.3.1 *Nickel Plating*—Application of electroplated nickel coating shall meet the requirements of Specifications **B689** and **B851**.

5.3.2 *Chrome Plating*—Application of electroplated chrome coating shall meet the requirements of Specification **B851**.

## 6. Performance Requirements

6.1 *General*—All performance tests shall be conducted on assemblies of fittings (cold-expansion fittings and compression-sleeves) and PEX pipe. Fittings shall meet the material and dimensional requirements of this specification. PEX pipe shall meet the requirements of Specifications **F876** and **F877**. Assembly of test specimens shall be in accordance with **9.3**. Each assembly shall contain at least two joints. Use separate sets of assemblies for each performance test requirement.

6.2 Fittings shall comply with the following performance requirements of Specification **F877**. When a section with an identical title appears in this Specification, it contains additional requirements that supplement those found in Specification **F877**.

6.2.1 Requirements,

6.2.2 Test Methods, and

6.2.3 Retest and Rejection.

## 7. Dimensions

7.1 *Dimensions and Tolerances*—The dimensions and tolerances of the cold-expansion fittings and compression-sleeves, when measured in accordance with **10.1**, shall be as shown in **Figs. 1 and 2**.

7.1.1 *Alignment*—The maximum angular variation of any opening shall not exceed 1° off the true centerline axis.

7.1.2 *Fittings with Solder-Joint Ends*—Solder-joint end dimensions shall be in accordance with ASME B16.18, ASME B16.22, or MSS SP-104.

7.1.3 *Tapered Threaded-Ends*—Fitting threads shall be right-hand, conforming to ASME B1.20.1, and shall be tapered threads (NPT).

7.1.4 *Straight Threaded-Ends*—Fitting threads shall be right-hand, conforming to ASME B1.20.1, and shall be straight mechanical threads (NPSM).

7.1.5 *Inside Diameter*—The minimum inside diameter, listed as Dimension F in **Fig. 1**, applies to the entire fitting not just the insert area. When fitting has ends that are of different sizes or configurations (for example, threaded, solder), or both, the minimum ID applies to entire insert area.

## 8. Workmanship, Finish, and Appearance

8.1 The fittings shall be made from materials that are homogeneous throughout. All sealing surfaces shall be smooth and free of foreign material. The walls of cold-expansion fittings and compression-sleeves shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the unaided eye and that affect wall integrity.

8.2 *Flash*—Except for the insert, molded polymer fittings shall be free of flash in excess of 0.005 in. On the insert, molded polymer fittings shall be free of flash in excess of 0.002 in. Flash, mismatch, and witness mark requirements for the insert shall be in accordance with **Figs. 3 and 4**.

8.3 *Splay*—Molded polymer fittings shall be free of visible splay excepting some light blushing at the gate location.

## 9. Assembly

9.1 *Joints*:

9.1.1 *Cold-Expansion Joints*—Fittings shall be joined to PEX pipe by first expanding the end of the pipe with the expander tool, inserting the cold-expansion fitting into expanded pipe, then pulling the compression-sleeve over the PEX pipe and the fitting, compressing the pipe between the compression-sleeve and the fitting. Cold-expansion fittings and compression-sleeves shall meet the dimensional and material requirements of this specification. PEX pipe shall meet the requirements of Specifications **F876** and **F877**.

9.2 *Expander Tool*:

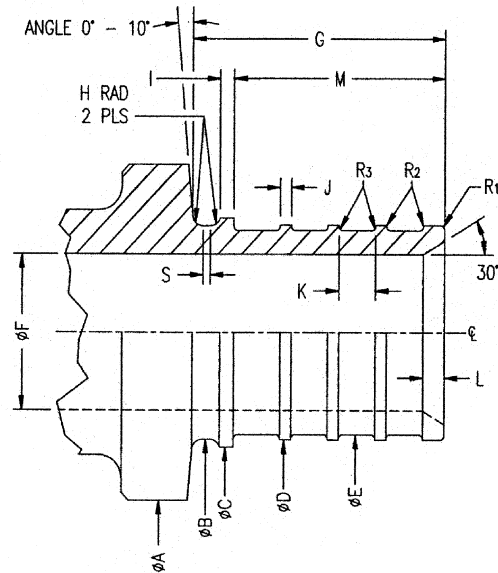
9.2.1 The expander tool shall have a six-section axial expanding cylindrical-shaped head with unexpanded and maximum expanded diameters as shown in **Table 1**.

9.2.2 The expander tool shall be inspected according to manufacturer's instructions.

9.3 *Procedure*:

9.3.1 Slide the compression-sleeve onto the pipe so that the inside-beveled end is facing toward the end of the pipe. Slide the compression-sleeve far enough down the pipe so that it will not prevent expansion of the pipe. Insert the head of the expander-tool into the pipe. The expander-tool segments shall be centered inside the pipe. Expand the pipe for approximately 3 s, and remove the tool. Rotate the tool approximately 30°, insert the expander-tool into the pipe and repeat the expansion process. The cold-expansion fitting shall be inserted within 30 s of the second expansion. The fitting is properly inserted when the PEX pipe

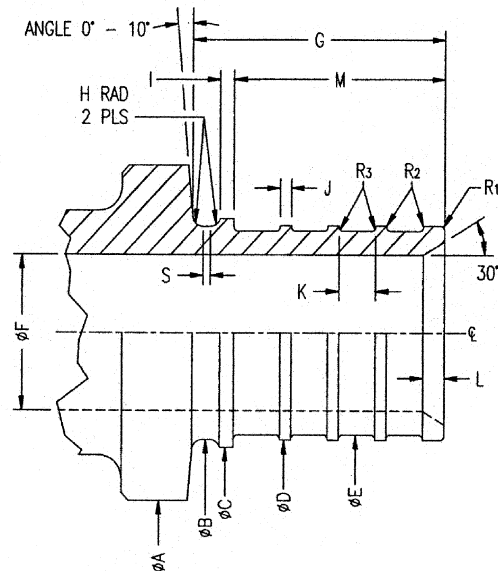
ASME F2080 - 12<sup>ε1</sup>



Note 1—All dimensions shall be measured with appropriate micrometers, such as pin or ball micrometers for wall thickness, and outside-diameter micrometers with flat anvils, or vernier calipers, to measure outside diameter and width of cold-expansion fittings and compression-sleeves.

Note 2—The average measurement is obtained from measurements taken in at least four locations spaced at approximately 45° around the circumference, in accordance with 10.1.

Size	A <sup>A</sup>	B	C	D	E	F	G	H	I	J <sup>B</sup>	K <sup>C</sup>	L	M	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	S
3/8 in.	0.745 <sup>±</sup>	0.408	0.451	0.408	0.385	0.280	0.516	0.034	0.034	0.023	0.059	0.055	0.407	0.008	0.005	0.005	0.000
		0.420	0.461	0.418	0.395	0.292	0.536	0.044	0.044	0.033	0.069	0.065	0.419	0.020	0.010	0.015	0.010
1/2 in.	0.840 <sup>±</sup>	0.538	0.578	0.540	0.515	0.390	0.700	0.034	0.034	0.026	0.098	0.055	0.585	0.008	0.005	0.005	0.000
		0.550	0.590	0.552	0.525	0.402	0.720	0.044	0.044	0.036	0.110	0.065	0.600	0.020	0.010	0.015	0.010
5/8 in.	1.110 <sup>±</sup>	0.596	0.671	0.634	0.605	0.480	0.820	0.034	0.034	0.026	0.133	0.055	0.700	0.008	0.005	0.005	0.000
		0.608	0.683	0.646	0.615	0.492	0.840	0.044	0.044	0.036	0.145	0.065	0.715	0.020	0.010	0.015	0.010
3/4 in.	1.110 <sup>±</sup>	0.703	0.778	0.742	0.715	0.590	0.820	0.034	0.034	0.026	0.134	0.055	0.700	0.008	0.005	0.005	0.000
		0.715	0.790	0.754	0.725	0.602	0.840	0.044	0.044	0.036	0.146	0.065	0.715	0.020	0.010	0.015	0.010
1 in.	1.375 <sup>±</sup>	0.900	0.988	0.944	0.908	0.768	1.070	0.054	0.034	0.034	0.180	0.062	0.915	0.008	0.005	0.005	0.000
1 1/4 in.	1.600 <sup>±</sup>	0.918	1.000	0.956	0.918	0.780	1.090	0.064	0.044	0.044	0.192	0.072	0.930	0.020	0.010	0.017	0.010
1 1/2 in.	1.910 <sup>±</sup>	1.110	1.159	1.157	1.110	0.923	1.316	0.005	0.034	0.034	0.189	0.113	1.016	0.018	0.005	0.005	0.253
		1.128	1.171	1.169	1.122	0.938	1.336	0.017	0.044	0.044	0.207	0.123	1.031	0.030	0.010	0.017	0.268
2 in.	2.300 <sup>±</sup>	1.327	1.377	1.375	1.327	1.133	1.322	0.005	0.046	0.046	0.177	0.125	1.016	0.034	0.005	0.005	0.253
		1.345	1.389	1.387	1.339	1.145	1.342	0.017	0.056	0.056	0.195	0.135	1.031	0.048	0.010	0.017	0.268
		1.727	1.797	1.795	1.727	1.493	1.595	0.005	0.058	0.058	0.212	0.156	1.239	0.034	0.005	0.005	0.288
	1.745	1.809	1.807	1.739	1.508	1.615	0.017	0.068	0.068	0.238	0.166	1.254	0.048	0.010	0.017	0.306	



Note 1—All dimensions shall be measured with appropriate micrometers, such as pin or ball micrometers for wall thickness, and outside-diameter micrometers with flat anvils, or vernier calipers, to measure outside diameter and width of cold-expansion fittings and compression-sleeves.

Note 2—The average measurement is obtained from measurements taken in at least four locations spaced at approximately 45° around the circumference, in accordance with 10.1.

Size	A <sup>A</sup>	B	C	D	E	F	G	H	I	J <sup>B</sup>	K <sup>C</sup>	L	M	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	S
3/8 in.	0.745 <sup>±</sup>	0.408	0.451	0.408	0.385	0.280	0.516	0.034	0.034	0.023	0.059	0.055	0.407	0.008	0.005	0.005	0.000
		0.420	0.461	0.418	0.395	0.292	0.536	0.044	0.044	0.033	0.069	0.065	0.419	0.020	0.010	0.015	0.010

**FIG. 1 Cold-Expansion Fittings Dimensions and Tolerances, in.**

is pushed up against the last rib (dimensioned as Rib I in Fig. 1) of the cold-expansion fitting. If full insertion is not possible, remove the cold-expansion fitting immediately and expand the pipe again for 3 s.

9.3.2 When the expansion is complete, and the cold-expansion fitting is inserted properly into the PEX pipe, the metal compression-sleeve shall be pulled over the fitting with a linear compression tool provided for the purpose.

9.3.3 The compression procedure shall be as follows: Pull the compression-sleeve over the cold-expansion fitting and the PEX pipe end using a suitable linear compression tool provided for the purpose. The maximum allowable gap between the edge of the compression-sleeve and the collar of the cold-expansion fitting (surface A on Fig. 1) shall be 0.040 in.

9.3.4 Each fitting assembly shall be checked per the manufacturer's instructions.

## 10. Test Methods

10.1 *Dimensions*—Use any randomly selected cold-expansion fittings and compression-sleeves to determine dimensions. Measurements shall be made in accordance with Test Method D2122, except to determine the diameters, by making measurements at four locations spaced at approximately 45° apart around the circumference. Inspection and gauging of solder joint ends shall be in accordance with ASME B16.18, ASME B16.22, or MSS SP-104.

## 11. Retests

11.1 If any failure occurs, a retest shall be conducted only if agreed upon between the purchaser and the seller. Failure in the retest is cause for rejection of the shipment.

## 12. Product Marking

12.1 *Quality of Marking*—The marking shall be applied to the fittings in such a manner that it remains legible after installation and inspection.

12.2 Markings or symbols may be rolled, molded, hot-stamped, etched or applied by printing methods.

12.3 Where recessed marking is used, the marking shall not cause cracks, or reduce the wall thickness below the minimum specified.

12.4 *Content of Marking for Cold-Expansion Fitting and Compression-Sleeve:*

12.4.1 Manufacturer's name or trademark, or both.

12.4.2 Certification mark or seal of the laboratory making the evaluation for this purpose.

12.4.3 This designation, F2080.

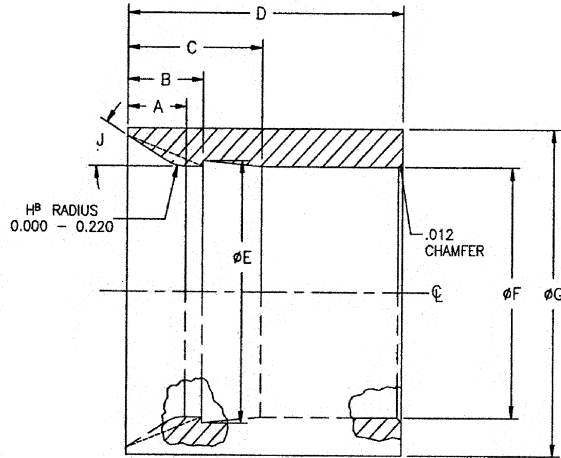
12.4.4 Nominal size.

## 13. Quality Assurance

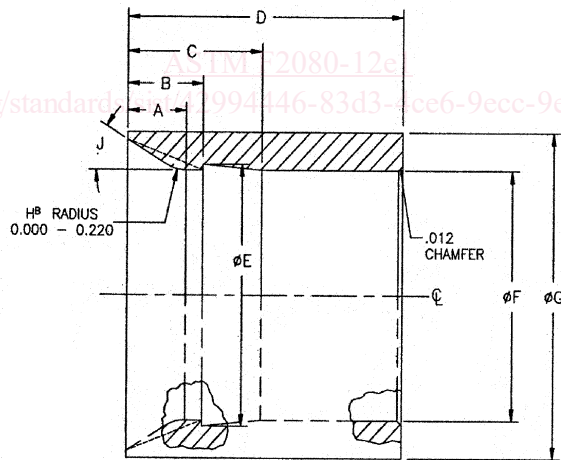
13.1 When the product is marked with this designation (ASTM F2080), the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with, and has been found to meet, the requirements of this specification.

## 14. Keywords

14.1 cold-expansion fittings; compression-sleeves; cross-linked polyethylene; hot- and cold-water distribution; PEX



Size	A	B	C	D	E	F	G <sup>A</sup>	J
3/8 in.	0.160	0.210	0.380	0.780	0.566	0.525	0.730 <sup>±</sup>	20°
	0.174	0.222	0.395	0.795	0.579	0.533		30°
1/2 in.	0.160	0.210	0.380	0.780	0.680	0.648	0.820 <sup>±</sup>	20°
	0.174	0.222	0.395	0.795	0.693	0.656		30°
5/8 in.	0.160	0.210	0.380	0.900	0.823	0.774	1.075 <sup>±</sup>	20°
	0.174	0.222	0.395	0.915	0.836	0.782		30°
3/4 in.	0.160	0.210	0.380	0.900	0.925	0.900	1.075 <sup>±</sup>	20°
	0.174	0.222	0.395	0.915	0.938	0.908		30°
1 in.	0.160	0.290	0.505	1.235	1.195	1.152	1.350 <sup>±</sup>	20°
1 1/4 in.	0.174	0.302	0.520	1.250	1.208	1.160	1.665 <sup>±</sup>	30°
1 1/2 in.	0.390	0.390	0.570	1.420	1.475	1.424	1.920 <sup>±</sup>	5°
	0.410	0.410	0.585	1.435	1.490	1.432	2.465 <sup>±</sup>	20°
	0.345	0.345	0.570	1.485	1.735	1.692		5°
	0.365	0.365	0.585	1.500	1.750	1.700		20°
2 in.	0.440	0.440	0.650	1.735	2.250	2.204		5°
	0.460	0.460	0.665	1.750	2.265	2.212		20°



Size	A	B	C	D	E	F	G <sup>A</sup>	J
3/8 in.	0.160	0.210	0.380	0.780	0.566	0.525	0.730 <sup>±</sup>	20°
	0.174	0.222	0.395	0.795	0.579	0.533		30°
1/2 in.	0.160	0.210	0.380	0.780	0.680	0.648	0.820 <sup>±</sup>	20°
	0.174	0.222	0.395	0.795	0.693	0.656		30°
5/8 in.	0.160	0.210	0.380	0.900	0.823	0.774	1.075 <sup>±</sup>	20°
	0.174	0.222	0.395	0.915	0.836	0.782		30°
3/4 in.	0.160	0.210	0.380	0.900	0.925	0.900	1.075 <sup>±</sup>	20°
	0.174	0.222	0.395	0.915	0.938	0.908		30°
1 in.	0.160	0.290	0.505	1.235	1.195	1.152	1.350 <sup>±</sup>	20°
1 1/4 in.	0.174	0.302	0.520	1.250	1.208	1.160		30°
	0.390	0.390	0.570	1.420	1.475	1.424	1.665 <sup>±</sup>	5°