



Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications¹

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1. Scope

1.1 This specification covers the pipe materials and dimensions for producing non-reinforced extruded tee connections manufactured by mechanical forming processes. The term “extruded tee connection” applies to butt-weld or socket-weld connections. This specification refers to the forming process that leads to welding or brazing.

1.2 The non-reinforced extruded pipe tee connection is an alternative to the tee fittings, nozzle, and other welded connections.

1.3 The non-reinforced extruded pipe tee connection has been widely used for systems in the marine, process piping, food, pharmaceutical, and similar industries.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 The extruded tee connection will be welded in accordance with Specification F722. Brazing of tee connections will be in accordance with ANSI B31.5.

2. Referenced Documents

2.1 ASTM Standards:²

- A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- A106/A106M Specification for Seamless Carbon Steel Pipe for High-Temperature Service
- A135 Specification for Electric-Resistance-Welded Steel Pipe
- A139/A139M Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
- A161 Specification for Seamless Low-Carbon and Carbon-

- Molybdenum Steel Still Tubes for Refinery (Withdrawn 1999)³
- A178/A178M Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes
- A199/A199M Specification for Seamless Cold-Drawn Intermediate Alloy-Steel Heat-Exchanger and Condenser Tubes (Withdrawn 1995)³
- A200 Specification for Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service (Withdrawn 1999)³
- A209/A209M Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
- A210/A210M Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes
- A250/A250M Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
- A252 Specification for Welded and Seamless Steel Pipe Piles
- A312/A312M Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- A333/A333M Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness
- A334/A334M Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
- A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- A512 Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
- A519 Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
- A587 Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry
- A589 Specification for Seamless and Welded Carbon Steel Water-Well Pipe
- A672 Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures
- B88 Specification for Seamless Copper Water Tube
- B88M Specification for General Requirements for Chemical

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

³ The last approved version of this historical standard is referenced on www.astm.org.

Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys B0881

B280 Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

B337 Specification for Seamless and Welded Titanium and Titanium Alloy Pipe (Withdrawn 1997)³

B338 Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers

B466/B466M Specification for Seamless Copper-Nickel Pipe and Tube

B467 Specification for Welded Copper-Nickel Pipe

F722 Specification for Welded Joints for Shipboard Piping Systems

2.2 ANSI Standards:⁴

B31.1 Power Piping

B31.3 Chemical Plant and Petroleum Refining Piping

B31.5 Refrigeration Piping

B36.10M Welded and Seamless Wrought Steel Pipe

2.3 ISO Standard:⁴

ISO-4200 Plain End Steel Tubes, Welded and Seamless—General Table 5 of Dimensions and Masses Per Unit Length

3. Terminology

3.1 Definitions:

3.1.1 *extruded tee connection*—the tee outlet formed from the run pipe, subsequently welded or brazed to make a connection (see Fig. 1), also known in industry as a branch connection, mechanically formed tee connection, and also extruded outlet.

3.2 *tee ratio*—the ratio of the formed tee connection diameter, divided by the run pipe diameter as follows:

$$\frac{D_t}{D_r} = \text{tee ratio} \quad (1)$$

4. Dimensions and Tolerances

4.1 For welded connections, the dimensions and tolerances of the extruded tee connection shall be within the tolerances of

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

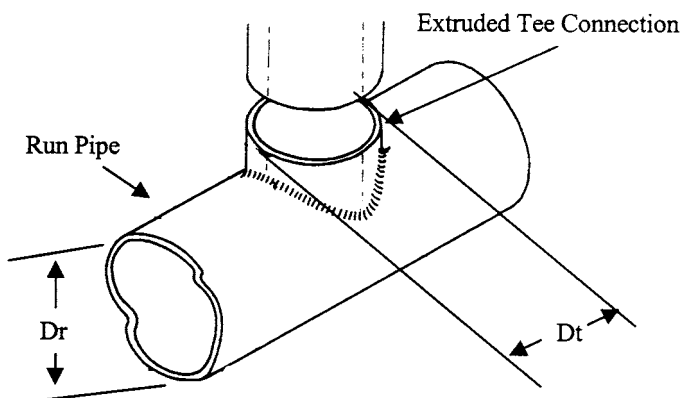


FIG. 1 Extruded Tee Connection

the mating pipe in accordance with Specification F722, as applicable to ANSI B31.1 and B31.3.

4.2 For braze connections, the dimensions and tolerances of the extruded tee connection shall be within the tolerances of the mating pipe in accordance with Specification F722, as applicable to B31.5.

5. Run Pipe Materials and Limitations

5.1 Table 1 contains a list of materials that have been found to have acceptable forming qualities to produce extruded tee connections:

6. Finish, Appearance, and Repairs

6.1 The extruded tee connection shall be free from burrs and cracks, which would affect the suitability for the intended service.

6.2 Pipe/tube repairs are permitted in accordance with the applicable ASTM specification.

TABLE 1 Materials That Have Acceptable Forming Qualities To Produce Extruded Tee Connections

Material	ASTM Material Specifications
Copper	B88, B88M B280
Copper nickel	B466/B466M B467
Titanium ^A	B337 Grades 1 and 2 B338 Grades 1 and 2
Steel ^{B,C}	A53/A53M A135 A161 low carbon A199/A199M Grade T11 A209/A209M Grade T1 A250/A250M Grade T16 A333/A333M Grade 1 A500 Grade A A519 Grade 1010 A589 Grade A A106/A106M Grade B A139/A139M Grade A A178/A178M A200 Grade T36 A210/A210M Grade A-1 A252 Grade 1 A334/A334M Grade 1 A512 Grade MT 1010 A587 A672 Grade A-4
Stainless steel	A312/A312M TP 304 A312/A312M TP 304L A312/A312M TP 309S A312/A312M TP 310S A312/A312M TP 316 A312/A312M TP 316L A312/A312M TP 317 A312/A312M TP 321 A312/A312M TP 347

^A Titanium run pipe must be commercially pure (99.1 %) and is limited to a maximum tee ratio of d.8.

^B The material shall be in a normalized or fully annealed condition before cold forming the extruded tee.

^C Steel shall be hot formed in the temperature range from 850 to 1000°C (from 1562 to 1832°F). Under these conditions, no subsequent stress relieving is required.

7. Run by Tee Connection Sizes (See Figs. 2-13)

7.1 The pipe/tube figures (Figs. 2-13) represent a matrix of the process capabilities, reflecting the extruded tee connections that can be formed from the main pipe/tube diameters and wall thicknesses.

7.2 The pipe and tube sizes and dimensions referred to in Figs. 2-13 are per ANSI B36.10M and ISO 4200. Interpolation is allowable for sizes not covered.

7.3 The limitations are based on current technology and are subject to amendment to equipment or process developments, or both.

8. Allowable Pressures and Temperatures

8.1 The allowable pressures and temperatures shall be in accordance with ANSI B31.1, B31.3, and B31.5 as applicable.

9. Keywords

9.1 extruded outlet; mechanically formed tee connections; outlets; tee connections

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		EXTRUDED TEE CONNECTION DIAMETER (OD)																
		1/4 (3/8")	3/8 (1/2")	1/2 (5/8")	5/8 (3/4")	3/4 (7/8")	1 (1 1/8")	1 1/4 (1 3/8")	1 1/2 (1 5/8")	2 (2 1/8")	2 1/2 (2 5/8")	3 (3 1/8")	4 (4 1/8")	5 (5 1/8")	6 (6 1/8")	8 (8 1/8")	10 (10 1/8")	12 (12 1/8")
R	Nominal	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12
U	Actual	.035	.049	.065	.065	.065	.065	.080	.090	.109	.114	.104	.203	.216	.237	.258	.258	.258
N		L	K	K	K	K	K	K	K	K	K	K	K	K	K	K	L	M
T		L	K	K	K	K	K	K	K	K	K	K	K	K	K	K	L	M
U		L	K	K	K	K	K	K	K	K	K	K	K	K	K	K	L	M
B		L	K	K	K	K	K	K	K	K	K	K	K	K	K	K	L	M
E		L	K	K	K	K	K	K	K	K	K	K	K	K	K	K	L	M
D		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
I		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
A																		
M																		
E																		
T																		
E																		
R																		
(Dr)																		



Nearest copper designation to maximum wall \square Max wall (in)

NOTE 1—Limitation shown in applicable box: K = K copper, L = L copper, and M = M copper.

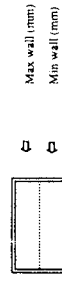
NOTE 2—Minimum wall copper is Class DWV.

NOTE 3—Dimensions are nominal copper tube size (CTS) with actual OD in parentheses.

NOTE 4—All dimensions are in inches.

FIG. 2 Extruded Tee Connection Sizes and Wall Thickness for Copper Tube (Inches)

		EXTRUDED TEE CONNECTION DIAMETER (Dr)														
		21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273	323.9	
R U N P I P E D I A M E T E R (Dr)	OD	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273	323.9	
		2.0														
		1.0														
		2.0	2.0													
		1.0	1.0													
		2.1	2.3	2.0												
		1.0	1.0	1.0												
		2.1	2.3	3.0	2.9	2.9										
		1.0	1.0	1.0	1.0	1.0										
		2.1	2.3	3.0	2.9	2.9	3.6									
		1.0	1.0	1.0	1.0	1.0	1.0									
		2.1	2.3	3.0	3.0	3.0	5.1	5.1								
		1.0	1.0	1.0	1.0	1.0	1.0	1.0								
		2.1	2.3	3.0	3.0	3.0	5.4	5.4	5.4							
		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0							
			3.0	3.2	3.2	5.9	5.9	5.9	5.9							
			1.0	1.0	1.0	1.0	1.0	1.0	1.0							
			2.9	3.6	3.6	6.2	6.2	6.2	6.2	6.2	5.0					
			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0				
			2.9	3.6	3.6	6.2	6.2	6.2	6.2	6.2	6.2	5.0				
			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0			
			2.9	3.7	3.7	6.2	6.2	6.2	6.2	6.2	6.2	6.2	4.5			
			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0			
			3.6	3.6	3.6	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	4.9		
			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
						6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	5.5		
						1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
						6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	4.9		
						1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		



NOTE 1—All sizes are shown in millimetres (mm).
FIG. 3 Extruded Tee Connection Sizes and Wall Thickness for Copper Nickel Pipe—Metric (mm)

		EXTRUDED TEE CONNECTION DIAMETER (D _c)														
PIPE (NPS)		½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12	
R	U	½	.065													
			.025													
N	¾	¾	.080	.080												
			.025	.040												
P	I	1	.080	.090	.080											
			.025	.040	.040											
P	I	1¼	.083	.090	.090	.109										
			.025	.040	.040	.040										
E	1½	1½	.083	.090	.120	.114	.114									
			.025	.040	.040	.040	.040									
D	I	2	.083	.090	.120	.114	.114	.154								
			.025	.040	.040	.040	.040	.040								
I	A	2½	.083	.090	.120	.120	.120	.203	.203							
			.025	.040	.040	.040	.040	.040	.040	.040						
M	E	3	.083	.090	.120	.120	.120	.216	.216	.216						
			.025	.040	.040	.040	.040	.040	.040	.040	.040					
T	E	4	.083	.090	.120	.126	.126	.237	.237	.237	.237					
			.025	.040	.040	.040	.040	.040	.040	.040	.040	.040				
R	6	5			.114	.142	.142	.258	.258	.258	.258	.200				
					.040	.040	.040	.040	.040	.040	.040	.040	.040			
(Dr)	8	6			.114	.142	.142	.258	.258	.258	.258	.258	.200			
					.040	.040	.040	.040	.040	.040	.040	.040	.040	.040		
10	8	8			.114	.148	.148	.258	.258	.258	.258	.258	.177			
					.040	.040	.040	.040	.040	.040	.040	.040	.040	.040		
12	10	10			.142	.142	.258	.258	.258	.258	.258	.258	.258	.197		
					.040	.040	.040	.040	.040	.040	.040	.040	.040	.040	.040	
12	12	12					.258	.258	.258	.258	.258	.258	.258	.220	.258	
							.040	.040	.040	.040	.040	.040	.040	.040	.040	.040

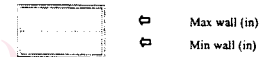


FIG. 4 Extruded Tee Connection Sizes and Wall Thickness for Copper and Copper Nickel Pipe—NPS

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