

BENKAN BUTT-WELDING FITTINGS

BENKAN



DISTRIBUTOR:



中華五金有限公司
CHUNG WAH METAL CO., LTD.

Benkan: the Fittings Specialist

Nippon Benkan Kogyo Co., Ltd. is the largest fittings maker in Japan and one of the world's leading makers in this highly specialized field. Its four main factories use the most up-to-date manufacturing facilities and equipment to produce some 63,000 tons of fittings each year. This makes Benkan the world's largest fittings maker in terms of output. The company's exports account for 80 percent of Japan's total fittings export volume and the Benkan brand is known and respected in more than 100 countries around the world. The result: thousands of Benkan fittings in use in a wide variety of energy-intensive industries — from power generation and oil refining to petrochemical and chemical processing, from LNG and LPG production to iron- and steelmaking and shipbuilding.

To meet the ever-increasing demand for high-quality, large-diameter fittings required for an ever wider variety of applications, the company expands production facilities and initiates research projects to develop new products and improve existing ones. For example, to meet the need for superlarge-diameter fittings, the company developed equipment which is capable of producing elbows with a maximum diameter of up to 80 inches in outside diameter for use in various kinds of large-diameter pipelines. And to move raw materials to market from such remote areas as Alaska and Siberia, Benkan developed low temperature steel large-diameter butt-welding fittings.

As a fully integrated manufacturer of fittings with stress placed on the development of a full product line, Benkan has the capabilities to meet the requirements of the industries it serves.

Benkan's four main factories have the following manufacturing capabilities.

The Kiryu Factory mass-produces steel-pipe butt-welding fittings including small- and medium-diameter elbows, tees and reducers.

The Gunma Factory mass-produces stainless steel elbows, tees, reducers, caps and lap joint stub ends as well as medium- and semi-large-diameter carbon steel pipe elbows in sizes ranging from 8 to 24 inches in outside diameter and special-purpose fittings tailored to client specifications. Its main products include steel butt-welding fittings from 1/2 to 24 inches.

The Osaka Factory specializes in the manufacture of large-diameter steel and stainless steel elbows, tees, reducers and caps up to 80 inches in outside diameter. Besides the mass production of butt-welding fittings made of carbon, alloy and stainless steel, the company is also actively working on the development of special alloy, hastelloy and aluminum fittings.

The Yokohama Factory produces by bending pipe with induction heating and cold bending in sizes ranging from 2 to 40 inches in outside diameter.

Benkan's factories are authorized by several governmental agencies and classification and engineering societies including MITI (the Ministry of International Trade and Industry, Japan), Lloyd's (Lloyd's Register of Shipping), NK (Nippon Kaiji Kyokai), NV (Det Norske Veritas) and JIS (Japan Industrial Standards).

Inspection Procedures

Benkan butt-welding fittings are subjected to strict in-process inspection at each stage of the production process — from raw materials handling to finished product shipping. They are visually examined for conformity to company specifications, and tested under the applicable ASTM, ANSI, ASME, MSS and JIS codes and standards. They are also tested to make sure they conform to their intended use. Upon request, we call in officially certified test agents to witness the inspection procedures. Benkan butt-welding fittings are manufactured in conformity with the following standards.

APPLICABLE STANDARDS

ASTM A234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A403	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A420	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service
ANSI B16.9	Factory-Made Wrought Steel Butt-Welding Fittings
ANSI B16.28	Wrought Steel Butt-Welding Short Radius Elbows and Returns
MSS SP-43	Wrought Stainless Steel Butt-Welding Fittings
MSS SP-75	Specification for High Test Wrought Welding Fittings
JIS B2311	Steel Butt-Welding Pipe Fittings for Ordinary Use
JIS B2312	Steel Butt-Welding Pipe Fittings for Special Use
JIS B2313	Steel Plate Butt-Welding Pipe Fittings
JIS B2316	Steel Socked-Welding Pipe Fittings
JIS B2321	Aluminium and Aluminium Alloy Butt-Welding Pipe Fittings

RAW MATERIALS RECEIVING INSPECTION

Benkan butt-welding fittings are made of materials which meet ASTM and intracompany specifications.

Raw materials inspections are carried out as follows:

1) Dimensional Inspections

Dimensions are inspected at each end of the sub-contracted raw material.

2) Visual Inspection

Inspections are performed according to Benkan's "acceptable surface condition" standard.

3) Collating

Judgement is made as to whether it is worthy of the inspection by collating the described items with the raw materials certificates.

The following other inspections are performed if necessary.

- Ultrasonic Examination
- Magnetic Particle Examination
- Radiographic Examination
- Liquid Penetrant Examination
- Ultrasonic Thickness Meter Examination
- Other

IN-PROCESS INSPECTION

Benkan butt-welding fittings are manufactured with carefully selected materials of the finest metallurgical quality on well-controlled jigs, tools or molds based on Benkan's various working standards. Meeting quality specifications is a key feature of Benkan butt-welding fittings.

The following are the major in-process inspection items.

- Visual Inspection
- Dimensional Inspection
- Shape Inspection
- Hardness Test
- Temperature Check
- Processing Conditions Check
- Raw Materials Identification (by marking)
- Other

FINAL INSPECTION

The final inspection of Benkan butt-welding fittings is performed as follows:

1) Standard Product Inspection

Applicable for Benkan butt-welding fittings produced under ANSI B16.9, B16.28 and other specifications.

VISUAL INSPECTION

Benkan butt-welding fittings are visually inspected to confirm that both internal and external surfaces are smooth and without harmful defects. Benkan's "acceptable surface condition" standard is used as the standard for visual tests.

DIMENSIONAL INSPECTION

Benkan butt-welding fittings are inspected for conformity with ANSI or MSS dimensional tolerances (see table on page 122).

2) Special Product Inspection

Applicable for products manufactured to meet specifications requested by customers. Generally, all goods are inspected.

VISUAL INSPECTION

Benkan butt-welding fittings are visually inspected. Criteria are based on those of the standard product. Special specifications are determined by agreement between Benkan and the customer.

DIMENSIONAL INSPECTION

The inspection is usually based on specifications stipulated by the customer.

SPECIAL INSPECTION

In the case of "special requirements" specified by the customer, nondestructive examinations and mechanical tests are performed.

3) Inspection Certificates

Benkan certificates are issued in the following form unless otherwise requested by the customer.

Inspected: _____

INSPECTION CERTIFICATE

BENKAN Nippon Kaigi Kyokai Co., Ltd.

Date: _____

Certificate No.: _____

ITEM/PAIR No. _____

Order No. _____

Job No.	Specification for Material	Specification for Inspection	Visual Examination	Destructive Inspection
			G o o k	G o o k

Manufacturing No. _____

Product & Size _____

Quantity _____

Material Manufacturer _____

Heat No. _____

Specifi-	Chemical Composition												Tensile Test		T S	E
	C	Si	Mn	P	S	Bi	Cr	Mo	Cu	Ti	Al	Ni				
resist	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Min.																
Max.																

By having verified that the product described herein has been manufactured in accordance with the specifications, inspection and test data the undersigned certifies that the Benkan Quality Control System was followed.

Chief of Quality Assurance Section

the customer. Benkan butt-welding fittings are inspected by the following Bureaus of Shipping:

ABS (American Bureau of Shipping)

BV (Bureau Veritas)

LRS (Lloyd's Register of Shipping)

NK (Nippon Kaiji Kyokai)

NV (Det Norske Veritas)

2) Inspection by Other Organizations

FESCO (Far East Superintendence Company, Ltd.)

INTECO (International Inspection and Testing Corporation)

JIC (Japanese Inspection Committee)

Inspection Certificate

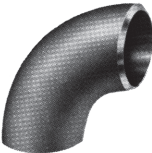
INSPECTION BY VARIOUS AUTHORITIES

1) Inspection by a Bureau of Shipping

Products subject to this inspection are made from raw materials stipulated by the regulations of the bureau. The raw materials and products are inspected for external appearance, dimensions, and conformity to designated specifications. The Bureau of Shipping witnesses and certifies inspection, and certificates from them are forwarded to

Benkan's Butt-Welding Fittings

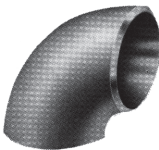
Stainless Steel Butt-Welding Fittings



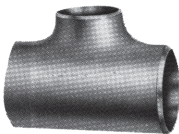
90° Elbow (Long)



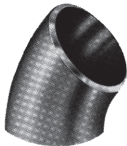
T (Straight)



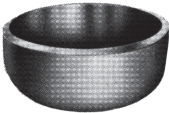
90° Elbow (Short)



T (Reducing)



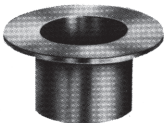
45° Elbow (Long)



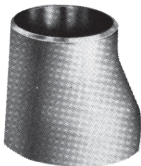
Cap



Reducer (Concentric)



Lap Joint Stub End



Reducer (Eccentric)

Carbon and Alloy Steel Special Fittings for Boilers and Heat Exchangers



Y-Piece

Material Items	Carbon and Alloy Steel	Stainless Steel
Coating	Rust-resistant paint (black)	Passivity treatment
Marking	Die stamping	Electrolytic etching

Wrought Steel Butt-Welding Fittings
(Carbon and Alloy Steel)



45° Elbow (Long)



Cap



90° Elbow (Long)



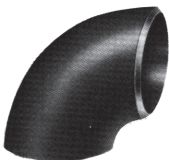
180° Elbow (Long)



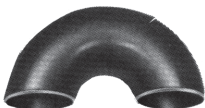
T (Straight)



Reducer (Concentric)



90° Elbow (Short)



180° Elbow (Short)



T (Reducing)



Reducer (Eccentric)

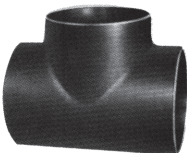
Large Diameter Wrought Steel Butt-Welding Fittings (Carbon, Alloy and Stainless Steel)



45° Elbow (Long)



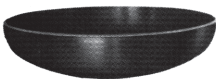
90° Elbow (Long)



T (Straight)



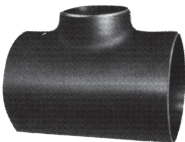
Reducer (Concentric)



Cap



90° Elbow (Short)



T (Reducing)



Reducer (Eccentric)

Wall Thickness Schedules

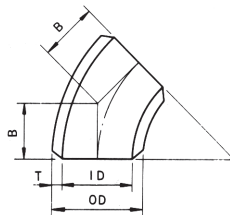
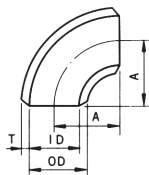
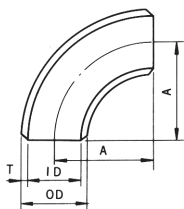
Nominal Pipe Size		Outside Diameter		Nominal Wall Thickness								
A	B	JIS	ANSI	Sch 5S	Sch 10S	Sch 20S	GS	Sch 10	LG (7.9)	Sch 20	Sch 30	STD
8	1/4	13.8	13.7	1.2	1.65	2.0	2.3	—	—	—	—	(2.2)
10	3/8	17.3	17.1	1.2	1.65	2.0	2.3	—	—	—	—	(2.3)
15	1/2	21.7	21.3	1.65	2.1	2.5	2.8	—	—	—	—	(2.8)
20	3/4	27.2	26.7	1.65	2.1	2.5	2.8	—	—	—	—	(2.9)
25	1	34.0	33.4	1.65	2.8	3.0	3.2	—	—	—	—	(3.4)
32	1-1/4	42.7	42.2	1.65	2.8	3.0	3.5	—	—	—	—	(3.6)
40	1-1/2	48.6	48.3	1.65	2.8	3.0	3.5	—	—	—	—	(3.7)
50	2	60.5	60.3	1.65	2.8	3.5	3.8	—	—	—	—	(3.9)
65	2-1/2	76.3	73.0	2.1	3.0	3.5	4.2	—	—	—	—	(5.2)
80	3	89.1	88.9	2.1	3.0	4.0	4.2	—	—	—	—	(5.5)
90	3-1/2	101.6	101.6	2.1	3.0	4.0	4.2	—	—	—	—	(5.7)
100	4	114.3	114.3	2.1	3.0	4.0	4.5	—	—	—	—	(6.0)
125	5	139.8	141.3	2.8	3.4	5.0	4.5	—	—	—	—	(6.6)
150	6	165.2	168.3	2.8	3.4	5.0	5.0	—	5.0**	—	—	(7.1)
175	7	190.7	—	—	—	—	5.3	—	—	—	—	—
200	8	216.3	219.1	2.8	3.8	6.5	5.8	—	5.8**	6.4	7.0	(8.2)
225	9	241.8	—	—	—	—	6.2	—	—	—	—	—
250	10	267.4	273.1	3.4	4.2	6.5	6.6	—	6.6**	6.4	7.8	(9.3)
300	12	318.5	323.9	4.0	4.6	6.5	6.9	—	6.9**	6.4	8.4	9.5
350	14	355.6	355.6	4.0	4.8	7.9	7.9	6.4	7.9	7.9	9.5	9.5
400	16	406.4	406.4	4.2	4.8	7.9	7.9	6.4	7.9	7.9	9.5	9.5
450	18	457.2	457.2	4.2	4.8	7.9	7.9	6.4	7.9	7.9	11.1	9.5
500	20	508.0	508.0	4.8	5.5	7.9	7.9	6.4	7.9	9.5	12.7	9.5
550	22	558.8	558.8	4.8	5.5	—	—	6.4	7.9	9.5	12.7	9.5
600	24	609.6	609.6	5.5	6.4	—	—	6.4	7.9	9.5	14.3	9.5
650	26	660.4	660.4	—	—	—	—	7.9	7.9	12.7	—	9.5
700	28	711.2	711.2	—	—	—	—	7.9	7.9	12.7	15.9	9.5
750	30	762.0	762.0	6.4	7.9	—	—	7.9	7.9	12.7	15.9	9.5
800	32	812.8	812.8	—	—	—	—	7.9	7.9	12.7	15.9	9.5
850	34	863.6	863.6	—	—	—	—	7.9	7.9	12.7	15.9	9.5
900	36	914.4	914.4	—	—	—	—	7.9	7.9	12.7	15.9	9.5
950	38	965.2	965.2	—	—	—	—	—	7.9	—	—	9.5
1000	40	1016.0	1016.0	—	—	—	—	—	7.9	—	—	9.5
1050	42	1066.8	1066.8	—	—	—	—	—	7.9	—	—	9.5
1100	44	1117.6	1117.6	—	—	—	—	—	7.9	—	—	9.5
1150	46	1168.4	1168.4	—	—	—	—	—	7.9	—	—	9.5
1200	48	1219.2	1219.2	—	—	—	—	—	7.9	—	—	9.5
1250	50	1270.0	1270.0	—	—	—	—	—	*7.9	—	—	*9.5
1300	52	1320.8	1320.8	—	—	—	—	—	*7.9	—	—	*9.5
1350	54	1371.6	1371.6	—	—	—	—	—	*7.9	—	—	*9.5
1400	56	1422.4	1422.4	—	—	—	—	—	*7.9	—	—	*9.5
1450	58	1473.2	1473.2	—	—	—	—	—	*7.9	—	—	*9.5
1500	60	1524.0	1524.0	—	—	—	—	—	*7.9	—	—	*9.5

JIS G3448 ANSI B36.10M
JIS G3454 ANSI B36.19M
JIS G3455
JIS G3459

(in mm)

Nominal Wall Thickness									Outside Diameter		Nominal Pipe Size	
Sch 40	Sch 60	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS	JIS	ANSI	A	B
2.2	2.4	(3.0)	3.0	—	—	—	—	—	13.8	13.7	8	1/4
2.3	2.8	(3.2)	3.2	—	—	—	—	—	17.3	17.1	10	3/8
2.8	3.2	(3.7)	3.7	—	—	—	4.7	7.5	21.7	21.3	15	1/2
2.9	3.4	(3.9)	3.9	—	—	—	5.5	7.8	27.2	26.7	20	3/4
3.4	3.9	(4.5)	4.5	—	—	—	6.4	9.1	34.0	33.5	25	1
3.6	4.5	(4.9)	4.9	—	—	—	6.4	9.7	42.7	42.2	32	1-1/4
3.7	4.5	(5.1)	5.1	—	—	—	7.1	10.2	48.6	48.3	40	1-1/2
3.9	4.9	(5.5)	5.5	—	—	—	8.7	11.1	60.5	60.3	50	2
5.2	6.0	(7.0)	7.0	—	—	—	9.5	14.0	76.3	73.0	65	2-1/2
5.5	6.6	(7.6)	7.6	—	—	—	11.1	15.2	89.1	88.9	80	3
5.7	7.0	(8.1)	8.1	—	—	—	12.7	—	101.6	101.6	90	3-1/2
6.0	7.1	(8.6)	8.6	—	11.1	—	13.5	17.1	114.3	114.3	100	4
6.6	8.1	(9.5)	9.5	—	12.7	—	15.9	19.0	139.8	141.3	125	5
7.1	9.3	(11.0)	11.0	—	14.3	—	18.2	21.9	165.2	168.3	150	6
—	—	—	—	—	—	—	—	—	190.7	—	175	7
8.2	10.3	(12.7)	12.7	15.1	18.2	20.6	23.0	22.2	216.3	219.1	200	8
—	—	—	—	—	—	—	—	—	241.8	—	225	9
9.3	12.7	12.7	15.1	18.3	21.4	25.4	28.6	25.4	267.4	273.1	250	10
10.3	14.3	12.7	17.4	21.4	25.4	28.6	33.3	25.4	318.5	323.9	300	12
11.1	15.1	12.7	19.0	23.8	27.8	31.8	35.7	—	355.6	355.6	350	14
12.7	16.7	12.7	21.4	26.2	30.9	36.5	40.5	—	406.4	406.4	400	16
14.3	19.0	12.7	23.8	29.4	34.9	39.7	45.2	—	457.2	457.2	450	18
15.1	20.6	12.7	26.2	32.5	38.1	44.4	50.0	—	508.0	508.0	500	20
—	22.2	12.7	28.6	34.9	41.3	47.6	54.0	—	558.8	558.8	550	22
17.5	24.6	12.7	31.0	38.9	46.0	52.4	59.5	—	609.6	609.6	600	24
—	—	12.7	—	—	—	—	—	—	660.4	660.4	650	26
—	—	12.7	—	—	—	—	—	—	711.2	711.2	700	28
—	—	12.7	—	—	—	—	—	—	762.0	762.0	750	30
17.5	—	12.7	—	—	—	—	—	—	812.8	812.8	800	32
17.5	—	12.7	—	—	—	—	—	—	863.6	863.6	850	34
19.1	—	12.7	—	—	—	—	—	—	914.4	914.4	900	36
—	—	12.7	—	—	—	—	—	—	965.2	965.2	950	38
—	—	12.7	—	—	—	—	—	—	1016.0	1016.0	1000	40
—	—	12.7	—	—	—	—	—	—	1066.8	1066.8	1050	42
—	—	12.7	—	—	—	—	—	—	1117.6	1117.6	1100	44
—	—	12.7	—	—	—	—	—	—	1168.4	1168.4	1150	46
—	—	12.7	—	—	—	—	—	—	1219.2	1219.2	1200	48
—	—	*12.7	—	—	—	—	—	—	1270.0	1270.0	1250	50
—	—	*12.7	—	—	—	—	—	—	1320.8	1320.8	1300	52
—	—	*12.7	—	—	—	—	—	—	1371.6	1371.6	1350	54
—	—	*12.7	—	—	—	—	—	—	1422.4	1422.4	1400	56
—	—	*12.7	—	—	—	—	—	—	1473.2	1473.2	1450	58
—	—	*12.7	—	—	—	—	—	—	1524.0	1524.0	1500	60

Long and Short Radius Elbows

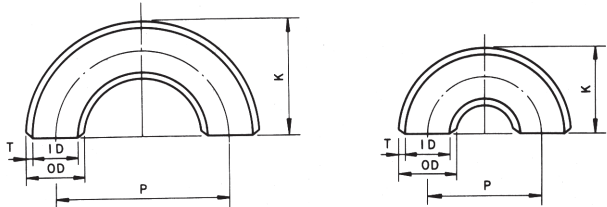


ANSI B16.9 B16.28

*Benkan's standard (in mm)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel D	Center-to-End			
		Long Radius Elbow		Short Radius Elbow	
		90 Deg. A	45 Deg. B	90 Deg. A	45 Deg.* B
1/2	21.3	38.1	15.7	—	—
3/4	26.7	28.4	11.2	—	—
1	33.4	38.1	22.4	25.4	—
1-1/4	42.2	47.8	25.4	31.8	—
1-1/2	48.3	57.2	28.4	38.1	—
2	60.3	76.2	35.1	50.8	—
2-1/2	73.0	95.2	44.4	63.5	—
3	88.9	114.3	50.8	76.2	31.6
3-1/2	101.6	133.4	57.2	88.9	36.8
4	114.3	152.4	63.5	101.6	42.1
5	141.3	190.5	79.2	127.0	52.6
6	168.3	228.6	95.2	152.4	63.4
8	219.1	304.8	127.0	203.2	84.2
10	273.1	381.0	158.8	254.0	105.2
12	323.9	457.2	190.5	304.8	126.3
14	355.6	533.4	222.2	355.6	147.3
16	406.4	609.6	254.0	406.4	168.3
18	457.2	685.8	285.8	457.2	189.4
20	508.0	762.0	317.5	508.0	210.4
22	558.8	838.2	342.9	558.8	231.5
24	609.6	914.4	381.0	609.6	252.5
26	660.4	990.6	406.4	660.4	273.5
28	711.2	1066.8	438.2	711.2	294.6
30	762.0	1143.0	469.9	762.0	315.6
32	812.8	1219.2	501.6	812.8	378.1
34	863.6	1295.4	533.4	863.6	357.7
36	914.4	1371.6	565.2	914.4	378.8
38	965.2	1447.8	599.9	—	—
40	1016.0	1524.0	632.0	1016.0	420.8
42	1066.8	1600.2	660.4	1066.8	441.9
44	1117.6	1676.4	695.5	1117.6	462.9
46	1168.4	1752.6	726.9	—	—
48	1219.2	1828.8	759.0	1219.2	505.0
54*	1371.6	2057.4	852.2	1371.6	568.1
52*	1320.8	—	—	1320.8	547.1
56*	1422.4	2133.6	883.8	1422.4	589.2
60*	1524.0	2286.0	946.9	1524.0	631.3
66*	1676.4	2514.6	1041.6	—	—

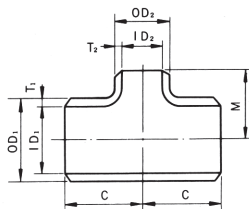
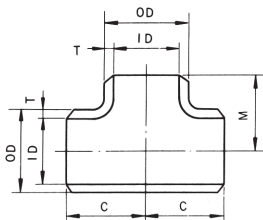
Long and Short Radius Return Elbows



ANSI B16.9
ANSI B16.28 (in mm)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel D	Long Radius		Short Radius	
		Center-to- Center P	Back-to- Face K	Center-to- Center P	Back-to- Face K
1/2	21.3	76.2	47.8	—	—
3/4	26.7	57.2	42.9	—	—
1	33.4	76.2	55.6	50.8	41.1
1-1/4	42.2	95.2	69.8	63.5	52.3
1-1/2	48.3	114.3	82.6	76.2	62.0
2	60.3	152.4	106.4	101.6	81.0
2-1/2	73.0	109.5	131.8	127.0	100.1
3	88.9	228.6	158.8	152.4	120.7
3-1/2	101.6	266.7	184.2	177.8	139.7
4	114.3	304.8	209.6	203.2	158.8
5	141.3	381.0	261.9	254.0	196.9
6	168.3	457.2	312.7	304.8	236.5
8	219.1	609.6	414.3	406.4	312.7
10	273.1	762.0	517.7	508.0	390.7
12	323.9	914.4	619.3	609.6	466.9
14	355.6	1066.8	711.2	711.2	533.4
16	406.4	1219.2	812.8	812.8	609.6
18	457.2	1371.6	914.4	914.4	685.8
20	508.0	1524.0	1016.0	1016.0	762.0
22	558.8	1676.4	1117.6	1117.6	838.2
24	609.6	1828.8	1219.2	1219.2	914.4

Straight and Reducing Tees



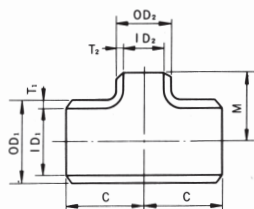
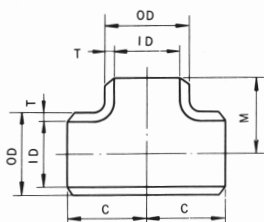
**MSS SP-75
ANSI B16.9**

*Berkan's Standards (in mm)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel D		Center-to-End		Nominal Pipe Size (NPS)	Outside Diameter at Bevel D		Center-to-End	
	Run	Outlet	Run C	Outlet(1) M		Run	Outlet	Run C	Outlet(1) M
1/2 x 1/2 3/8 1/4	21.3	21.3	25.4	25.4	5 x 5 4 3-1/2 3 2-1/2 2 1-1/2*	141.3	141.3	124.0	124.0
		17.1		25.4			114.3		117.3
		13.7		25.4			101.6		114.3
3/4 x 3/4 1/2 3/8	26.7	26.7	28.4	28.4	6 x 6 5 4 3-1/2 3 2-1/2 2*	168.3	168.3	142.7	142.7
		21.3		28.4			141.3		136.7
		17.1		28.4			114.3		130.0
1 x 1 3/4 1/2	33.4	33.4	38.1	38.1	8 x 8 6 5 4 3-1/2 3*	219.1	219.1	177.8	177.8
		26.7		38.1			168.3		168.1
		21.3		38.1			141.3		162.1
1-1/4 x 1-1/4 1 3/4 1/2	42.2	42.2	47.8	47.8	10 x 10 8 6 5 4 3-1/2 3*	273.1	273.1	215.9	215.9
		33.4		47.8			219.1		203.2
		26.7		47.8			168.3		193.5
1-1/2 x 1-1/2 1-1/4 1 3/4 1/2	48.3	48.3	57.2	57.2	12 x 12 10 8 6 5 4 3-1/2 3*	323.9	323.9	254.0	254.0
		42.2		57.2			273.1		241.3
		33.4		57.2			219.1		228.6
2 x 2 1-1/2 1-1/4 1 3/4 1/2*	60.3	60.3	63.5	63.5	14 x 14 12 10 8 6 5 4 3-1/2 3*	355.6	355.6	279.4	279.4
		48.3		60.5			323.9		269.7
		42.2		57.2			273.1		257.0
2-1/2 x 2-1/2 2 1-1/2 1-1/4 1	73.0	73.0	76.2	76.2	16 x 16 14 12 10 8 6 5 4 3-1/2 3*	406.4	406.4	304.8	304.8
		60.3		69.8			355.6		304.8
		48.3		66.5			323.9		295.1
3 x 3 2-1/2 2 1-1/2 1-1/4 1*	88.9	88.9	85.9	85.9	18 x 18 16 14 12 10 8 6 5 4 3-1/2 3*	457.2	457.2	342.9	342.9
		73.0		82.6			406.4		330.2
		60.3		76.2			355.6		320.5
3-1/2 x 3-1/2 3 2-1/2 2 1-1/2 1-1/4 1*	101.6	101.6	95.2	95.2	4 x 4 3-1/2 3 2-1/2 2 1-1/2 1-1/4 1*	114.3	114.3	104.6	104.6
		88.9		91.9			101.6		101.6
		73.0		88.9			88.9		98.6

Note (1) Outlet dimension "M" for run sizes 14 and larger is recommended but not mandatory.

Straight and Reducing Tees



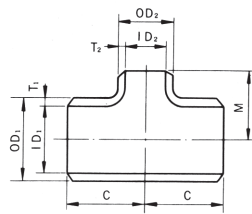
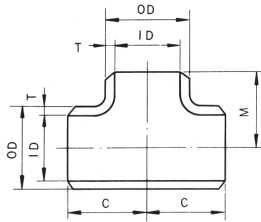
**MSS SP-75
ANSI B16.9**

*Berkan's Standards (in mm)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel D		Center-to-End		Nominal Pipe Size (NPS)	Outside Diameter at Bevel D		Center-to-End	
	Run	Outlet	Run C	Outlet(1) M		Run	Outlet	Run C	Outlet(1) M
20 x 20	508.0	508.0	381.0	381.0	30 x 12	762.0	323.9	558.8	472.6
18		457.2		369.3	10		273.1		460.2
16		406.4		355.6					
14		355.6		355.6	32 x 32	812.8	812.8	596.9	596.9
12		323.9		345.9	30		762.0		584.2
10		273.1		333.2	28		711.2		571.5
8		219.1		323.8	26		660.4		571.5
					24		609.6		558.8
22 x 22	558.8	558.8	419.1	419.1	22		558.8		546.1
20		508.0		406.4	20		508.0		533.4
18		457.2		393.7	18		457.2		520.7
16		406.4		381.0	16		406.4		508.0
14		355.6		381.0	14		355.6		508.0
12		323.9		371.3					
10		273.1		358.6	34 x 34	863.6	863.6	635.0	635.0
24 x 24	609.6	609.6	431.8	431.8	32		812.8		622.3
22		558.8		431.8	30		762.0		609.6
20		508.0		431.8	28		711.2		596.9
18		457.2		419.1	26		660.4		596.9
16		406.4		406.4	24		609.6		584.2
14		355.6		406.4	22		558.8		571.5
12		323.9		396.7	20		508.0		558.8
10		273.1		384.0	18		457.2		546.1
					16		406.4		533.4
26 x 26	660.4	660.4	495.3	495.3	36 x 36	914.4	914.4	673.1	673.1
24		609.6		482.6	34		863.6		660.4
22		558.8		469.9	32		812.8		647.7
20		508.0		457.2	30		762.0		635.0
18		457.2		444.5	28		711.2		622.3
16		406.4		431.8	26		660.4		622.3
14		355.6		431.8	24		609.6		609.6
12		323.1		422.1	22		558.8		596.9
					20		508.0		584.2
28 x 28	711.2	711.2	520.7	520.7	18		457.2		571.5
26		660.4		520.7	16		406.4		558.8
24		609.6		508.0					
22		558.8		495.3	38 x 38	965.2	965.2	711.2	711.2
20		508.0		482.6	36		914.4		711.2
18		457.2		469.9	34		863.6		698.5
16		406.4		457.2	32		812.8		685.8
14		355.6		457.2	30		762.0		673.1
12		323.1		447.5	28		711.2		647.7
					26		660.4		647.7
30 x 30	762.0	762.0	558.8	558.8	24		609.6		635.0
28		711.2		546.1	22		558.8		622.3
26		660.4		546.1	20		508.0		609.6
24		609.6		533.4	18		457.2		596.9
22		558.8		520.7					
20		508.0		508.0					
18		457.2		495.3					
16		406.4		482.6					
14		355.6		482.6					

Note (1) Outlet dimension "M" for run sizes 14 and larger is recommended but not mandatory.

Straight and Reducing Tees



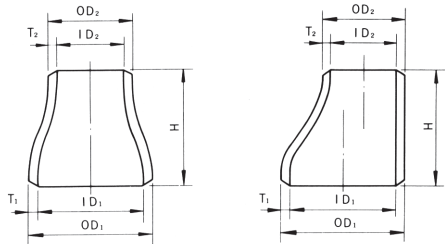
MSS SP-75
ANSI B16.9

*Berkas's Standards (in mm)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel D		Center-to-End		Nominal Pipe Size (NPS)	Outside Diameter at Bevel D		Center-to-End	
	Run	Outlet	Run C	Outlet(1) M		Run	Outlet	Run C	Outlet(1) M
40 x 40	1016.0	1016.0	749.3	749.3	46 x 26	1168.4	660.4	850.9	736.6
38		965.2		749.3	24		609.6		723.9
36		914.4		736.6	20*		508.0		723.9
34		863.6		723.9	48 x 48	1219.2	1219.2	889.0	838.2
32		812.8		711.2	46		1168.4		838.2
30		762.0		698.5	44		1117.6		838.2
28		711.2		673.1	42		1066.8		812.8
26		660.4		673.1	40		1016.0		812.8
24		609.6		660.4	38		965.2		812.8
22		558.8		647.7	36		914.4		787.4
20		508.0		635.0	34		863.6		787.4
18		457.2		622.3	32		812.8		787.4
42 x 42	1066.8	1066.8	762.0	711.2	30		762.0		762.0
40		1016.0		711.2	28		711.2		762.0
38		965.2		711.2	26		660.4		762.0
36		914.4		711.2	24		609.6		736.6
34		863.6		711.2	22		558.8		736.6
32		812.8		711.2	52 x 52*	1320.8	1320.8	965.2	914.4
30		762.0		711.2	48*		1219.2		863.6
28		711.2		698.5	44*		1117.6		812.8
26		660.4		698.5	40*		1016.0		762.0
24		609.6		660.4	54 x 54*	1371.6	1371.6	1003.3	952.5
22		558.8		660.4	52*		1320.8		914.4
20		508.0		660.4	48*		1219.2		863.6
18		457.2		647.7	44*		1117.6		863.6
16		406.4		635.0	40*		1016.0		812.8
44 x 44	1117.6	1117.6	812.8	762.0	28*		711.2		787.4
42		1066.8		762.0	20*		508.0		787.4
40		1016.0		749.3	56 x 56*	1422.4	1422.4	1041.4	965.2
38		965.2		736.6	52*		1320.8		914.4
36		914.4		723.9	48*		1219.2		863.6
34		863.6		723.9	44*		1117.6		812.8
32		812.8		711.2	40*		1016.0		812.8
30		762.0		711.2	28*		711.2		812.8
28		711.2		698.5	20		508.0		812.8
26		660.4		698.5	60 x 60*	1524.0	1524.0	1117.6	1016.0
24		609.6		698.5	56*		1422.4		965.2
22		558.8		685.8	52*		1320.8		914.4
20		508.0		685.8	48*		1219.2		863.6
46 x 46	1168.4	1168.4	850.9	800.1	40*		1016.0		863.6
44		1117.6		800.1	28*		711.2		863.6
42		1066.8		787.4	20*		508.0		863.6
40		1016.0		774.7	66 x 66*	1676.4	1676.4	1219.2	1066.8
38		965.2		762.0					
36		914.4		762.0					
34		863.6		749.3					
32		812.8		749.3					
30		762.0		736.6					
28		711.2		736.6					

Note (1) Outlet dimension "M" for run sizes 14 and larger is recommended but not mandatory.

Concentric and Eccentric Reducers

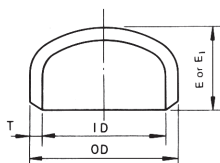


MSS SP-75
ANSI B16.9

* Benkar'd Standard (in mm)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel		End-to- End	Nominal Pipe Size (NPS)	Outside Diameter at Bevel		End-to- End	Nominal Pipe Size (NPS)	Outside Diameter at Bevel		End-to- End
	Large End	Small End			Large End	Small End			Large End	Small End	
3/4 x 1/2 3/8	26.7	21.3 17.3	38.1	10 x 8 6 5 4	273.1	29.1 168.3 141.3 114.3	177.8	34 x 32 30 26 24	863.6	812.8 762.0 711.2 660.4	609.6
1 x 3/4 1/2	33.4	26.7 21.3	50.8								
1-1/4 x 1 3/4 1/2	42.2	33.4 26.7 21.3	50.8								
1-1/2 x 1-1/4 1 3/4 1/2	48.3	42.2 33.4 26.7 21.3	63.5	12 x 10 8 6 5	323.9	273.1 219.1 168.3 141.3	203.2	36 x 34 32 30 26 24	914.4	863.6 812.8 762.0 711.2 660.4	609.6
2 x 1-1/2 1-1/4 1 3/4	60.3	48.3 42.2 33.4 26.7	76.2	14 x 12 10 8 6	355.6	323.9 273.1 219.1 168.3	330.2	38 x 36 34 32 30 28 26	965.2	914.4 863.6 812.8 762.0 711.2 660.4	609.6
2-1/2 x 2 1-1/2 1-1/4 1	73.0	60.3 48.3 42.2 33.4	88.9	16 x 14 12 10 8	406.4	355.6 323.9 273.1 219.1	355.6	40 x 38 36 34 32 30	1016.0	965.2 914.4 863.6 812.8 762.0	609.6
3 x 2-1/2 2 1-1/2 1-1/4	88.9	73.0 60.3 48.3 42.2	88.9	18 x 16 14 12 10	457.2	406.4 355.6 323.9 273.1	381.0	42 x 40 38 36 34 32 30	1066.8	1016.0 965.2 914.4 863.6 812.8 762.0	609.6
3-1/2 x 3 2-1/2 2 1-1/2 1-1/4	101.6	88.9 73.0 60.3 48.3 42.2	101.6	20 x 18 16 14	508.0	457.2 406.4 355.6	508.0	44 x 42 40 38 36	1117.6	1066.8 1016.0 965.2 914.4	609.6
4 x 3-1/2 3 2-1/2 2 1-1/2	114.3	101.6 88.9 73.0 60.3 48.3	101.6	22 x 20 18 16	558.8	508.0 457.2 406.4	508.0	46 x 42 42 40 38	1168.4	1117.6 1066.8 1016.0 965.2	711.2
5 x 4 3-1/2 3 2-1/2 2	141.3	114.3 101.6 88.9 73.0 60.3	127.0	24 x 22 20 18	609.6	558.8 508.0 457.2	508.0	48 x 46 44 42 40	1219.2	1168.4 1117.6 1066.8 1016.0	711.2
6 x 5 4 3-1/2 3 2-1/2	168.3	141.3 114.3 101.6 88.9 73.0	139.7	26 x 24 22 20 18	660.4	609.6 558.8 508.0 457.2	609.6				
8 x 6 5 4 3-1/2	219.1	168.3 141.3 114.3 101.6 88.9 73.0	152.4	30 x 28 26 24 20	762.0	711.2 660.4 609.6 508.0	609.6				
				32 x 30 28 26 24	812.8	762.0 711.2 660.4 609.6	609.6				

Caps



MSS SP-75 ANSI B16.9 (in mm)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel D	Length(2) E	Limiting Wall Thickness for Length E	Length(3) E ₁
1/2	21.3	25.4	4.6	25.4
3/4	26.7	25.4	3.8	25.4
1	33.4	38.1	4.6	38.1
1-1/4	42.2	38.1	4.8	38.1
1-1/2	48.3	38.1	5.1	38.1
2	60.3	38.1	5.6	44.4
2-1/2	73.0	38.1	7.1	50.8
3	88.9	50.8	7.6	63.5
3-1/2	101.6	63.5	8.1	76.2
4	114.3	63.5	8.6	76.2
5	141.3	76.2	9.7	88.9
6	168.3	88.9	10.9	101.6
8	219.1	101.6	12.7	127.0
10	273.1	127.0	12.7	152.4
12	323.9	152.4	12.7	177.8
14	355.6	165.1	12.7	190.5
16	406.4	177.8	12.7	203.2
18	457.2	203.2	12.7	228.6
20	508.0	228.6	12.7	254.0
22	558.8	254.0	12.7	254.0
24	609.6	266.7	12.7	304.8

Nominal Pipe Size (NPS)	Outside Diameter at Bevel D	Length(2) E
26	660.4	266.7
28	711.2	266.7
30	762.0	266.7
32	812.8	266.7
34	863.6	266.7
36	914.4	266.7
38	965.2	304.8
40	1016.0	304.8
42	1066.8	304.8
44	1117.6	342.9
46	1168.4	342.9
48	1219.2	342.9

- Wall thicknesses for Caps up to and including 36" conform to ANSI B36.10 Specifications; Caps 38" and larger conform to XS Specifications for wall thicknesses of 36". These are Benkan Standards as no Internationally Recognized Standards have been set for such large size wall thickness.

- The shape of these caps shall be ellipsoidal and shall conform to the shape requirements as given in the ASME Boiler and Pressure Vessel Code.
- Length E applies for thickness not exceeding that given in column "Limiting Wall Thickness for Length E".
- Length E₁ applies for thickness greater than that given in column "Limiting Wall Thickness" for NPS 24 and smaller. For NPS 26 and larger, Length E₁ shall be by agreement between manufacturer and purchaser.

Materials Specifications for Butt-Welding Fittings

ASTM A234-86
Standard Specification for
PIPING FITTINGS OF WROUGHT CARBON STEEL AND
ALLOY STEEL FOR MODERATE AND ELEVATED
TEMPERATURES

Grade and Marking Symbol ^D	Composition, %					
	Carbon, max	Manganese	Phosphorus, max	Sulfur, max	Silicon	Chromium
WPB ^{A,B,C}	0.30	0.29–1.06	0.050	0.058	0.10 min	...
WPC ^{B,C}	0.35	0.29–1.06	0.050	0.058	0.10 min	...
WP1	0.28	0.30–0.90	0.045	0.045	0.10–0.50	...
WP12	0.20	0.30–0.80	0.045	0.045	0.60 max	0.80–1.25
WP12b	0.20	0.30–0.80	0.045	0.045	0.60 max	0.80–1.25
WP11	0.20	0.30–0.80	0.040	0.040	0.50–1.00	1.00–1.50
WP11a	0.20	0.30–0.80	0.040	0.040	0.50–1.00	1.00–1.50
WP11b	0.15	0.30–0.60	0.030	0.030	0.50–1.00	1.00–1.50
WP22	0.15	0.30–0.60	0.040	0.040	0.50 max	1.90–2.60
WP22a	0.15	0.30–0.60	0.040	0.040	0.50 max	1.90–2.60
WP5	0.15	0.30–0.60	0.040	0.030	0.50 max	4.00–6.00
WP7	0.15	0.30–0.60	0.030	0.030	0.50–1.00	6.00–8.00
WP9	0.15	0.30–0.60	0.030	0.030	0.25–1.00	8.00–10.00
WPR	0.20	0.40–1.06	0.045	0.050	...	...
WP91	0.08–0.12	0.30–0.60	0.020	0.010	0.20–0.50	8.00–9.50

- A Fittings made from plate may have 0.35 max carbon.
B Fittings made from forgings may have 0.35 max carbon and 0.35 max silicon with no minimum.
C For each reduction of 0.01% carbon below 0.30%, an increase of 0.05% manganese above 1.06% will be permitted to a maximum of 1.35% manganese.
D When fittings are of welded construction, the grade and marking symbol shown above shall be supplemented by letter "W".

	Elongation Requirements					
	Grades					
	All Grades except WPR and WP91		WPR		WP91	
	Longi- tudinal	Trans- verse	Longi- tudinal	Trans- verse	Longi- tudinal	Trans- verse
Elongation:						
Standard round specimen, or small proportional specimen, min % in 4D	22	14	20	...	20	...
Rectangular specimen for wall thickness 7.94mm and over, and for all small sizes tested in full section; min % in 50mm	30	20 ^A	29	...	...	...
Rectangular specimen for wall thickness less than 7.94mm, min % in 50mm (40-mm wide specimen)	xx ^B	xx ^B	xx ^B	...	...	...

- A WPB and WPC fittings manufactured from plate shall have a minimum elongation of 17%.
B For each 0.79mm decrease in wall thickness below 7.94mm, a deduction of 1.5% for longitudinal and 1.0% for transverse from the values shown above is permitted.

Molybdenum	Nickel	Copper	Others	Tensile Requirements		Marking Symbols
				Tensile Strength Min. or Range ksi (MPa)	Yield Strength Min. ksi (MPa)	
...	...	...	...	60 [415]	35 [240]	WPB
...	...	...	...	70 [485]	40 [275]	WPC
0.44–0.65	...	...	...	55 [380]	30 [205]	WP1
0.44–0.65	...	...	...	70 [485]	40 [275]	WP12
0.44–0.65	...	...	...	60 [415]	30 [205]	WP12b
0.44–0.65	...	...	...	70 [485]	40 [275]	WP11
0.44–0.65	...	...	...	75 [515]	45 [310]	WP11a
0.44–0.65	...	...	...	60 [415]	30 [205]	WP11b
0.87–1.13	...	...	...	75 [515]	45 [310]	WP22
0.87–1.13	...	...	...	60 [415]	30 [203]	WP22a
0.44–0.65	...	...	...	60 [415]	30 [205]	WP5
0.44–0.65	...	...	...	60 [415]	30 [205]	WP7
0.90–1.10	...	...	...	60 [415]	30 [205]	WP9
...	1.60–2.24	0.75–1.25	...	63 [435]	46 [315]	WPR
0.85–1.05	0.40 max	...	Vanadium 0.18–0.25 Columbium 0.06–0.10 Nitrogen 0.03–0.07 Aluminum 0.04 max	85 [585]	60 [415]	WP91

The following table gives the minimum value for various wall thicknesses.

Wall Thickness	Grades		Grade	
	All Grades except WPR		WPR	
	Longitudinal	Transverse	Longitudinal	Transverse
mm				
7.94	30.0	20.0	28.0	...
7.14	28.5	19.0	26.5	...
6.35	27.0	18.0	25.0	...
5.56	25.5	...	23.5	...
4.76	24.0	...	22.0	...
3.97	22.5	...	20.5	...
3.17	21.0	...	19.0	...
2.38	19.5	...	17.5	...
1.59	18.0	...	16.0	...

NOTE— This table gives the computed minimum elongation values for each 0.79-mm decrease in wall thickness. Where the wall thickness lies between two values above, the minimum elongation value is determined by the following equations:

Direction of Test:	Equation
Longitudinal	$E = 48t + 15.00$
Transverse	$E = 32t + 10.00$

where:

E = elongation in 2 in. or 50 mm, % and

t = actual thickness of specimens, mm

Materials Specifications for Butt-Welding Fittings

ASTM A234-82a
Standard Specification for
PIPING FITTINGS OF WROUGHT CARBON STEEL AND
ALLOY STEEL FOR MODERATE AND ELEVATED
TEMPERATURES

Grade and Marking Symbol	Chemical Composition (Percent)					
	Max. or Range (Unless otherwise indicated)					
	C	Si	Min	P	S	Ni
WPB	0.30	0.10 min	0.29–1.06	0.050	0.058	—
WPC	0.35	0.10 min	0.29–1.06	0.050	0.058	—
WP1	0.28	0.10–0.50	0.30–0.90	0.045	0.045	—
WP12	0.20	0.60 max	0.30–0.80	0.045	0.045	—
WP11	0.20	0.50–1.00	0.30–0.80	0.040	0.040	—
WP22	0.15	0.50 max	0.30–0.60	0.040	0.040	—
WP5	0.15	0.50 max	0.30–0.60	0.040	0.030	—
WP7	0.15	0.50–1.00	0.30–0.60	0.030	0.030	—
WP9	0.15	0.25–1.00	0.30–0.60	0.030	0.030	—
WPR	0.20		0.40–1.06	0.045	0.050	1.60–2.24

- A Fittings made from plate may have 0.35 max carbon.
B Fittings made from forgings may have 0.35 max carbon and 0.35 max silicon with no minimum.
C For each reduction of 0.01% carbon below 0.30%, an increase of 0.05% manganese above 1.06% will be permitted to a maximum of 1.35% manganese.
D When fittings are of welded construction, the grade and marking symbol shown above shall be supplemented by letter “W”.

Elongation Requirements				
	Grades		Grade	
	WPB, WPC, WP1, WP12, WP11, WP22, WP5, WP7, WP9		WPR	
	Longitudinal	Transverse	Longitudinal	Transverse
Elongation in 50 mm (or 4 D), min, %:				
Basic minimum elongation for wall thickness, strip tests, and for all small sizes tested in full section	30	20 ^A	28	...
When standard round 50-mm gage length or smaller proportionally sized specimen with the gage length equal to 4 D is used	22	14	20	...
For strip tests, the width of the gage section shall be 38.1 mm and a deduction for each 0.79 mm decrease in wall thickness below 7.94 mm from the basic minimum elongation of the following percentage points:	1.50 ^B	1.00 ^B	1.50 ^B	...

A Carbon-steel fittings manufactured from plate shall have a minimum elongation of 17%.

Cr	Mo	Cu	Other Elements	Tensile Requirements			Marking Symbols
				Tensile Strength Min. of Range ksi (MPa)	Yield Strength Min. ksi (MPa)	Longitudinal Elongation in 2 in. (50 mm) Min., %	
—	—	—		60 (415)	35 (240)		WPB
—	—	—		70 (485)	40 (275)		WPC
—	0.44–0.65	—		55 (320)	30 (205)		WP1
0.80–1.25	0.44–0.65	—		60 (415)	30 (205)		WP12
1.00–1.50	0.44–0.65	—		60 (415)	30 (205)		WP11
1.90–2.60	0.87–1.13	—		60 (415)	30 (205)		WP22
4.00–6.00	0.44–0.65	—		60 (415)	30 (205)		WP5
6.00–8.00	0.44–0.65	—		60 (415)	30 (205)		WP7
8.00–10.00	0.90–1.10	—		60 (415)	30 (205)		WP9
—	—	0.75–1.25		63 (435)	46 (315)		WPR

B The following table gives the calculated minimum values:

Wall Thickness	Grades		Grade		
	WPB, WPC, WP1 , WP12, WP11, WP22, WP5, WP7, WP9		WPR		
	mm	Longitudinal	Transverse	Longitudinal	Transverse
7.94	30.0	20.0	28.0	...	...
7.14	28.5	19.0	26.5	...	...
6.35	27.0	18.0	25.0	...	...
5.56	25.5	...	23.5	...	...
4.76	24.0	...	22.0	...	...
3.97	22.5	...	20.5	...	...
3.17	21.0	...	19.0	...	...
2.38	19.5	...	17.5	...	...
1.59	18.0	...	16.0	...	...

NOTE— This table gives the computed minimum elongation values for each 0.79-mm decrease in wall thickness. Where the wall thickness lies between two values above, the minimum elongation value is determined by the following equations:

Direction of Test:	Equation
Longitudinal	$E = 48t + 15.00$
Transverse	$E = 32t + 10.00$

where:

E = elongation in 2 in. or 50 mm, % and

t = actual thickness of specimens, in.

Materials Specifications for Butt-Welding Fittings

ASTM A420
PIPING FITTINGS OF WROUGHT CARBON STEEL AND
ALLOY STEEL FOR LOW-TEMPERATURE SERVICE

Grade and Marking Symbol ^A	Chemical Composition (Percent)						
	Max. or Range (Unless otherwise indicated)						
	C	Mn	P	S	Si	Ni	Cu
WPL 6 ^{B,C}	0.30	0.39–1.06	0.048	0.058	0.10 min	—	—
WPL 9	0.20	0.40–1.06	0.045	0.050	—	1.60–2.24	0.75–1.25
WPL 3 ^D	0.20	0.31–0.64	0.05	0.05	0.13–0.37	3.18–3.82	—
WPL 8 ^E	0.13	0.90	0.045	0.045	0.13–0.37	8.40–9.60	—

^AWhen fittings are of welded construction, the symbols above shall be supplemented by the letter "W".
^BFor each reduction of 0.01% carbon below 0.30%, an increase of 0.05% manganese above 1.06% will be permitted to a maximum of 1.35% manganese.
^CFittings made from forgings may have 1.35% max manganese.
^DFittings made from plate or forgings may have 0.90% max manganese.
^EFittings made from plate may have 0.98% max manganese.

Charpy Impact Requirements for WPL6,
WPL9, and WPL3^A

Size of Specimen, mm	Charpy V-Notch Impact Value Re- quired for Accept- ance (Average of Three Specimens)		Minimum Charpy V-Notch Impact Value Without Requiring Retest (One Specimen Only of a Set)	
	ft•lbf	J	ft•lbf	J
10 by 10.0	13	17.6	10	13.6
10 by 7.5	10	13.6	8	10.8
10 by 5.0	7	9.5	5	7.0
10 by 2.5	4	5.4	3	4.1

^A Straight-line interpolation for intermediate values permitted.

Charpy Impact Requirements for WPL8

Size of Specimen, mm	Charpy V-Notch Impact Value Re- quired for Accept- ance (Average of Specimens)		Minimum Charpy V-Notch Impact Value Without Requiring Retest (One Specimen Only of a Set)	
	ft•lbf	J	ft•lbf	J
10 by 10.0	25.0	33.9	20.0	27.1
10 by 7.5	21.0	28.5	17.0	23.1
10 by 5.0	17.0	23.1	14.0	19.0
10 by 2.5	8.0	10.8	6.0	8.1

Impact Test Temperature

Grade	Impact Test Temperature °F (°C)
WPL6	–50 (–50)
WPL9	–100 (–75)
WPL3	–150 (–100)
WPL8	–320 (–195)

Tensile Requirements

	WPL 6		WPL 9		WPL 3		WPL 8	
	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa
Tensile strength, min	60	415	63	435	65	450	100	690
Yield strength, min	35	240	46	315	35	240	75	515
	Longi- tudinal	Transverse	Longi- tudinal	Transverse	Longi- tudinal	Transverse	Longi- tudinal	Transverse
Elongation in 2 in. or 50mm, min. %:								
Basic minimum elongation for walls	30	16.5	28	18	30	20	22	...
7.94mm and over in thickness,								
strip tests, and for all small sizes tested								
in full section								
When standard round 2-in or 50-mm	22	12	20	...	22	14	16	...
gage length test specimen is used								
For strip tests, a deduction for each	1.50 ^A	1.00 ^A	1.50 ^A	1.00 ^A	1.50 ^A	1.00 ^A	1.25 ^A	...
0.80mm decrease in wall thick-								
ness below 7.94mm from the								
basic minimum elongation of the fol-								
lowing percentage points:								

^A The following table gives the calculated minimum values:

Wall Thicknesses	Elongation in 2 in. or 50mm, min, %							
	WPL 6		WPL 9		WPL 3		WPL 8	
	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse
mm								
7.94	30.00	16.50	28.00	18.00	30.00	20.00	22.00	...
7.14	28.50	15.50	26.50	17.00	28.50	19.00	20.75	...
6.35	27.00	14.50	25.00	16.00	27.00	18.00	19.50	...
5.56	25.50	...	23.50	15.00	25.50	...	18.25	...
4.76	24.00	...	22.00	14.00	24.00	...	17.00	...
3.97	22.50	...	20.50	13.00	22.50	...	15.75	...
3.17	21.00	...	19.00	12.00	21.00	...	14.50	...
2.38	19.50	...	17.50	11.00	19.50	...	13.25	...
1.59	18.00	...	16.00	10.00	18.00	...	12.00	...

Materials Specifications for Butt-Welding Fittings

ASTM A403 Standard Specification for WROUGHT AUSTENITIC STAINLESS STEEL PIPING FITTINGS

Marking Symbol ^A Class and Grade		C/ ^I	Mn/ ^I	P/ ^I	S/ ^I	Si/ ^I	Ni	Cr	Mo	Ti	N ₂ ^H	Others
WP Class Fittings	CR Class Fittings											
WP 304	CR 304	0.08	2.00	0.045	0.030	1.00	8.00-11.0	18.0-20.0	...	...	...	...
WP 304H	CR 304H	0.04-0.10	2.00	0.045	0.030	1.00	8.00-11.0	18.0-20.0	...	...	...	...
WP 304L	CR 304L	0.035 ^B	2.00	0.045	0.030	1.00	8.00-13.0	18.0-20.0	...	...	...	...
WP 304L	CR 304LN	0.030	2.00	0.040	0.030	0.75	8.00-10.50	18.0-20.0	...	...	0.10-0.16	...
WP 304N	CR 304N	0.08	2.00	0.040	0.030	0.75	8.00-11.0	18.0-20.0	...	...	0.10-0.16	...
WP 309	CR 309	0.15	2.00	0.045	0.030	1.00	12.0-15.0	22.0-24.0	...	...	...	...
WP 310	CR 310	0.15	2.00	0.045	0.030	1.50	19.0-22.0	24.0-26.0	...	...	...	...
WP 316	CR 316	0.08	2.00	0.045	0.030	1.00	10.0-14.0	16.0-18.0	2.00-3.00	...	...	...
WP 316H	CR 316H	0.04-0.10	2.00	0.045	0.030	1.00	10.0-14.0	16.0-18.0	2.00-3.00	...	...	...
WP 316LN	CR 316LN	0.030	2.00	0.040	0.030	0.75	11.0-14.0	16.0-18.0	2.00-3.00	...	0.10-0.16	...
WP 316L	CR 316L	0.035 ^B	2.00	0.045	0.030	1.00	10.0-15.0 ^C	16.0-18.0	2.00-3.00	...	...	...
WP 316N	CR 316N	0.08	2.00	0.040	0.030	0.75	11.0-14.0	16.0-18.0	2.00-3.00	...	0.10-0.16	...
WP 317	CR 317	0.08	2.00	0.045	0.030	1.00	11.0-15.0	18.0-20.0	3.00-4.00	...	...	...
WP 317L	CR 317L	0.030	2.00	0.045	0.030	1.00	11.0-15.0	18.0-20.0	3.00-4.00	...	...	...
WP 321	CR 321	0.08	2.00	0.045	0.030	1.00	9.00-13.0	17.0-20.0	...	^D	...	...
WP 321H	CR 321H	0.04-0.10	2.00	0.045	0.030	1.00	9.00-13.0	17.0-20.0	...	^E	...	...
WP 347	CR 347	0.08	2.00	0.045	0.030	1.00	9.00-13.0	17.0-20.0	...	...	...	^F
WP 347H	CR 347H	0.04-0.10	2.00	0.045	0.030	1.00	9.00-13.0	17.0-20.0	...	...	...	^G
WP 348	CR 348	0.08	2.00	0.045	0.030	1.00	9.00-13.0	17.0-20.0	...	...	...	Ta ^F = 0.10 max
WP 348H	CR 348H	0.04-0.10	2.00	0.045	0.030	1.00	9.00-13.0	17.0-20.0	...	...	...	Ta ^G = 0.10 max
WP XH-19	CR XH-10	0.060	4.00-6.00	0.040	0.030	1.00	11.5-13.5	20.5-23.5	1.50-3.00	...	0.20-0.40	^J

^A In addition to the WP class designation, WP fittings shall be marked with the additional symbols indicated in 1.1.1 (that is; WP 304S, WP 304W, WP 304WX).

^B For small diameter or thin walls, or both, where many drawing passes are required, a carbon maximum of 0.040% is necessary in grades TP 304L and TP 316L. Small outside diameter tubes are defined as those less than 12.7mm in outside diameter and light wall tubes as those less than 1.24mm in average wall thickness.

^C On pierced tubing, the nickel may be 11.0-16.00%.

^D The titanium content shall be not less than five times the carbon content and not more than 0.70%.

^E The titanium content shall be not less than four times the carbon content and not more than 0.70%.

^F The columbium plus tantalum content shall be not less than ten times the carbon content and not more than 1.10%.

^G The columbium plus tantalum content shall be not less than eight times the carbon content and not more than 1.00%.

^H The method of analysis for nitrogen shall be a matter of agreement between the purchaser and manufacturer.

^I Maximum, unless otherwise indicated.

^J Columbium plus tantalum, 0.10-0.30%: vanadium, 0.10-0.30%.

Grade	Yield Strength, min, ksi [MPa]	Tensile Strength, min, ksi [MPa]	Elongation	
			Longitudinal	Transverse
304, 304LN, 304H, 309, 310, 316, 316LN, 316H, 317, 317L, 321, 321H, 347, 347H, 348, 348H	30 [205]	75 [515]	Elongation:	
			Standard round specimen, or small proportional specimen, minimum % in 4D	28 20
			Rectangular specimen for wall thickness 7.94mm and over, and for all small sizes tested in full section; minimum % in 50mm	35 25
304L, 316L	25 [170]	70 [485]		
304L, 316N	35 [240]	80 [550]		
XM-19	55 [380]	100 [690]	Rectangular specimen for wall thickness less than 5/16 in. [7.94mm]; minimum % in 50mm (40mm wide specimen)	... ^A ... ^A

^A For each 0.79mm decrease in wall thickness below 7.94mm, a deduction of 1.5% for longitudinal and 1.0% for transverse from the values shown above is permitted. The following table gives the minimum value for various wall thickness

Wall Thickness	Elongation in 2 in. or 50 mm, min, %	
mm	Longitudinal	Transverse
7.94	35.00	25.00
7.14	33.25	23.75
6.35	31.50	22.50
5.56	29.75	...
4.76	28.00	...
3.97	26.25	...
3.17	24.50	...
2.38	22.75	...
1.59	21.00	...

Note — The above table gives the computed minimum elongation values for each 0.8-mm decrease in wall thickness. When the wall thickness lies between two values shown above, the minimum elongation value is determined by the following equation:

$$\text{Longitudinal} \quad E = 56t + 17.50$$

$$\text{Transverse} \quad E = 40t + 12.50$$

where:

E = elongation in 2 in. or 50 mm, %, and

t = actual thickness of specimen, mm.

Materials Specifications for Butt-Welding Fittings

ASTM A815
Standard Specification for
WROUGHT FERRITIC, FERRITIC/AUSTENITIC, AND
MARTENSITIC STAINLESS STEEL PIPING FITTINGS

Composition, %												
Grade	C max	Min, max	P max	S max	Si max	Ni	Cr	Mo	Cu max	N	Ti	Other
Ferrite Steels												
WP27	0.010	0.75	0.020	0.020	0.40	0.50 max	25.0-27.50	0.75-1.50	0.20	0.015 max	...	Cb 0.05-0.20
WP33	0.06	0.75	0.040	0.020	0.75	0.50 max	25.0-27.0	0.75-1.50	0.20	0.040 max	0.20-1.00 (7x(C+N)) min	...
WP429	0.12	1.00	0.040	0.030	0.75	0.50 max	14.0-16.0	...	...	...	...	...
WP430	0.12	1.00	0.040	0.030	1.00	0.50 max	16.0-18.0	...	...	...	...	...
WP430TI	0.10	1.00	0.040	0.030	1.00	0.75 max	16.0-19.50	...	...	...	(5xC) min 0.75 max	...
WP446	0.20	1.50	0.040	0.030	0.75	0.50 max	23.0-30.0	...	...	0.10-0.25	...	...
Ferritic/Austenitic Steels												
UNS S31803	0.030	2.0	0.030	0.020	1.0	4.50-6.50	21.0-23.0	2.50-3.50	...	0.08-0.20	...	...
Martensitic Steels												
WP410	0.15	1.00	0.040	0.030	1.00	0.50 max	11.5-13.5	...	...	...	...	...
UNS S41500	0.05	0.5-1.0	0.030	0.030	0.60	3.5-5.5	11.5-14.0	0.5-1.0	...	...	...	...

Tensile and Hardness Requirements

Product Analysis Tolerances for Higher Alloy and Stainless Steels^A

Grade	Tensile Strength, min, ksi [MPa]	Yield Strength, min, ksi [MPa]	Elongation in 2 in. [50 mm] or 4D, min, %	Brinell Hardness, max	Elements	Limit or Maximum of Specified Range, %	Tolerance Over the Maximum Limit or Under the Minimum Limit						
Ferritic Steels:					Carbon	0.030, incl over 0.030 to 0.20 incl	0.005 0.01						
WP27	65 [450]	40 [275]	20.0	190	Manganese	to 1.00, incl over 1.00 to 3.00, incl over 3.00 to 6.00 over 6.00 to 10.00	0.03 0.04 0.05 0.06						
WP33	68 [470]	45 [310]	20.0	241									
WP429	60 [415]	35 [240]	20.0	190									
WP430	65 [450]	35 [240]	20.0	190									
WP430Ti	60 [415]	35 [240]	20.0	190									
WP446	70 [485]	40 [275]	18.0	207									
Ferritic/Austenitic Steels:					Phosphorus	to 0.040, incl	0.005						
UNS S31803	90 [620]	65 [450]	25.0	290	Sulfur	to 0.030, incl	0.005						
Martensitic Steels:					Silicon	to 1.00, incl over 1.00 to 1.40, incl	0.05 0.10						
WP410	60 [415]	30 [205]	20.0	207	Chromium	over 4.00 to 10.00, incl over 10.00 to 15.00, incl over 15.00 to 20.00, incl over 20.00 to 27.50, incl	0.10 0.15 0.20 0.25						
UNS S41500	115 [795]	90 [620]	15.0	295									
								Nickel	to 1.00, incl over 1.00 to 5.00, incl over 5.00 to 10.00, incl over 10.00 to 20.00, incl over 20.00 to 22.00, incl	0.03 0.07 0.10 0.15 0.20			
											Molybdenum	over 0.20 to 0.60, incl over 0.60 to 2.00, incl over 2.00 to 7.00, incl	0.03 0.05 0.10
					Copper	to 0.50	0.03						
					Nitrogen	to 0.19 incl over 0.19 to 0.25 over 0.25 to 0.35 over 0.35 to 0.45	0.01 0.02 0.03 0.04						
					Columbium	0.05 to 0.20, incl	0.01						

^A This table does not apply to heat analysis.

Materials Specifications for Butt-Welding Fittings

ASTM B366
Standard Specification for
FACTORY-MADE WROUGHT NICKEL AND NICKEL
ALLOY WELDING FITTINGS

Permissible Raw Materials

Making ^A			Product and ASTM Designation ^B			
Corrosion Resistant Fittings	ANSI Pressure Fittings	Name	UNS Designation	Pipe or Tube	Plate, Sheet, or Strip	Bar Forging and Forging Stock
CRN	WPN	Pure Nickel	N02200	B161	B162	B160
CRNL	WPNL	Pure, Low Carbon Nickel	N02201	B161	B162	B160
CRNCC	WPNCC	Monel 400	N04400	B165	B127	B164, B564
CRNCI	WPNCI	Inconel 600	N06600	B167, B516 B517	B168	B166, B564
CRNIC	WPNIC	Incoly 200	N08800	B407, B514, B515	B409	B408, B564
CR330	WP330		N08330	B535, B710	B536	B511, B512
CRNICMC	WPNICMC	Incoly 825	N08825	B423, B704, B705	B424	B425
CR20CB	WP20CB	Carpenter 20cb	N08020	B464, B468	B463	B472, B473
CR HB	WPHB	Hastely B	N10001	B169, B622, B626	B333	B335
CR HB2	WPHB-2	Hastely B-2	N10665	B619, B622, B626	B333	B335
CR HC276	WPHC276	Hastely C276	N10276	B619, B622, B626	B575	B574
CR HC4	WPHC4	Hastely C4	N06455	B619, B622, B626	B575	B574
CR HC22	WPHC22	Hastely C22	N06022	B619, B622, B626	B575	B574
CR HG	WPHG	Hastely G	N06007	B619, B622, B626	B582	B581
CR HG3	WPHG3	Hastely G3	N06985	B619, B622, B626	B582	B581
CR HG30	WPHG30	Hastely G30	N06030	B619, B622, B626	B582	B581
CR HN	WPHN	Hastely N	N10003		B434	B573
CR HX	WPHX	Hastely X	N06002	B619, B622, B626	B435	B572
CRNCMC	WPNCMC	Incoly 625	N06625	B444, B704, B705	B443	B446

^AWhen UP fittings are of welded construction or made from welded pipe, the symbol shall be supplemented with W or WX as applicable. If ultrasonic examination is used, the symbol shall be supplemented by WU or WXU as applicable.

^BConform to all the requirements of the ASTM specifications.

^CYield strength shall be 25 000 psi (172 MPa) min, for all hot-formed, annealed fittings made from WPNC material.

Materials Specifications for Butt-Welding Fittings

ASTM B363

Standard Specification for

SEAMLESS AND WELDED UNALLOYED TITANIUM AND TITANIUM ALLOY WELDING FITTINGS

Permissible Raw Materials

Grade ^A	Product and ASTM Designation					
	Pipe	Tube	Plate	Bar and Billet	Casting	Forging
WPT1	B337 Grade 1	B338 Grade 1	B265 Grade 1	B348 Grade 1	B367 Grade C1	B381 Grade F-1
WPT2	B337 Grade 2	B338 Grade 2	B265 Grade 2	B348 Grade 2	B367 Grade C2	B381 Grade F-2
WPT3	B337 Grade 3	B338 Grade 3	B265 Grade 3	B348 Grade 3	B367 Grade C3	B381 Grade F-3
WPT7	B337 Grade 7	B338 Grade 7	B265 Grade 7	B348 Grade 7	B367 Grade C7	B381 Grade F-7
WPT9	B337 Grade 9	B338 Grade 9	B265 Grade 9	B348 Grade 9	...	B381 Grade F-9
WPT11	B337 Grade 11	B338 Grade 11	B265 Grade 11	B348 Grade 11	B367 Grade C11	B381 Grade F-11
WPT12	B337 Grade 12	B338 Grade 12	B265 Grade 12	B348 Grade 12	...	B381 Grade F-12

^AWhen fittings are of welded construction, the symbol shown shall be supplemented by the letter "W."

Chemical Requirements (Ex. B338)

Element	Composition, %						
	Grade 1	Grade 2	Grade 3	Grade 7	Grade 9	Grade 11	Grade 12
Nitrogen, max	0.03	0.03	0.05	0.03	0.02	0.03	0.03
Carbon, max	0.10	0.10	0.10	0.10	0.10	0.10	0.08
Hydrogen, ^A max	0.015	0.015	0.015	0.015	0.013	0.015	0.015
Iron, max	0.20	0.30	0.30	0.30	0.25	0.20	0.3
Oxygen, max	0.18	0.25	0.35	0.25	0.12	0.18	0.25
Palladium	...	...	...	0.12 to 0.25	...	0.12 to 0.25	...
Aluminum	...	...	...	...	2.5 to 3.5	...	...
Vanadium	...	...	...	...	2.0 to 3.0	...	...
Molybdenum	...	...	...	...	...	...	0.2 to 0.4
Zirconium	...	...	...	...	...	...	...
Tin	...	...	...	...	...	...	...
Nickel	...	...	...	...	...	...	0.6 to 0.9
Residuals ^{B, C} (each), max	0.1	0.1	0.1	0.1	0.1	0.1	0.05
Residuals ^{B, C} (total), max	0.4	0.4	0.4	0.4	0.4	0.4	0.3
Titanium (by difference)	remainder	remainder	remainder	remainder	remainder	remainder	remainder

^A Lower hydrogen values may be obtained by negotiation with the manufacturer.

^B Need not be reported.

^C A residual is an element present in a metal or an alloy in small quantities inherent to the manufacturing process but not added intentionally.

Tensile Requirements (Ex. B338)

Grade	Tensile Strength, min		Yield Strength, 0.2% Offset				Elongation in 2 in. or 50 mm. min, %
	ksi	MPa	min		max		
			ksi	MPa	ksi	MPa	
1 <i>A</i>	35	240	25	170	45	310	24
2 <i>A</i>	50	345	40	275	65	450	20
3 <i>A</i>	65	450	55	380	80	550	18
7 <i>A</i>	50	345	40	275	65	450	20
9 <i>B</i>	125	860	105	725	...	...	10
11	35	240	25	170	45	310	24
12	70	483	50	345	...	...	18

Materials Specifications for Butt-Welding Fittings

STANDARD PRACTICE SP-75
SPECIFICATION FOR HIGH TEST
WROUGHT BUTT WELDING FITTINGS

MAXIMUM LIMIT OF CHEMICAL ELEMENTS WHICH MAY
BE USED IN MATERIAL UNDER THIS STANDARD

	(% Max.)
Carbon	0.30
Manganese	1.60
Phosphorus	0.05
Sulphur	0.06
Copper	1.50
Nickel	1.00
Silicon	0.50
Chromium	0.25
Molybdenum	0.25
Vanadium	0.13
Columbium	0.10
Alternate alloy elements may be used but they shall be discussed with the user prior to delivery of the material. This table is not intended to represent the composition of any heart of steel, but merely to record the maximum permissible amounts of an element. The combination of elements of any heat must conform to carbon equivalent, following C. E.	

Carbon equivalent shall be computed by the following equation:

$$C.E. = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

and shall not exceed 0.50%.

TABLE 2. Tensile Requirements

Class Symbol	Yield Strength Min. psi	Tensile Strength, Min. psi		Minimum Elongation In 2 in., %
		Thickness 0.375 in. and under	Thickness Greater than 0.375 in.	
WPHY-42	42 000	60 000	60 000	25
WPHY-46	46 000	63 000	63 000	25
WPHY-52	52 000	72 000	66 000	25
WPHY-60	60 000	78 000	75 000	20
WPHY-65	65 000	80 000	77 000	20
WPHY-70	70 000	82 000	80 000	18

Materials Specifications for Butt-Welding Fittings

ASTM B361 FACTORY-MADE WROUGHT ALUMINUM AND ALUMINUM-ALLOY WELDING FITTINGS

Requirements for Aluminum and Aluminum-Alloy Materials Used in the Manufacture of Fittings

Alloy Designation ^{A,B}	Type of Material	Applicable ASTM Specification			
		Pipe or Tube	Plate	Bar	Forging
WP1060 ^C F H112	99.6% pure aluminum	B210			
		B221			
		B234		B211	
		B241	B209	B221	...
WP1100 ^C F H112	Commercially pure low-strength aluminum alloy	B210			
		B221		B211	
		B241	B209	B221	B247
WP3003 ^C F H112	Aluminum-base manganese alloy	B210			
		B221		B211	
		B234	B209	B221	B247
		B241			
WP Alclad ^C 3003 F H112	Aluminum-base manganese alloy core, clad on one side (inside only) in case of pipe	B210			
		B221			
		B234	B209		
		B241			
WP5083 ^D O, F H112	Aluminum-base magnesium-manganese alloy	B210			
		B221	B209	B221	B247
		B241			
WP5086 ^D O, F H112	Aluminum-base magnesium-manganese alloy	B210			
		B221	B209	B221	
		B241			
WP5154 ^C F H112	Aluminum-base magnesium alloy	B210		B211	
		B221	B209	B221	
WP6061	Aluminum-base magnesium-silicon heat-treatable alloy	B210			
		B221			
		B234		B211	
		B241	B209	B221	B247
WP6063	Aluminum-base magnesium-silicon heat-treatable alloy	B210			
		B221			
		B241	...	B221	...

^A When fittings are of welded construction, designation shall be supplemented by the suffix "W."

^B These alloy designations were established in accordance with ANSI H35.1, except for the letter symbols "WP," which denote wrought product.

^C Fittings in nonheat-treatable alloys 1060, 1100, 3003, Alclad 3003, and 5154 are available only in the F or H112 tempers as covered by the applicable raw material specification.

^D Fittings in nonheat-treatable alloys 5083 and 5086 are available in the O, F, or H112 tempers as covered by the applicable raw material specification.

Chemical Composition Limits^{A, B, C} (Ex. B241)

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Other Elements		Aluminum
									Each	Total	
1060 ^D	0.25	0.35	0.05	0.03	0.03	...	0.05	0.03	0.03 ^D	...	99.60 ^E
1100	0.95 Si + Fe		0.05-0.20	0.05	...	...	0.10	...	0.05	0.15	99.00 ^E
3003	0.6	0.7	0.05-0.20	1.0-1.5	...	...	0.10	...	0.05	0.15	remainder
Alclad 3003 ^N	...	...	...	...	...	...	...	...	...	...	...
5052	0.25	0.40	0.10	0.10	2.2-2.8	0.15-0.35	0.10	...	0.05	0.15	remainder
5083	0.40	0.40	0.10	0.40-1.0	4.0-4.9	0.05-0.25	0.25	0.15	0.05	0.15	remainder
5086	0.40	0.50	0.10	0.20-0.7	3.5-4.5	0.05-0.25	0.25	0.15	0.05	0.15	remainder
6061 ^I	0.40-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.04-0.35	0.25	0.15	0.05	0.15	remainder
6063	0.20-0.6	0.35	0.10	0.10	0.45-0.9	0.10	0.10	0.10	0.05	0.15	remainder

^A Limits are in percent maximum unless shown as a range or stated otherwise.

^B Analysis shall regularly be made for the elements specified in this table. If, however, the presence of other elements is suspected or indicated in amounts greater than the specified limits, further analysis shall be made to determine that these elements are not present in amounts in excess of specified limits.

^C For purposes of determining conformance to these limits, an observed value or a calculated value obtained from analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the specified limit, in accordance with the rounding method of Recommended Practice E29.

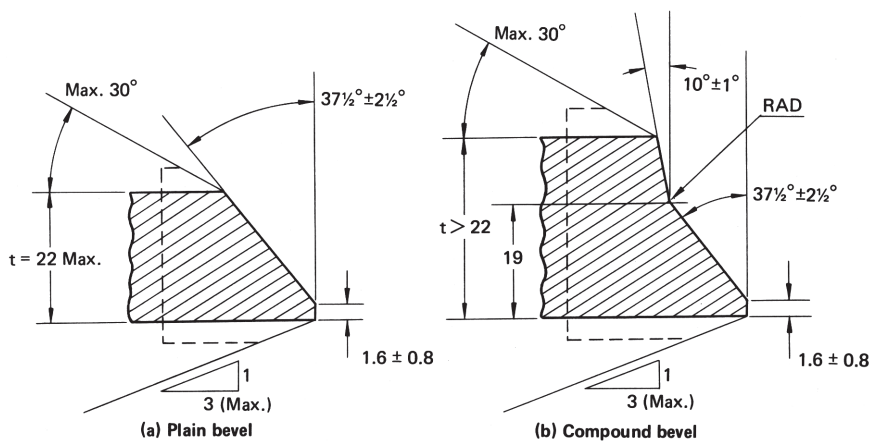
^D Vanadium 0.05% maximum.

^E By difference.

^N Alloy 3003 clad with alloy 7072.

^I Beginning in the 1965 issue, the requirements for alloy 6062 were combined with alloy 6061 by revision of the minimum chromium content of 6061 from 0.15 to 0.04. This action cancelled alloy 6062.

Welding End Preparation



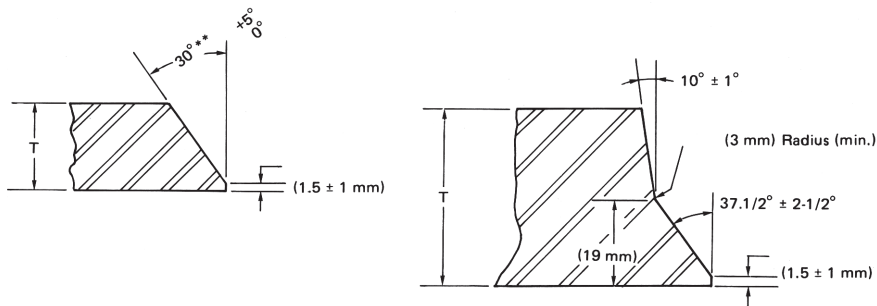
(in mm)

Nominal Pipe Wall Thickness (t)	End Preparation
Less than x*	Cut square or slightly chamfer, at mfr.'s option
x* to 22 incl.	Plain bevel as in sketch "a" above
More than 22	Compound bevel as in sketch "b" above

*x = 5 for carbon steel, ferritic alloy steel or wrought iron;
4 for austenitic alloy steel

- Notes: 1. End preparations are in accordance with ANSI B16.25 Paragraph 4.2
2. End preparations conforming to customer specifications will be specially manufactured upon consultation.

MSS SP-75, API 5L



* Or 1 in. (25 mm) at option of the manufacturer.
** Fittings size 24 and smaller may be furnished with 37-1/2 bevel at option of manufacturer.

RECOMMENDED BEVEL FOR WALL THICKNESS (T)
AT END OF FITTING, 19 mm* OR LESS

RECOMMENDED BEVEL FOR WALL THICKNESS (T)
AT END OF FITTING, GREATER THAN 19 mm



HEAD OFFICE

Benkan Corporation

5-13, 2-chome, Sanno, Ohta-ku, Tokyo, Japan
Telephone: Tokyo 777-1511 Telex: 246-6858 BENKANJ

MANUFACTURING FACTORIES

- Osaka Factory:** 3-9-4 Nishinagasu Hondori, Amagasaki-shi, Hyogo-ken, Japan
Telephone: Osaka 482-1351 Telex: 524-2957 BENKAN
- Kiryu Factory:** 2-651 Aioi-cho, Kiryu-shi, Gunma-ken, Japan
Telephone: Kiryu 44-8146 Telex: 3463-504 BENKANJ
- Gunma Factory:** 5 Higashiura Rokusengoku, Yabuzuka Hon-cho, Nitta-gun,
Gunma-ken, Japan
Telephone: Yabuzuka 4111
- Yokohama Factory:** 1-10 Koura, Kanazawa-ku, Yokohama-shi,
Kanagawa-ken, Japan
Telephone: Yokohama 774-7771

AFFILIATED COMPANIES

- Benkan America, Inc.** 1221 Lamar, Suite 1132, Houston, Texas 77010, U.S.A.
Tel: (713) 739-7251 Facsimile: (713) 739-7257
Telex: 765561 BENKAN HOU
- B. K. L. Fittings Ltd.** Washford Industrial Estate, Reddith
Worcestershire England B98ODR
Tel: (0527) 24224
- Tube-Line Company** 651 Lehigh Ave., Union
New Jersey, 07083
Tel: (201) 686-6800
- Thai Benkan Co., Ltd.** 58 Soi Wat Krunai Bangkru Sub-District,
Phrapraeng District Samutprakarn Province Thailand
Tel: 99-2-463-6237
- EBK S.P.A.** Viale della Liberazione, 18 20124 Milano, Italy
Tel: (02) 66980628, 66980632

DISTRIBUTOR:



中華五金有限公司

CHUNG WAH METAL CO., LTD.