Designation: C450 – 17

Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging[1]

This standard is issued under the fixed designation C450; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides tables of dimensions of preformed insulation that shall be used in fabricating insulation covers for use on valves, ells, tees, flanges, and vessels in the pressure range from 150 to 1500 psi (1 to 10 MPa). These tables, which are part of this standard, are published separately as the ASTM Recommended Dimensional Standards for Fabrication of Thermal Insulation Fitting Covers for NPS Piping and Vessel Lagging. The tables were developed to provide dimensions for shop fabrication use in forming pipe insulation fitting covers on NPS pipe operating at high temperature and low temperature. The tables also include dimensions for use in forming thermal insulation into curved segments, and lagging, for application on vessels. This practice does not apply to reflective-type insulation, insulation on screwed elbows, Short Radius (SR) & Long Radius (LR) Elbows Fitting Covers for tubing, dutchman (extended leg) insulation fitting covers, double-layered staggered-joint pipe insulation fitting covers, flexible preformed pipe-tube elastomeric foam fitting covers in accordance with Specification C534/C534M or polyolefin foam fitting covers in accordance with Specification C1427.

1.1.1 Refer to Guide C1710 when referring to insulation materials for fabrication of preformed flexible closed cell insulated 90° elbows, tees, or similar products.

1.2 This practice does not specify fabrication methods. Thermal insulation for fitting covers is formed by numerous fabrication methods. In general, insulations are cut by circular or band saws, shaped by grinders or millers, or molded/preformed. Each method has certain advantages and disadvantages, depending upon the material to be formed, number of cuts required, material waste permissible, and quantity of fittings being produced. Fitting parts are assembled using adhesives and fabrication cements applied using dip pots, rollers, doctor blades, brush, or trowel, depending upon the materials being used. Any specification of the fabrication techniques is beyond the scope of this standard.

1.3 The values stated in inch-pound units are to be regarded as standard. In a few parts of this practice, the values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard. The dimensional standard tables with fractional inch-pound (I.P.) system provided from the *adjunct* and in this document's tables are currently not available in decimal and metric equivalents.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C168 Terminology Relating to Thermal Insulation

C534/C534M Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing

C1427 Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form

C1710 Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form

[1] This practice is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on Homogeneous Inorganic Thermal Insulations.

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

2.2 *ASTM Adjuncts:*

2.3 *ASTM Adjuncts:*[3]

Fabrication of Thermal Insulating Covers for NPS Piping and Vessel Lagging on CD-ROM

2.3.1 *Adjunct Table of Contents:*

2.3.1.1 *Forward and Introduction:*

(1) Practice C585 Base Dimensions for NPS Inner Diameters with plus and minus tolerance

(2) Practice C585 Base Dimensions for NPS Outer Diameters with no tolerances

2.3.1.2 *Insulation Covers for NPS Pipe Fittings*—Short and Long Radius Welded Elbows

2.3.1.3 *Coverings for Vessels: Sidewall – Cylindrical Flat Lagging*—Single-Edge Cut and Double-Edge Cut

2.3.1.4 *Flanged – High & Low Temperature Service:*

(1) 150-lb, 300-lb, 400-lb, 600-lb, 900-lb, and 1500-lb Line Flanges

(2) 150-lb, 300-lb, 400-lb, 600-lb, 900-lb, and 1500-lb Flanged Globe Valves

(3) 1 to 5 in. NPS and 6 to 24 in. NPS 125 and 150 lb Flanged Gate Valves

(4) 1 to 3 in. NPS, 3½ to 5 in. NPS and 12 to 24 in. NPS 150-lb Flanged 90° Ells

(5) 300-lb, 400-lb, 600-lb, 900-lb, and 1500-lb Flanged Gate Valves

(6) 1 to 5 in. NPS and 6 to 24 in. NPS 150-lb Flanged 45° Ells

(7) 1 to 5 in. NPS and 6 to 24 in. NPS 150-lb Flanged 45° Tees

3. Terminology

3.1 *Definitions*—For definitions used in this practice see Terminology C168.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *base dimension, n*—a measurement of, for example, a pipe insulation's inside diameter (ID), outside diameter (OD), and miter dimensions, all without any I.D. and O.D. tolerances.

3.2.2 *dutchman, n*—an extended pipe insulation fitting leg attached to, for example, the ends of an insulated 90° elbow fitting cover.

3.2.3 *pipe fitting, n*—a fitting is used in pipe systems to connect straight pipe or tubing sections with, for example, 90° elbows.

4. Significance and Use

4.1 This system of dimensions provides a guide for forming thermal insulation in advance of field application. Forming is done by cutting, grinding, milling, or molding, depending upon the method most suitable for the thermal insulation being fabricated. It is equally applicable for all service temperature ranges.

[3] Available from ASTM International Headquarters. Order Adjunct Stock No. ADJC0450A. Original adjunct produced in 1976. The 2002 edition of the Adjunct's Short Radius Ells Tables and Long Radius Ells Tables for Welded Elbows Fitting Covers were updated.

5. Basis of Design

5.1 All dimensions presented are based on the use of pipe insulation manufactured to Practice C585 with no pipe insulation outside diameter (OD) tolerances and to the Basic Dimensional Standards for Pipe Insulation as given in ADJC0450A Table 1, Pipe Insulation Inside Diameters, and Table 2, Pipe Insulation Outside Diameters, with no tolerances of the Fabrication of Thermal Insulating Fitting Covers for NPS Piping and Vessel Lagging.[3]

5.1.1 The Short Radius Insulated Welded Elbows Tables and the Long Radius Insulated Welded Elbow Tables from ADJC0450A have been carried over to this practice, Sections 9 and 10, respectively.

5.2 There are two tables that provide dimensions for welded elbow insulation fitting covers in this practice and ADJC0450A for installation on nominal pipe size (NPS) pipe operating at high and low temperatures.

NOTE 1—Should the base dimension pipe insulation O.D. have a dimensional tolerance other than "zero" inches, more than likely the mitered insulated fitting cover will not fit the exact curvature of the pipe fitting. The table dimensions will have to be adjusted for a proper fit on the pipe fitting with O.D. tolerances.

5.3 Dimensions presented for cutting beveled blocks from preformed thermal insulation (lags) are based on blocks 6 in. (152 mm) wide by the thickness required.

5.4 Dimensions given for flanged pairs, flanged fittings, and flanged valves do not allow for flange bolt removal. When bolt removal is required, the pipe insulation next to the flange is shortened to provide the space necessary to remove the bolts and the pipe insulation length over the flange shall be increased commensurately to prevent gaps in the insulation coverage. The details of this shall be specified by the purchaser.

5.5 Pipe and fittings with heat tracer tubing or conduit, refer to the tables and increase the insulation I.D. (Practice C585 or the Adjunct Tables 1 and 2) one size larger. Where multiple tracers are required, the insulation I.D. must be adjusted accordingly. To stabilize the insulation on the pipe and fittings, it is potentially necessary to install spacer strips. Fabricate the spacer strips from the same material as the pipe insulation or a rigid insulation capable of the same service. Locate the spacer strips so as not to impede heat transfer. See Section 2.2.2.1: Adjunct's Figure 1.

6. Fabrication

6.1 Use any method of forming if the resulting fitting conforms to inside and outside the dimensions listed.

6.2 The main body of the insulation fitting shall be cut from standard pipe size pipe insulation of the proper size and thickness.

6.3 Double layering insulated fitting covers is not always possible unless the fabrication of the elbow is assembled with the inner and outer layers being nested prior to cutting the individual miters.

NOTE 2—Staggered joint double layered insulated fitting covers are not possible using the insulated Short Radius Welded Elbows Tables and the Long Radius Insulated Welded Elbow Tables from ADJC0450A or

Sections 9 and 10, respectively.

6.4 Where two insulations of different temperature ratings are required, each insulation type shall be assembled in its proper location in the fitting using double layer construction.

6.4.1 The temperature at the interface between insulation layers is not to exceed the maximum temperature limit of the outer layer of insulation.

6.5 Flat block, cut to proper curvature, may be used in place of preformed pipe insulation. The user shall be informed when a change, for example, supplying a fabricated product instead of a molded or preformed pipe insulation, that has the potential to cause differences in the thermal or mechanical performance characteristics of the end product.

6.6 Where the body of the flange cover extends over adjacent pipe insulation, the portion of the cover shall be fabricated using the pipe insulation as the body and adding an insert collar. Another method, which has been used, is by adding an insert or section, commonly called a "dutchman," made of block.

6.7 Valves manufactured by various companies for the same pressure and nominal pipe size will not necessarily have the same bonnet dimensions, or height of bonnet flange above centerline of valve. Because of this, the valve insulation is designed to fit the largest valve of a size, type, and pressure. In some instances, there is the potential that additional insulation will be required to fill or build up the insulation for proper fitting around the bonnet. In other instances, there is the potential that it will be necessary to cut back insulation around the bonnet to provide access to the packing gland. Perform the cutout for hand wheel assembly and packing gland at time of application.

7. Assembly and Tolerances

7.1 All formed pieces shall fit tightly together so that both sides and length of the insulation joint can close within a maximum of 1⁄16 in. (1.6 mm).

7.2 Low-temperature pipe insulation fabricated from block or board stock shall contain no more than four cemented "through" joints per full section of insulation, excluding the half section mating plane.

7.3 Finished pieces shall be identified using tags, attached strip, etc. for ease of field installation.

7.4 The inner and outer surface of vessel insulation sections shall be concentric with the outer surface. The deviation from concentricity shall not exceed 3⁄16 in. (5 mm).

7.5 Material (glue, adhesives, etc.) used in the fabrication of fitting covers shall be those recommended by the manufacturer for the specific application and exposure conditions.

8. Field Application Sequence

8.1 Apply insulation coverings for welded or screwed fittings before the pipe insulation.

8.2 Install the pipe insulation up to all flanges, flanged fittings, and flanged valves. Provide sufficient space for future bolt removal where required.

8.3 Install insulation covers for flanges, flanged fittings, and flanged valves so as to extend, not less than specified thickness, over adjacent pipe insulation or minimum 2 in. (50 mm).

8.4 Where required, the junction between the pipe insulation and flanged insulation fittings covers can, by use of non-setting cements, sealants, or other methods, also serve as part of an expansion or contraction joint system.

9. Short Radius Welded Elbows – Recommended Dimensional Standards

9.1 See Fig. 1.

10. Long Radius Welded Elbows – Recommended Dimensional Standards

10.1 See Fig. 2.

11. Keywords

11.1 dimensions; thermal insulating materials; thermal insulating materials—fabrication; thermal insulating materials—fittings; thermal insulating materials—pipe

Insulation Thickness

Pipe Size	1"					1 1/2"					2"					2 1/2"				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1	4	1 3/32	*	0.58	2	4	1 3/16	*	0.64	2 3/16	4	1 1/2	*	0.84	2 23/32	4	1 11/16	*	0.97	3 3/32
1 1/4	4	1 3/16	*	0.55	1 27/32	4	1 15/32	*	0.74	2 11/32	4	1 19/32	*	0.81	2 17/32	4	1 13/16	*	0.94	2 29/32
1 1/2	4	1 3/8	*	0.58	1 27/32	4	1 9/16	*	0.71	2 3/16	4	1 29/32	*	0.91	2 3/4	4	2 3/32	*	1.03	3 3/32
2	4	1 9/16	*	0.53	1 1/2	4	1 7/8	*	0.72	2 1/32	4	2 3/32	*	0.85	2 13/32	4	2 9/32	*	0.98	2 3/4
2 1/2	4	1 31/32	*	0.59	1 1/2	4	2 9/32	*	0.79	2 1/16	4	2 1/2	*	0.92	2 13/32	4	2 11/16	*	1.04	2 3/4
3	4	2 9/32	1/16	0.41		4	2 1/2	*	0.74	1 11/16	4	2 11/16	*	0.86	2 1/16	4	2 29/32	*	0.98	2 13/32
3 1/2	4	2 11/16	1/16	0.47		4	2 29/32	*	0.80	1 11/16	4	3 3/32	*	0.93	2 1/16	6	2 3/16	*	1.05	2 13/32
4	4	2 29/32	1/4	0.54		4	3 3/32	1/16	0.54		6	2 3/16	*	0.87	1 23/32	6	2 5/16	*	0.99	2 1/16
4 1/2	4	3 3/32	1/16	0.54		6	2 3/16	*	0.87	1 23/32	6	2 5/16	*	0.99	2 1/16	6	2 7/16	*	1.13	2 7/16
5	6	2 5/16	9/32	0.67		6	2 7/16	5/32	0.67		6	2 9/16	1/32	0.67		6	2 23/32	*	1.02	1 3/4
6	6	2 11/16	7/16	0.80		6	2 27/32	9/32	0.80		6	2 31/32	5/32	0.81		6	3 1/8	1/32	0.81	
7	6	2 27/32	9/32	0.80		6	2 31/32	5/32	0.81		6	3 1/8	1/32	0.81		6	3 1/4	*	1.15	1 3/4
8	6	3 1/2	21/32	1.07		6	3 5/8	17/32	1.07		6	3 25/32	13/32	1.07		6	3 15/16	1/4	1.07	
9						6	3 25/32	13/32	1.07		6	3 15/16	1/4	1.07		6	4 1/16	1/8	1.07	
10						6	4 15/32	25/32	1.33		6	4 19/32	5/8	1.33		6	4 23/32	1/2	1.33	
11						6	4 19/32	5/8	1.33		6	4 23/32	1/2	1.33		8	3 5/8	9/32	1.33	
12						8	3 15/16	25/32	1.60		8	4 1/32	21/32	1.60		8	4 1/8	9/16	1.60	
14						8	4 13/32	1 1/16	1.86		8	4 1/2	31/32	1.86		8	4 5/8	7/8	1.86	
15						8	4 1/2	31/32	1.86		8	4 5/8	7/8	1.86		8	4 23/32	25/32	1.86	
16						8	5	1 1/4	2.12		8	5 3/32	1 5/32	2.12		8	5 7/32	1 1/16	2.12	
17						8	5 3/32	1 5/32	2.12		8	5 7/32	1 1/16	2.12		8	5 5/16	31/32	2.12	
18						8	5 19/32	1 15/32	2.38		8	5 11/16	1 11/32	2.38		8	5 25/32	1 1/4	2.38	
19						8	5 29/32	1 9/16	2.51		8	5 25/32	1 1/4	2.38		8	5 29/32	1 5/32	2.38	
20						8	6 3/16	1 21/32	2.64		8	6 9/32	1 9/16	2.64		10	5 3/32	1 5/32	2.65	
21						10	5 3/16	1 13/32	2.78		10	5 3/32	1 5/32	2.65		10	5 3/16	1 3/32	2.65	
22						10	5 13/32	1 15/32	2.91		10	5 1/2	1 13/32	2.91		10	5 9/16	1 5/16	2.91	
23						10	5 21/32	1 9/16	3.04		10	5 9/16	1 5/16	2.91		10	5 21/32	1 1/4	2.91	
24						10	5 7/8	1 5/8	3.17		10	5 31/32	1 9/16	3.17		10	6 1/32	1 15/32	3.17	

A = Minimum Number of Miters for 90° Ell, use half for 45° Ell
B = Miter Base Dimension
C = Miter Top Dimension (* Denotes Negative Radius, See Column E)
D = Lineal Feet of Pipe Covering for One Fitting Cover
(Based on alternating cuts and allowing for saw kerf and waste)
E = Tangent Length for Negative Radius Fittings (Figure 2.2)[1]

[1] - Mitered Negative Radius Fitting Covers create a 'humped' phonomenon in the throat of the fitting. This 'hump' must be rasped down to ensure proper fit with metal elbow covers.

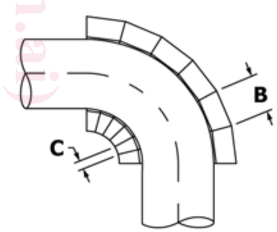

Figure 2.1 Regular Short Radius Ell

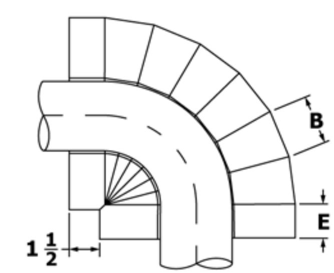

Figure 2.2 Negative Radius Ell

FIG. 1 Short Radius Ells – Recommended Dimensional Standards

Pipe Size	3"					3 1/2"					4"					4 1/2"				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1	4	1 29/32	*	1.09	3 7/16	4	2 3/32	*	1.22	3 25/32	4	2 9/32	*	1.34	4 1/8	4	2 17/32	*	1.48	4 17/32
1 1/4	4	2	*	1.06	3 1/4	4	2 3/16	*	1.19	3 19/32	4	2 13/32	*	1.31	3 31/32	4	2 5/8	*	1.45	4 11/32
1 1/2	4	2 9/32	*	1.16	3 7/16	4	2 1/2	*	1.28	3 25/32	4	2 23/32	*	1.42	4 5/32	4	2 29/32	*	1.55	4 17/32
2	4	2 1/2	*	1.10	3 3/32	4	2 11/16	*	1.22	3 7/16	4	2 29/32	*	1.36	3 13/16	4	3 1/8	*	1.49	4 5/32
2 1/2	4	2 29/32	*	1.17	3 3/32	4	3 1/8	*	1.31	3 15/32	6	2 3/16	*	1.43	3 27/32	6	2 5/16	*	1.56	4 3/16
3	4	3 3/32	*	1.11	2 3/4	6	2 3/16	*	1.25	3 5/32	6	2 5/16	*	1.38	3 1/2	6	2 7/16	*	1.50	3 27/32
3 1/2	6	2 5/16	*	1.19	2 13/16	6	2 7/16	*	1.32	3 5/32	6	2 19/32	*	1.44	3 1/2	6	2 3/4	*	1.60	3 15/16
4	6	2 7/16	*	1.13	2 7/16	6	2 19/32	*	1.26	2 13/16	6	2 23/32	*	1.38	3 5/32	6	2 7/8	*	1.54	3 19/32
4 1/2	6	2 19/32	*	1.26	2 13/16	6	2 23/32	*	1.38	3 5/32	6	2 7/8	*	1.54	3 19/32	6	3	*	1.66	3 15/16
5	6	2 27/32	*	1.14	2 3/32	6	2 31/32	*	1.27	2 7/16	6	3 5/32	*	1.42	2 7/8	6	3 9/32	*	1.55	3 1/4
6	6	3 1/4	*	1.15	1 3/4	6	3 13/32	*	1.30	2 3/16	6	3 17/32	*	1.43	2 17/32	6	3 21/32	*	1.55	2 7/8
7	6	3 13/32	*	1.30	2 3/16	6	3 17/32	*	1.43	2 17/32	6	3 21/32	*	1.55	2 7/8	6	3 13/16	*	1.68	3 1/4
8	6	4 1/16	1/8	1.07		6	4 3/16	*	1.32	1 1/2	6	4 11/32	*	1.44	1 27/32	6	4 15/32	*	1.57	2 3/16
9	6	4 3/16	*	1.32	1 1/2	6	4 11/32	*	1.44	1 27/32	6	4 15/32	*	1.57	2 3/16	6	4 19/32	*	1.69	2 17/32
10	8	3 5/8	9/32	1.33		8	3 23/32	3/16	1.33		8	3 13/16	3/32	1.33		8	3 15/16	*	1.58	1 1/2
11	8	3 23/32	3/16	1.33		8	3 13/16	3/32	1.33		8	3 15/16	*	1.58	1 1/2	8	4 1/32	*	1.71	1 27/32
12	8	4 7/32	15/32	1.60		8	4 5/16	3/8	1.60		8	4 13/32	9/32	1.60		8	4 1/2	3/16	1.60	
14	8	4 23/32	25/32	1.86		8	4 13/16	21/32	1.86		8	4 29/32	9/16	1.86		8	5	15/32	1.86	
15	8	4 13/16	21/32	1.86		8	4 29/32	9/16	1.86		8	5	15/32	1.86		8	5 3/32	3/8	1.86	
16	8	5 5/16	31/32	2.12		8	5 13/32	7/8	2.12		8	5 1/2	25/32	2.12		8	5 19/32	21/32	2.12	
17	8	5 13/32	7/8	2.12		8	5 1/2	25/32	2.12		8	5 19/32	21/32	2.12		8	5 11/16	9/16	2.12	
18	8	5 29/32	1 5/32	2.38		8	6	1 1/16	2.38		8	6 3/32	31/32	2.38		8	6 3/16	7/8	2.38	
19	8	6	1 1/16	2.38		8	6 3/32	31/32	2.38		8	6 3/16	7/8	2.38		10	5 3/16	15/32	2.39	
20	10	5 3/16	1 3/32	2.65		10	5 1/4	1	2.65		10	5 11/32	15/16	2.65		10	5 13/32	27/32	2.65	
21	10	5 1/4	1	2.65		10	5 11/32	15/16	2.65		10	5 13/32	27/32	2.65		10	5 1/2	25/32	2.65	
22	10	5 21/32	1 1/4	2.91		10	5 23/32	1 5/32	2.91		10	5 13/16	1 3/32	2.91		10	5 7/8	1	2.91	
23	10	5 23/32	1 5/32	2.91		10	5 13/16	1 3/32	2.91		10	5 7/8	1	2.91		10	5 31/32	15/16	2.91	
24	10	6 1/8	1 13/32	3.17		10	6 3/16	1 5/16	3.17		10	6 9/32	1 1/4	3.17		10	6 11/32	1 5/32	3.17	

Insulation Thickness

A = Minimum Number of Miters for 90° Ell, use half for 45° Ell
B = Miter Base Dimension
C = Miter Top Dimension (* Denotes Negative Radius, See Column E)
D = Lineal Feet of Pipe Covering for One Fitting Cover
(Based on alternating cuts and allowing for saw kerf and waste)
E = Tangent Length for Negative Radius Fittings (Figure 2.2)[1]

1 - Mitered Negative Radius Fitting Covers create a 'humped' phonomenon in the throat of the fitting. This 'hump' must be rasped down to ensure proper fit with metal elbow covers.

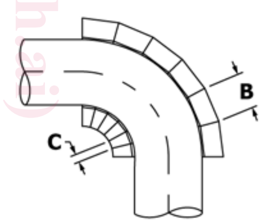

Figure 2.1 Regular Short Radius Ell

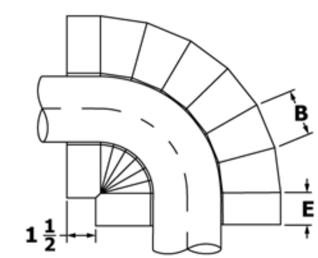

Figure 2.2 Negative Radius Ell

FIG. 1 Short Radius Ells – Recommended Dimensional Standards *(continued)*

Insulation Thickness

Pipe Size	5"					5 1/2"					6"				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1	4	2 23/32	*	1.60	4 7/8	4	2 29/32	*	1.73	5 7/32	6	2 3/32	*	1.89	5 11/16
1 1/4	4	2 13/16	*	1.57	4 11/16	4	3 1/32	*	1.70	5 1/32	6	2 5/32	*	1.86	5 1/2
1 1/2	4	3 1/8	*	1.67	4 7/8	6	2 7/32	*	1.83	5 11/32	6	2 11/32	*	1.95	5 11/16
2	6	2 3/16	*	1.62	4 9/16	6	2 11/32	*	1.77	5	6	2 1/2	*	1.90	5 11/32
2 1/2	6	2 1/2	*	1.71	4 5/8	6	2 5/8	*	1.84	5	6	2 3/4	*	1.96	5 11/32
3	6	2 5/8	*	1.65	4 9/32	6	2 3/4	*	1.78	4 5/8	6	2 7/8	*	1.90	5
3 1/2	6	2 7/8	*	1.72	4 9/32	6	3	*	1.84	4 5/8	6	3 5/32	*	1.97	5
4	6	3	*	1.66	3 15/16	6	3 5/32	*	1.79	4 9/32	6	3 9/32	*	1.91	4 5/8
4 1/2	6	3 5/32	*	1.79	4 9/32	6	3 9/32	*	1.91	4 5/8	6	3 13/32	*	2.03	5
5	6	3 13/32	*	1.67	3 19/32	6	3 17/32	*	1.79	3 15/16	6	3 21/32	*	1.92	4 9/32
6	6	3 13/16	*	1.68	3 1/4	6	3 15/16	*	1.80	3 19/32	6	4 1/16	*	1.93	3 15/16
7	6	3 15/16	*	1.80	3 19/32	6	4 1/16	*	1.93	3 15/16	6	4 3/16	*	2.05	4 9/32
8	6	4 19/32	*	1.69	2 17/32	6	4 23/32	*	1.82	2 7/8	8	3 5/8	*	1.94	3 1/4
9	6	4 23/32	*	1.82	2 7/8	8	3 5/8	*	1.94	3 1/4	8	3 23/32	*	2.07	3 19/32
10	8	4 1/32	*	1.71	1 27/32	8	4 1/8	*	1.83	2 3/16	8	4 7/32	*	1.96	2 17/32
11	8	4 1/8	*	1.83	2 3/16	8	4 7/32	*	1.96	2 17/32	8	4 5/16	*	2.08	2 29/32
12	8	4 5/8	3/32	1.60		8	4 23/32	*	1.85	1 1/2	8	4 13/16	*	1.97	1 27/32
14	8	5 3/32	3/8	1.86		8	5 7/32	9/32	1.86		8	5 5/16	3/16	1.86	
15	8	5 7/32	9/32	1.86		8	5 5/16	3/16	1.86		8	5 13/32	3/32	1.86	
16	8	5 11/16	9/16	2.12		8	5 25/32	15/32	2.12		8	5 29/32	3/8	2.12	
17	8	5 25/32	15/32	2.12		8	5 29/32	3/8	2.12		8	6	9/32	2.12	
18	8	6 9/32	25/32	2.38		10	5 3/32	17/32	2.39		10	5 3/16	15/32	2.39	
19	10	5 3/32	17/32	2.39		10	5 3/16	15/32	2.39		10	5 1/4	3/8	2.39	
20	10	5 1/2	25/32	2.65		10	5 9/16	11/16	2.65		10	5 21/32	5/8	2.65	
21	10	5 9/16	11/16	2.65		10	5 21/32	5/8	2.65		10	5 23/32	17/32	2.65	
22	10	5 31/32	15/16	2.91		10	6 1/32	27/32	2.91		10	6 1/8	25/32	2.91	
23	10	6 1/32	27/32	2.91		10	6 1/8	25/32	2.91		10	6 3/16	11/16	2.91	
24	10	6 7/16	1 3/32	3.17		10	6 17/32	1	3.17		10	6 19/32	15/16	3.17	

A = Minimum Number of Miters for 90° Ell, use half for 45° Ell
B = Miter Base Dimension
C = Miter Top Dimension (* Denotes Negative Radius, See Column E)
D = Lineal Feet of Pipe Covering for One Fitting Cover
(Based on alternating cuts and allowing for saw kerf and waste)
E = Tangent Length for Negative Radius Fittings (Figure 2.2)[1]

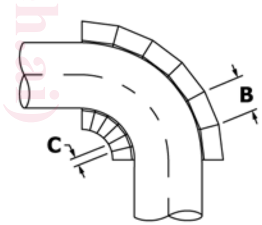

Figure 2.1 Regular Short Radius Ell

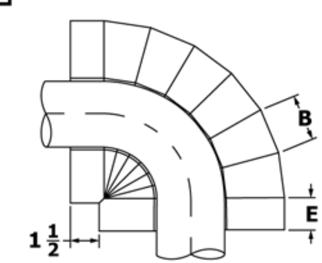

Figure 2.2 Negative Radius Ell

1 - Mitered Negative Radius Fitting Covers create a 'humped' phonomenon in the throat of the fitting. This 'hump' must be rasped down to ensure proper fit with metal elbow covers.

FIG. 1 Short Radius Ells – Recommended Dimensional Standards *(continued)*