ASME B16.52-2018

Forged Nonferrous Fittings, Socket-Welding and Threaded

(Titanium, Titanium Alloys, Aluminum, and Aluminum Alloys)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

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ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME B16 Committee may be published as Cases. Cases and interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org/ as they are issued.

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The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD

During 2013, the B16 Subcommittee F began discussions on the addition of more nonferrous materials to ASME B16.11. After much deliberation, it was decided that a better approach was to develop a new standard that linked the nonferrous fitting design to a nonferrous pipe wall thickness of equivalent material, pipe schedule, and size as the fitting instead of using Class designation. This project gained momentum in 2016 and a new document was developed and balloting commenced. Several differences between this Standard and ASME B16.11 are provided to incorporate designated pipe schedule wall thickness to fitting designs and material marking requirements.

Following approval by the ASME B16 Standards Committee, ASME B16.52-2018 was approved as an American National Standard by ANSI on March 29, 2018.

ASME B16 COMMITTEE
Standardization of Valves, Flanges, Fittings, and Gaskets

(The following is the roster of the Committee at the time of approval of this Standard.)

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Secretary, B16 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the B16 Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B16 Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may e-mail the request to the Secretary of the B16 Standards Committee at SecretaryB16@asme.org, or mail it to the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The B16 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B16 Standards Committee.

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FORGED NONFERROUS FITTINGS, SOCKET-WELDING AND THREADED (Titanium, Titanium Alloys, Aluminum, and Aluminum Alloys)

1 SCOPE AND GENERAL

1.1 Scope

1.1.1 Standard Fittings. This Standard covers ratings, dimensions, tolerances, marking, and material requirements for titanium, titanium alloy, aluminum, and aluminum alloy forged fittings, both socket-welding and threaded ends.

1.1.2 Special Fittings. Fittings with special dimensions, threads, or counterbores may be made by agreement between the manufacturer and purchaser. When such fittings meet all other requirements of this Standard, they shall be considered in compliance with this Standard.

1.2 General

1.2.1 Fitting Types/Configuration. Types of fittings covered by this Standard are shown in Table 1.2.1-1, by Designated Schedule Fitting by pipe schedule and size range. Fittings shown in Tables 1.2.1-2 through 1.2.1-6 may also be made with combinations of socket-welding and threaded ends.

1.2.2 Referenced Standards. Standards and specifications adopted by reference in this Standard are shown in Mandatory Appendix I. It is not considered practical to identify the specific edition of each standard and specification in the individual references. Instead, the specific edition reference is identified in Mandatory Appendix I. A fitting made in conformance and conforming to this Standard, in all other respects, will be considered to be in conformance to the Standard, even though the edition reference may be changed in a subsequent revision of the Standard.

1.2.3 Codes and Regulations. A fitting used under the jurisdiction of the ASME Boiler and Pressure Vessel Code, the ASME Code for Pressure Piping, or a governmental regulation is subject to any limitation of that code or regulation. This includes any maximum temperature limitation, rule governing the use of a material at low temperature, or provisions for operation at a pressure exceeding the ratings in this Standard.

1.2.4 Service Conditions. Criteria for selection of fitting types and materials suitable for particular fluid service are not within the scope of this Standard.

1.2.5 Quality Systems. Nonmandatory requirements relating to the product manufacturer's quality system program are described in Nonmandatory Appendix A.

1.2.6 Welding. Installation welding requirements are not within the scope of this Standard. Installation welding shall be in accordance with the applicable piping code or regulation covering the piping system into which the fittings are installed.

1.2.7 Relevant Units. This Standard states values in both SI (Metric) and U.S. Customary units. These systems of units are to be regarded separately as standard. Within the text, the U.S. Customary units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, it is required that each system be used independently of the other. Combining values from the two systems constitutes nonconformance with the Standard.

2 PRESSURE RATINGS

2.1 General

Fittings under this Standard shall be Designated Schedule 40, 80, or 160 for threaded end and socket-weld end fittings.

2.1.1 Basis of Rating. The schedule of pipe corresponding to each Designated Schedule fitting for rating purposes is shown in Table 2.1.1-1. Design temperature and other service conditions shall be limited as provided by the applicable piping code or regulation for the material of construction of the fitting. Within these limits, the minimum wall thickness for pipe to be used with a Table 2.1.1-1 Designated Schedule fitting shall be computed based on appropriate size straight seamless pipe of equivalent material as the fitting (as shown by comparison of composition and mechanical properties in the respective material specifications). The minimum pipe wall thickness calculation shall include pressure design and all applicable additional allowances (e.g., erosion, corrosion, and thread depth for threaded pipe). The minimum wall thickness for selected pipe, considering manufacturing minus wall thickness tolerance (typically 12.5%), shall not be less than the minimum wall calculation. The fitting is suitable for the application if the wall thickness of the selected pipe equals or is less than the ASME B36.10M or ASME B36.19M Schedule No. pipe wall thickness

correlated with the fitting in Table 2.1.1-1 [see Notes (1) and (2) in Table 2.1.1-1].

2.1.2 Nonstandard Pipe Wall Thickness. Since ASME B36.10M does not include Schedule 160 thickness for NPS 1/8, 1/4, and 3/8, the values in Table 2.1.2-1 shall be used as the nominal wall thicknesses of the pipe for rating purposes.

2.1.3 Combination End Fittings. The Designated Schedule Class designation for fittings made with combinations of socket-welding and threaded ends rating shall be based on the end configuration that has the lowest pipe schedule rating.

2.2 Pressure Test Capability

Pressure testing is not required by this Standard, but the fittings shall be capable of withstanding a hydrostatic test pressure required by the applicable piping code for seamless pipe of material equivalent to the fitting forging and of the schedule or wall thickness correlated with the fitting and end connection of Table 2.1.1-1.

3 SIZE AND TYPE

3.1 General

NPS, followed by a dimensionless number, is the designation for nominal fitting size. NPS is related to the reference nominal diameter, DN, used in international standards. The relationship is typically as follows:

NPS	DN
1/8	6
1/4	8
3/8	10
1/2	15
3/4	20
1	25
1 1/4	32
1 1/2	40
2	50
2 1/2	65
3	80
4	100

3.2 Reducing Fitting Size

In the case of reducing tees and crosses, the size of the largest run opening shall be given first, followed by the size of the opening at the opposite end of the run. Where the fitting is a tee, the size of the branch is given last (e.g., 1 1/2 × 3/4 × 1 1/4). Where the fitting is a cross, the largest side outlet is the third dimension given, followed by the size of the opening at the opposite end (e.g., 1 1/2 × 3/4 × 1 1/4 × 1/2). See Figure 3.2-1.

4 MARKING

4.1 General

Each fitting shall be permanently marked with the required identification by raised lettering and/or stamping, electroetching, or vibro-tool marking on the collar portion, raised pad, or raised boss portion of the forging.

Cylindrical fittings shall be marked on the O.D. or end of the fitting in a location such that the marking will not be obliterated as a result of welding installation. The marking of bushings and plugs is not required by this Standard.

4.1.1 Specific Marking. The marking shall include (but is not limited to) the following:

(a) Manufacturer's Name or Trademark

(b) Material Identification. Material shall be identified in accordance with the marking requirements of either the appropriate ASTM Fitting or ASTM Forging Specifications (see para. 5.1).

(c) Product Conformance. Fittings covered under para. 1.1.1 shall be marked with either the ASTM Fittings Specification material alloy designation (e.g., "WPxxxx" for aluminum or "WPTxxx" for titanium) or ASTM Forging Alloy (e.g., B247 xxxxTx) and the symbol "B16" to denote conformance to this Standard. Fittings covered under para. 1.1.2 shall be marked with a supplementary suffix as follows:

(1) for ASTM Fitting Specifications B361 and B363, suffix "B16" with "SPLD"

(2) for ASTM Forging Specifications B247 and B381, suffix "B16" with "SPLD"

(d) Designated Schedule Fitting 40, 80, or 160, as applicable.

(e) Size. The nominal pipe size related to the end connections.

4.1.2 Omission of Markings. Where size and shape of fittings do not permit all of the above markings, they may be omitted in the reverse order given above.

5 MATERIAL

5.1 Standard Materials

Fittings shall be made of materials consisting of forgings, bar, seamless pipe, or seamless tubular products, except tees, elbows, and crosses shall not be machined directly from bar stock. Aluminum and aluminum alloys shall conform to the requirements for the WP seamless construction materials of ASTM Fitting Specification B361 or ASTM Forging Specification B247. Titanium and titanium alloys shall conform to the requirements for the WP seamless construction materials of ASTM Fitting Specification B363 or ASTM Forging Specification B381.

6 DIMENSIONS

6.1 General

Unless otherwise noted, the dimensions without tolerances for socket-welding fittings given in Table 1.2.1-2 and the dimensions without tolerances for threaded fittings given in Tables 1.2.1-3 through 1.2.1-6 are nominal values and subject to the designated manufacturing tolerances.

6.2 Socket Fittings

6.2.1 Body Wall Thickness. The body wall thickness of socket-welding fittings shall be equal to or greater than the values, *G*, shown in Table 1.2.1-2.

6.2.2 Socket Wall Thickness. The socket wall average thickness and minimum thickness shall not be less than the corresponding values, *C*, shown in Tables 1.2.1-2 and 1.2.1-3.

6.2.3 Socket Position. The fixed position for the bottom of the socket with reference to the centerline of the socket-welding fitting shall be maintained as required by the dimension, *A*, of Table 1.2.1-2. For reducing fittings, see para. 6.5.

6.2.4 Socket Depth. The socket depth shall not be less than the minimum values, *J*, shown in Tables 1.2.1-2 and 1.2.1-3.

6.2.5 Socket Bore. The inside surface of the socket bore shall present a good workmanlike finish that is free of burrs.

6.2.6 Perpendicularity. The end flats of socket-welding fittings shall be at right angles to the socket axis.

6.2.7 Width. The forging radius shall not reduce the width of the flat welding surface to less than the value shown in Figure 6.2.7-1. The minimum flat length is not an indicator for fillet weld leg length.

6.3 Threaded Fittings

6.3.1 Wall Thickness. The body or end wall thickness of threaded fittings shall be equal to or greater than the minimum values, *G*, as shown in Tables 1.2.1-4 through 1.2.1-6.

6.3.2 Internal Threading. All fittings with internal threads shall be threaded with American National Standard Taper Pipe Threads (ASME B1.20.1). Variations in threading shall be limited to one turn large or one turn small from the gaging notch when using working gages. The reference point for gaging is the starting end of the fitting, provided the chamfer does not exceed the major diameter of the internal thread. When a chamfer on the internal thread exceeds this limit, the reference point becomes the last thread scratch on the chamfer cone.

6.3.3 External Threads. All externally threaded fittings shall be threaded with American National Standard Taper Pipe Threads (ASME B1.20.1), and the variation in threading shall be limited to one turn large or one turn small from the gage face of ring when using working gages. The reference point for gaging is the end of the thread, provided the chamfer is not smaller than the minor diameter of the external thread. When a chamfer on the external thread exceeds this limit, the reference point becomes the last thread scratch on the chamfer cone.

6.3.4 Countersink or Chamfer. All internal threads shall be countersunk a distance not less than one-half the pitch of the thread at an angle of approximately 45 deg with the axis of the thread, and all external threads shall be chamfered at an angle of 30 deg to 45 deg from the axis, for easier entrance in making a joint and protection of the thread. Countersinking and chamfering shall be concentric with the threads. The length of threads specified in all tables shall be measured to include the countersink or chamfer.

6.4 Collars

End collars of both socket-welding and threaded fittings shall be such that they overlap the crotch area as illustrated in the sketches in Tables 1.2.1-2 and 1.2.1-3.

6.5 Reducing Fittings

Reducing fittings, combination straight and reducing threaded × threaded, threaded × socket welding, and socket welding × socket welding couplings shall have the same center-to-end, center-to-bottom of socket, band diameter, and outside diameters as the uniform size fitting corresponding to the largest size end connection of the reducing fitting.

7 ADDITIONAL TOLERANCES

These are additional tolerances to those listed in Table 1.2.1-2.

7.1 Concentricity of Bores

The socket and fitting bores shall be concentric within a tolerance of 0.8 mm (0.03 in.) for all sizes. Opposite socket bores shall be concentric within a tolerance of 1.5 mm (0.06 in.) for all sizes.

7.2 Perpendicularity/Angularity of Threaded and Socket-Welding Connections

The maximum allowable variation in the perpendicularity of the socket weld 90-deg outlets to the face of the fitting shall be 1 mm in 200 mm (0.06 in. in 1 ft). For 45-deg elbows, the maximum allowable variation in the angularity of the socket-welding connections shall be 1 mm in 200 mm (0.06 in. in 1 ft) to the face

of fitting. For threaded fittings, the maximum allowable variation in perpendicularity of 90-deg threads or angularity of 45-deg threads shall be 1 mm in 200 mm (0.06 in. in 1 ft) to the opposite 90-deg or 45-deg thread.

8 PROOF TESTING

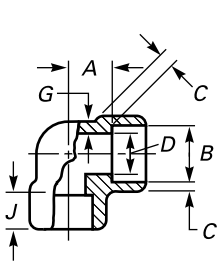
Proof testing for fittings made to this Standard is not required.

Table 1.2.1-1 Types of Designated Schedule Fittings by Pipe Schedule and NPS Size Range

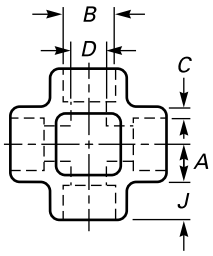
Description	Socket-Welding		Threaded	
	Designated Schedule		Designated Schedule	
	40 and 80	160	80	160
45-deg, 90-deg elbows, tees, crosses, couplings, half couplings, and caps	1/8–4	1/8–2	1/8–4	1/8–4
	1/8–4	1/8–2	1/8–4	1/8–4
	1/8–4	1/8–2	...	1/8–4
	1/8–4	1/8–2	...	1/8–4
Street elbows	...	...	...	1/8–2
Square, hex, round plug, and flush bushing	...	...	1/8–4 [Note (1)]	1/8–4 [Note (1)]
	...	...	1/4–4 [Note (1)]	1/4–4 [Note (1)]

NOTE: (1) Plugs and bushings are not identified by Designated Schedule. They may be used with piping system of equivalent material grade as the fitting for ratings up to Designated Schedule 160.

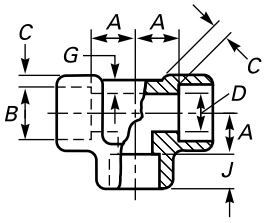
Table 1.2.1-2 Socket-Welding Fittings



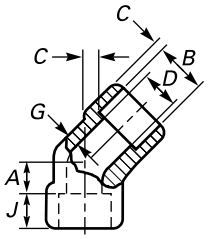
90-deg Elbow



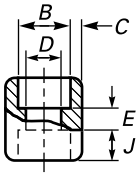
Cross



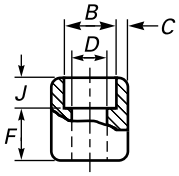
Tee



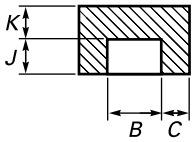
45-deg Elbow



Coupling



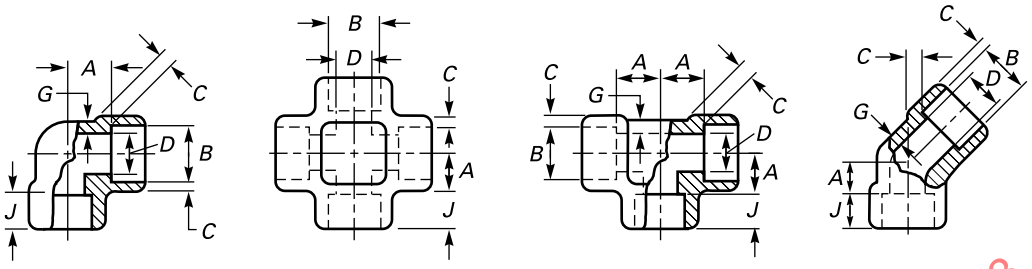
Half Coupling

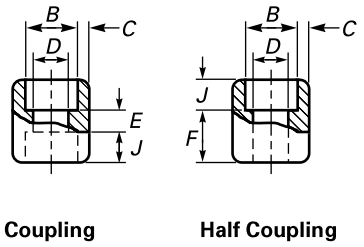


Cap

Nominal Pipe Size	Socket Bore Dia., *B*		Bore Diameter of Fittings, *D*						Socket Wall Thickness, *C* [Note (1)]					
			Designated Schedule						Designated Schedule					
			40		80		160		40		80		160	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Avg.	Min.	Avg.	Min.	Avg.	Min.
	SI Units, mm													
1/8	11.2	10.8	7.6	6.1	6.3	4.8	4.8	3.2	3.18	3.18	3.18	3.18	3.96	3.43
1/4	14.6	14.2	10.0	8.5	8.5	7.0	7.1	5.6	3.18	3.18	3.78	3.30	4.60	4.01
3/8	18.0	17.6	13.3	11.8	11.5	10.0	9.9	8.4	3.18	3.18	4.01	3.50	5.03	4.37
1/2	22.2	21.8	16.6	15.0	14.6	13.1	12.5	11.0	3.46	3.18	4.67	4.09	5.97	5.18
3/4	27.6	27.2	21.7	20.2	19.7	18.2	16.3	14.8	3.59	3.18	4.90	4.27	6.96	6.04
1	34.3	33.9	27.4	25.9	25.1	23.6	21.5	19.9	4.22	3.68	5.69	4.98	7.92	6.93
1 1/4	43.1	42.7	35.8	34.3	33.3	31.8	30.2	28.7	4.45	3.88	6.07	5.28	7.92	6.93
1 1/2	49.2	48.8	41.6	40.1	38.9	37.4	34.7	33.2	4.60	4.01	6.35	5.54	8.92	7.80
2	61.7	61.2	53.3	51.7	50.0	48.5	43.6	42.1	4.89	4.29	6.93	6.04	10.92	9.50
2 1/2	74.4	73.9	64.2	61.2	60.5	57.5	...	...	6.45	5.62	8.76	7.67	...	...
3	90.3	89.8	79.4	76.4	75.2	72.2	...	...	6.86	5.98	9.52	8.30	...	...
4	115.7	115.2	103.8	100.7	98.7	95.7	...	...	7.52	6.56	10.69	9.35	...	...

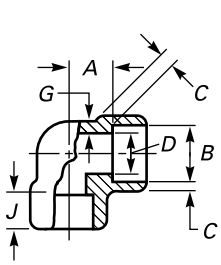
Table 1.2.1-2 Socket-Welding Fittings (Cont'd)



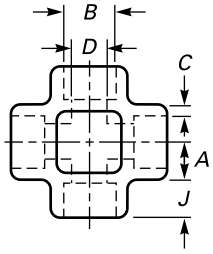


Body Wall, *G*				Center-to-Bottom of Socket, *A*											
Designated Schedule				90-deg Elbows, Tees, and Crosses		45-deg Elbows		Laying Lengths		Tolerances, ±			End Wall Thickness, K_{min} Pipe Designation		
40	80	160		Designated Schedule		Designated Schedule									
Min.	Min.	Min.	Socket, *J*	40/80	160	40/80	160	Couplings, *E*	Half Couplings, *F*	*A*	*E*	*F*	40/80	160	Nominal Pipe Size
SI Units, mm															
1.73	2.41	3.15	9.5	11.0	11.0	8.0	8.0	6.5	16.0	1.0	1.5	1.0	4.8	6.4	1/8
2.24	3.02	3.68	9.5	11.0	13.5	8.0	8.0	6.5	16.0	1.0	1.5	1.0	4.8	6.4	1/4
2.31	3.20	4.01	9.5	13.5	15.5	8.0	11.0	6.5	17.5	1.5	3.0	1.5	4.8	6.4	3/8
2.77	3.73	4.78	9.5	15.5	19.0	11.0	12.5	9.5	22.5	1.5	3.0	1.5	6.4	7.9	1/2
2.87	3.91	5.56	12.5	19.0	22.5	13.0	14.0	9.5	24.0	1.5	3.0	1.5	6.4	7.9	3/4
3.38	4.55	6.35	12.5	22.5	27.0	14.0	17.5	12.5	28.5	2.0	4.0	2.0	9.6	11.2	1
3.56	4.85	6.35	12.5	27.0	32.0	17.5	20.5	12.5	30.0	2.0	4.0	2.0	9.6	11.2	1 1/4
3.68	5.08	7.14	12.5	32.0	38.0	20.5	25.5	12.5	32.0	2.0	4.0	2.0	11.2	12.7	1 1/2
3.91	5.54	8.74	16.0	38.0	41.0	25.5	28.5	19.0	41.0	2.0	4.0	2.0	12.7	15.7	2
5.16	7.01	...	16.0	41.0	...	28.5	...	19.0	43.0	2.5	5.0	2.5	15.7	19.0	2 1/2
5.49	7.62	...	16.0	57.0	...	32.0	...	19.0	44.5	2.5	5.0	2.5	19.0	22.4	3
6.02	8.56	...	19.0	66.5	...	41.0	...	19.0	48.0	2.5	5.0	2.5	22.4	28.4	4

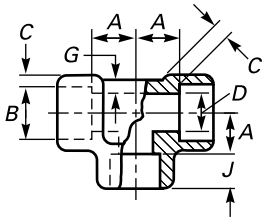
Table 1.2.1-2 Socket-Welding Fittings (Cont'd)



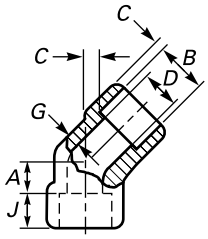
90-deg Elbow



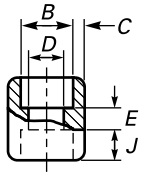
Cross



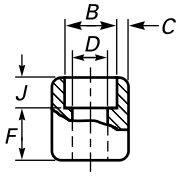
Tee



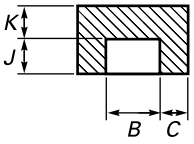
45-deg Elbow



Coupling



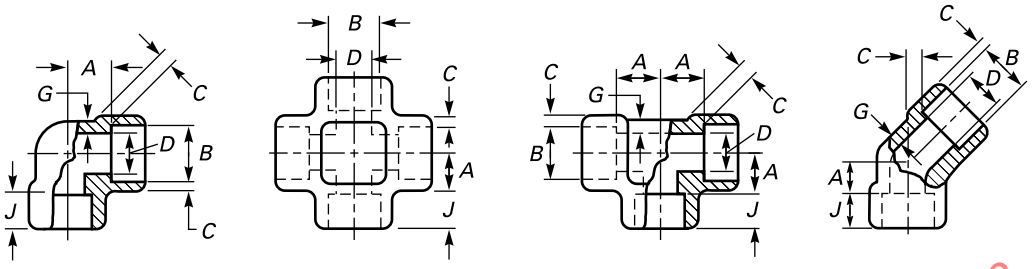
Half Coupling



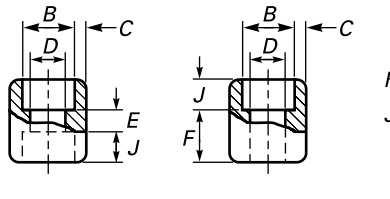
Cap

Nominal Pipe Size	Socket Bore Dia., *B*		Bore Diameter of Fittings, *D*						Socket Wall Thickness, *C* [Note (1)]					
			Designated Schedule						Designated Schedule					
			40		80		160		40		80		160	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Avg.	Min.	Avg.	Min.	Avg.	Min.
U.S. Customary Units, in.														
1/8	0.440	0.420	0.299	0.239	0.245	0.185	0.189	0.126	0.125	0.125	0.125	0.125	0.156	0.135
1/4	0.575	0.555	0.394	0.334	0.332	0.272	0.280	0.220	0.125	0.125	0.149	0.130	0.181	0.158
3/8	0.710	0.690	0.523	0.463	0.453	0.393	0.389	0.329	0.125	0.125	0.158	0.138	0.198	0.172
1/2	0.875	0.855	0.652	0.592	0.576	0.516	0.494	0.434	0.136	0.125	0.184	0.161	0.235	0.204
3/4	1.085	1.065	0.854	0.794	0.772	0.712	0.642	0.582	0.141	0.125	0.193	0.168	0.274	0.238
1	1.350	1.330	1.079	1.019	0.987	0.927	0.845	0.785	0.166	0.145	0.224	0.196	0.312	0.273
1 1/4	1.695	1.675	1.410	1.350	1.308	1.248	1.190	1.130	0.175	0.153	0.239	0.208	0.312	0.273
1 1/2	1.935	1.915	1.640	1.580	1.530	1.470	1.368	1.308	0.181	0.158	0.250	0.218	0.351	0.307
2	2.426	2.406	2.097	2.037	1.969	1.909	1.717	1.657	0.193	0.169	0.273	0.238	0.430	0.374
2 1/2	2.931	2.906	2.529	2.409	2.383	2.263	...	...	0.254	0.222	0.345	0.302	...	...
3	3.560	3.535	3.128	3.008	2.960	2.840	...	...	0.270	0.236	0.375	0.327	...	...
4	4.570	4.545	4.086	3.966	3.886	3.766	...	...	0.296	0.258	0.421	0.368	...	...

Table 1.2.1-2 Socket-Welding Fittings (Cont'd)



90-deg Elbow | Cross | Tee | 45-deg Elbow



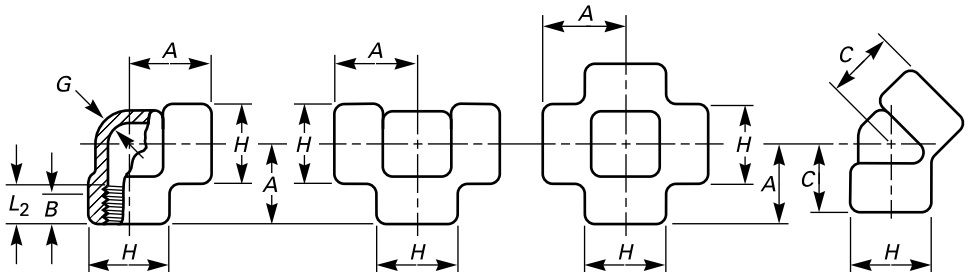
Coupling | Half Coupling | Cap

Body Wall, *G*				Center-to-Bottom of Socket, *A*									End Wall Thickness, K_{min}		
Designated Schedule				90-deg Elbows, Tees, and Crosses		45-deg Elbows		Laying Lengths		Tolerances, ±			Pipe Designation		
40	80	160		Designated Schedule		Designated Schedule									
Min.	Min.	Min.	Socket, *J*	40/80	160	40/80	160	Couplings, *E*	Half Couplings, *F*	*A*	*E*	*F*	40/80	160	Nominal Pipe Size
U.S. Customary Units, in.															
0.068	0.095	0.124	0.38	0.44	0.44	0.31	0.31	0.25	0.62	0.03	0.06	0.03	0.19	0.25	1/8
0.088	0.119	0.145	0.38	0.44	0.53	0.31	0.31	0.25	0.62	0.03	0.06	0.03	0.19	0.25	1/4
0.091	0.126	0.158	0.38	0.53	0.62	0.31	0.44	0.25	0.69	0.06	0.12	0.06	0.19	0.25	3/8
0.109	0.147	0.188	0.38	0.62	0.75	0.44	0.50	0.38	0.88	0.06	0.12	0.06	0.25	0.31	1/2
0.113	0.154	0.219	0.50	0.75	0.88	0.50	0.56	0.38	0.94	0.06	0.12	0.06	0.25	0.31	3/4
0.133	0.179	0.250	0.50	0.88	1.06	0.56	0.69	0.50	1.12	0.08	0.16	0.08	0.38	0.44	1
0.140	0.191	0.250	0.50	1.06	1.25	0.69	0.81	0.50	1.19	0.08	0.16	0.08	0.38	0.44	1 1/4
0.145	0.200	0.281	0.50	1.25	1.50	0.81	1.00	0.50	1.25	0.08	0.16	0.08	0.44	0.50	1 1/2
0.154	0.218	0.344	0.62	1.50	1.62	1.00	1.12	0.75	1.62	0.08	0.16	0.08	0.50	0.62	2
0.203	0.276	...	0.62	1.62	...	1.12	...	0.75	1.69	0.10	0.20	0.10	0.62	0.75	2 1/2
0.216	0.300	...	0.62	2.25	...	1.25	...	0.75	1.75	0.10	0.20	0.10	0.75	0.88	3
0.237	0.337	...	0.75	2.62	...	1.62	...	0.75	1.88	0.10	0.20	0.10	0.88	1.12	4

Table 1.2.1-2 Socket-Welding Fittings (Cont'd)

NOTE: (1) Average of socket wall thickness around periphery shall not be less than listed values. The minimum values are permitted in localized areas.

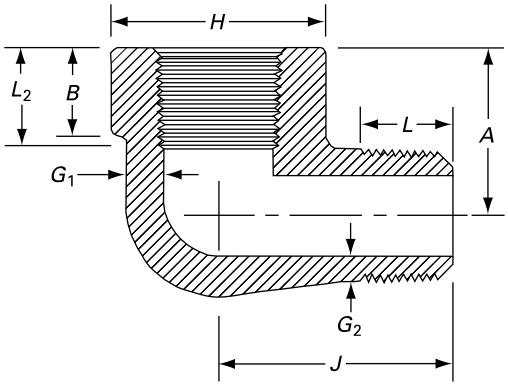
Table 1.2.1-3 Forged Threaded Fittings



Nominal Pipe Size	Center-to-End Elbows, Tees, and Crosses, *A*, mm (in.)		Center-to-End 45-deg Elbow, *C*, mm (in.)		Outside Diameter of Band, *H*, mm (in.)		Minimum Wall Thickness, *G*, mm (in.)		Minimum Length of Thread, mm (in.) [Note (1)]	
	Designated Schedule		Designated Schedule		Designated Schedule		Designated Schedule			
	80	160	80	160	80	160	80	160	*B*	L_2
1/8	21 (0.81)	21 (0.81)	17 (0.69)	17 (0.69)	22 (0.88)	22 (0.88)	3.18 (0.125)	3.18 (0.125)	6.4 (0.25)	6.7 (0.2639)
1/4	21 (0.81)	25 (0.97)	17 (0.69)	19 (0.75)	22 (0.88)	25 (1.00)	3.18 (0.125)	3.30 (0.130)	8.1 (0.32)	10.2 (0.4018)
3/8	25 (0.97)	28 (1.12)	19 (0.75)	22 (0.88)	25 (1.00)	33 (1.31)	3.18 (0.125)	3.51 (0.138)	9.1 (0.36)	10.4 (0.4078)
1/2	28 (1.12)	33 (1.31)	22 (0.88)	25 (1.00)	33 (1.31)	38 (1.50)	3.18 (0.125)	4.09 (0.161)	10.9 (0.43)	13.6 (0.5337)
3/4	33 (1.31)	38 (1.50)	25 (1.00)	28 (1.12)	38 (1.50)	46 (1.81)	3.18 (0.125)	4.32 (0.170)	12.7 (0.50)	13.9 (0.5457)
1	38 (1.50)	44 (1.75)	28 (1.12)	33 (1.31)	46 (1.81)	56 (2.19)	3.68 (0.145)	4.98 (0.196)	14.7 (0.58)	17.3 (0.6828)
1 1/4	44 (1.75)	51 (2.00)	33 (1.31)	35 (1.38)	56 (2.19)	62 (2.44)	3.89 (0.153)	5.28 (0.208)	17.0 (0.67)	18.0 (0.7068)
1 1/2	51 (2.00)	60 (2.38)	35 (1.38)	43 (1.69)	62 (2.44)	75 (2.97)	4.01 (0.158)	5.56 (0.219)	17.8 (0.70)	18.4 (0.7235)
2	60 (2.38)	64 (2.50)	43 (1.69)	44 (1.72)	75 (2.97)	84 (3.31)	4.27 (0.168)	7.14 (0.281)	19.0 (0.75)	19.2 (0.7565)
2 1/2	76 (3.00)	83 (3.25)	52 (2.06)	52 (2.06)	92 (3.62)	102 (4.00)	5.61 (0.221)	7.65 (0.301)	23.6 (0.93)	28.9 (1.1380)
3	86 (3.38)	95 (3.75)	64 (2.50)	64 (2.50)	109 (4.31)	121 (4.75)	5.99 (0.236)	8.84 (0.348)	25.9 (1.02)	30.5 (1.2000)
4	106 (4.19)	114 (4.50)	79 (3.12)	79 (3.12)	146 (5.75)	152 (6.00)	6.55 (0.258)	11.18 (0.440)	27.7 (1.09)	33.0 (1.3000)

NOTE: (1) Dimension *B* is minimum length of perfect thread. The length of useful thread (*B* plus threads with fully formed roots and flat crests) shall not be less than L_2 (effective length of external thread) required by American National Standard for Pipe Threads (ASME B1.20.1; see para. 6.3).

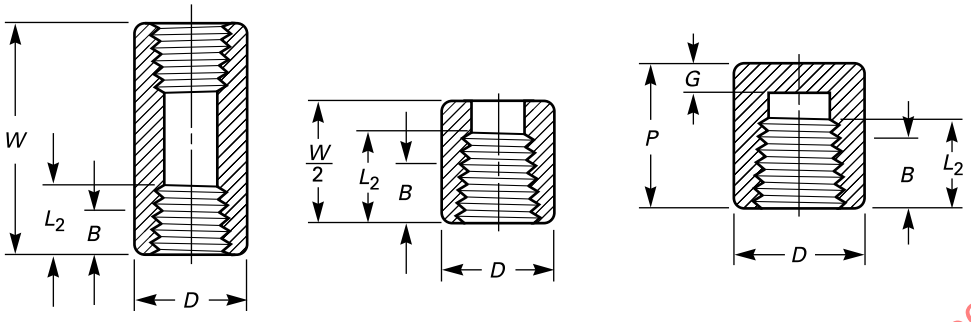
Table 1.2.1-4 Forged Threaded Fittings — Street Elbows



Nominal Pipe Size	Center-to-Female End Street Ells, *A*, mm (in.) [Note (1)]	Center-to-Male End Street Ells, *J*, mm (in.)	Outside Diameter of Band, *H*, mm (in.) [Note (2)]	Minimum Wall Thickness, G_1, mm (in.)	Minimum Wall Thickness, G_2, mm (in.) [Note (3)]	Minimum Length Internal Thread, mm (in.) [Note (4)]		Minimum Length Male Thread, *L*, mm (in.)
	Designated Schedule 160					*B*	L_2	
1/8	19 (0.75)	25 (1.00)	19 (0.75)	3.18 (0.125)	2.74 (0.108)	6.4 (0.25)	6.7 (0.2639)	10 (0.38)
1/4	22 (0.88)	32 (1.25)	25 (1.00)	3.30 (0.130)	3.22 (0.127)	8.1 (0.32)	10.2 (0.4018)	11 (0.44)
3/8	25 (1.00)	38 (1.50)	32 (1.25)	3.51 (0.138)	3.50 (0.138)	9.1 (0.36)	10.4 (0.4078)	13 (0.50)
1/2	28 (1.12)	41 (1.62)	38 (1.50)	4.09 (0.161)	4.16 (0.164)	10.9 (0.43)	13.6 (0.5337)	14 (0.56)
3/4	35 (1.38)	48 (1.88)	44 (1.75)	4.32 (0.170)	4.88 (0.192)	12.7 (0.50)	13.9 (0.5457)	16 (0.62)
1	44 (1.75)	57 (2.25)	51 (2.00)	4.98 (0.196)	5.56 (0.219)	14.7 (0.58)	17.3 (0.6828)	19 (0.75)
1 1/4	51 (2.00)	66 (2.62)	62 (2.44)	5.28 (0.208)	5.56 (0.219)	17.0 (0.67)	18.0 (0.7068)	21 (0.81)
1 1/2	54 (2.12)	71 (2.81)	70 (2.75)	5.56 (0.219)	6.25 (0.246)	17.8 (0.70)	18.4 (0.7235)	21 (0.81)
2	64 (2.50)	84 (3.31)	84 (3.31)	7.14 (0.281)	7.64 (0.301)	19.0 (0.75)	19.2 (0.7565)	22 (0.88)

NOTES:
(1) Dimension *A* of Table 1.2.1-3 for the appropriate fitting size may also be used at the option of the manufacturer.
(2) Dimension *H* of Table 1.2.1-3 for the appropriate fitting size may also be used at the option of the manufacturer.
(3) Wall thickness before threading.
(4) Dimension *B* is minimum length of perfect thread. The length of useful thread (*B* plus threads with fully formed roots and flat crests) shall not be less than L_2 (effective length of external thread) required by American National Standard for Pipe Threads (ASME B1.20.1; see para. 6.3).

Table 1.2.1-5 Threaded Fittings



Coupling | Half Coupling | Cap

Nominal Pipe Size	End-to-End Couplings, *W*, mm (in.)	End-to-End Caps, *P*, mm (in.)	Outside Diameter, *D*, mm (in.)	Minimum End Wall Thickness, *G*, mm (in.)	Minimum Length of Thread, mm (in.) [Note (1)]	
	Designated Schedule 160				*B*	L_2
1/8	32 (1.25)	19 (0.75)	16 (0.62)	4.8 (0.19)	6.4 (0.25)	6.7 (0.2639)
1/4	35 (1.38)	25 (1.00)	19 (0.75)	4.8 (0.19)	8.1 (0.32)	10.2 (0.4018)
3/8	38 (1.50)	25 (1.00)	22 (0.88)	4.8 (0.19)	9.1 (0.36)	10.4 (0.4078)
1/2	48 (1.88)	32 (1.25)	28 (1.12)	6.4 (0.25)	10.9 (0.43)	13.6 (0.5337)
3/4	51 (2.00)	37 (1.44)	35 (1.38)	6.4 (0.25)	12.7 (0.50)	13.9 (0.5457)
1	60 (2.38)	41 (1.62)	44 (1.75)	9.7 (0.38)	14.7 (0.58)	17.3 (0.6828)
1 1/4	67 (2.62)	44 (1.75)	57 (2.25)	9.7 (0.38)	17.0 (0.67)	18.0 (0.7068)
1 1/2	79 (3.12)	44 (1.75)	64 (2.50)	11.2 (0.44)	17.8 (0.70)	18.4 (0.7235)
2	86 (3.38)	48 (1.88)	76 (3.00)	12.7 (0.50)	19.0 (0.75)	19.2 (0.7565)
2 1/2	92 (3.62)	60 (2.38)	92 (3.62)	15.7 (0.62)	23.6 (0.93)	28.9 (1.1380)
3	108 (4.25)	65 (2.56)	108 (4.25)	19.0 (0.75)	25.9 (1.02)	30.5 (1.2000)
4	121 (4.75)	68 (2.69)	140 (5.50)	22.4 (0.88)	27.7 (1.09)	33.0 (1.3000)

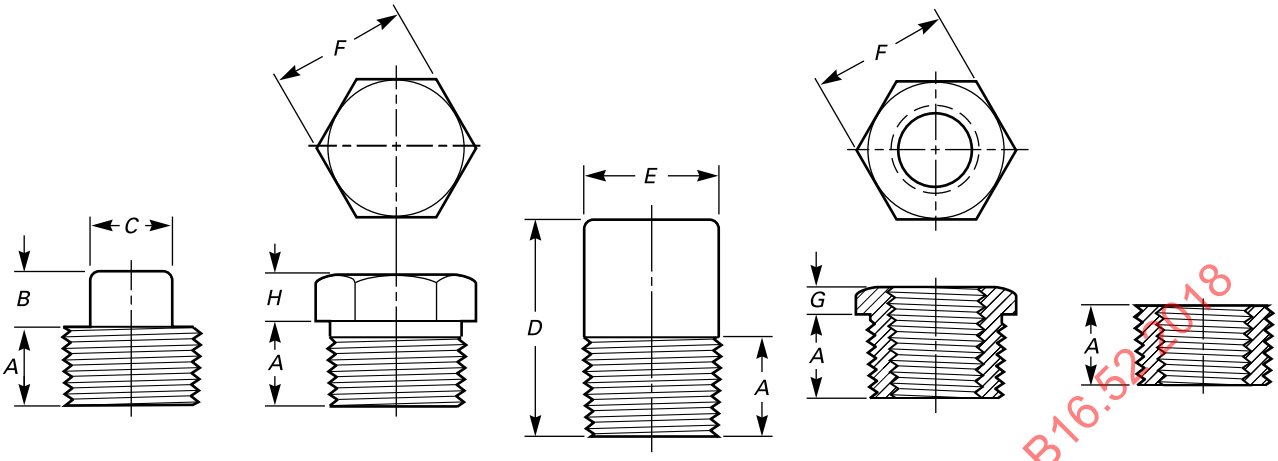
GENERAL NOTES:

(a) Designated Schedule 160 coupling, half coupling, and cap dimensions are included in this Standard. Coupling, half coupling, and cap wall thickness shall meet (b) except for the specified end wall thickness, *G*.

(b) The wall thickness away from the threaded ends shall meet the minimum wall thickness requirements of Table 1.2.1-3 for the appropriate NPS and Designated Schedule fitting.

NOTE: (1) Dimension *B* is minimum length of perfect thread. The length of useful thread (*B* plus thread with fully formed roots and flat crests) shall not be less than L_2 (effective length of external thread) required by American National Standard for Pipe Threads (ASME B1.20.1; see para. 6.3).

Table 1.2.1-6 Plugs and Bushings



Square Head Plug | Hex Head Plug | Round Head Plug | Hex Head Bushing [Note (1)] | Flush Bushing

Nominal Pipe Size	Minimum Length, *A*, mm (in.)	Square Head Plugs		Round Head Plugs		Hex Plugs and Bushings		
		Minimum Square Height, *B*, mm (in.)	Minimum Width Flats, *C*, mm (in.) [Note (2)]	Nominal Head Diameter, *E*, mm (in.)	Minimum Length, *D*, mm (in.)	Nominal Width Flats, *F*, mm (in.) [Note (2)]	Minimum Hex Height	
							Bushing, *G*, mm (in.)	Plug, *H*, mm (in.)
1/8	10 (0.38)	6 (0.25)	7.15 (0.28)	10 (0.41)	35 (1.38)	11.11 (0.44)	...	6 (0.25)
1/4	11 (0.44)	6 (0.25)	9.53 (0.38)	14 (0.53)	41 (1.62)	15.88 (0.62)	3 (0.12)	6 (0.25)
3/8	13 (0.50)	8 (0.31)	11.11 (0.44)	18 (0.69)	41 (1.62)	17.46 (0.69)	4 (0.16)	8 (0.31)
1/2	14 (0.56)	10 (0.38)	14.29 (0.56)	21 (0.84)	44 (1.75)	22.23 (0.88)	5 (0.19)	8 (0.31)
3/4	16 (0.62)	11 (0.44)	15.88 (0.62)	27 (1.06)	44 (1.75)	26.99 (1.06)	6 (0.22)	10 (0.38)
1	19 (0.75)	13 (0.50)	20.64 (0.81)	33 (1.31)	51 (2.00)	34.93 (1.38)	6 (0.25)	10 (0.38)
1 1/4	21 (0.81)	14 (0.56)	23.81 (0.94)	43 (1.69)	51 (2.00)	44.45 (1.75)	7 (0.28)	14 (0.56)
1 1/2	21 (0.81)	16 (0.62)	28.58 (1.12)	48 (1.91)	51 (2.00)	50.80 (2.00)	8 (0.31)	16 (0.62)
2	22 (0.88)	18 (0.69)	33.27 (1.31)	60 (2.38)	64 (2.50)	63.50 (2.50)	9 (0.34)	18 (0.69)
2 1/2	27 (1.06)	19 (0.75)	38.10 (1.50)	73 (2.88)	70 (2.75)	76.20 (3.00)	10 (0.38)	19 (0.75)
3	28 (1.12)	21 (0.81)	42.86 (1.69)	89 (3.50)	70 (2.75)	88.90 (3.50)	10 (0.41)	21 (0.81)
4	32 (1.25)	25 (1.00)	63.50 (2.50)	114 (4.50)	76 (3.00)	117.48 (4.62)	13 (0.50)	25 (1.00)

NOTES:

(1) **CAUTION:** Hex head bushings of one-size reduction should not be used in services where they might be subject to harmful loads and forces other than internal pressures.

(2) Manufacturer's applied tolerance shall ensure dimension will fit U.S. Customary tooling.

Table 2.1.1-1 Correlation of Designated Schedule Fittings With Pipe Schedule for Calculation of Ratings

Designated Schedule Fitting	Type of Fitting	Pipe Used for Rating Basis [Notes (1) and (2)]	
		Schedule No.	Wall Designation
80	Threaded	80/80S	XS
160	Threaded	160	...
40	Socket-welding	40/40S	Std.
80	Socket-welding	80/80S	XS
160	Socket-welding	160	...

NOTES:

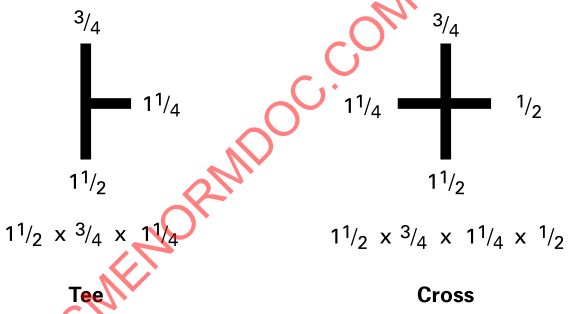
(1) This Table is not intended to restrict the use of pipe of thinner or thicker wall with fittings. Pipe actually used may be thinner or thicker in nominal wall than that shown in Table 2.1.1-1. When thinner pipe is used, its strength may govern the rating. When thicker pipe is used (e.g., for mechanical strength), the strength of the fitting governs the rating.

(2) For NPS fittings in this Standard, Schedules 40S and 80S pipe have same wall thickness and dimensions as Schedules 40 and 80 pipe, respectively.

Table 2.1.2-1 Nominal Wall Thickness of Schedule 160 Pipe

NPS	Schedule 160	
	mm	in.
1/8	3.15	0.124
1/4	3.68	0.145
3/8	4.01	0.158

Figure 3.2-1 Method of Designating Outlets of Reducing Tees and Crosses



GENERAL NOTE: See para. 3.2.