Dimensions, in Inches (Cont.)

Class	Size	A	C	D	E	F	G	H	J	K
400 Pound	4	8	5 1/2	16	4 1/2	20 1/2	8 1/4	6	6 1/2	7/8
	5	9	6	16 3/4	5	21 3/4	9 1/4	6 3/4	7 1/2	1
	6	9 3/4	6 1/4	18 3/4	5 1/4	24	10	7 1/2	7 1/2	1
	8	11 3/4	6 3/4	22 1/4	5 3/4	28	12	9	10	1 1/4
	10	13 1/4	7 3/4	25 3/4	6 1/4	32	13 1/2	10 1/2	10	1 1/4
	12	15	8 3/4	29 3/4	6 1/2	36 1/4	15 1/4	12	12 1/2	1 7/16
	14	16 1/4	9 1/4	32 3/4	7	39 3/4	16 1/2	13 1/2	12 1/2	1 7/16
	16	17 3/4	10 1/4	36 1/4	8	44 1/4	18 1/2	14 3/4	12 1/2	1 7/16
	18	19 1/4	10 3/4	39 1/4	8 1/2	47 3/4	19 1/2	16 1/4	15	1 5/8
	20	20 3/4	11 1/4	42 3/4	9	51 3/4	21	17 7/8	15	1 5/8
	24	24 1/4	12 3/4	50 1/4	10 1/2	60 3/4	24 1/2	20 3/4	17 1/2	1 7/8
600 Pound	1/2	3 1/4	2	5 3/4	1 3/4	7 1/2	5			
	3/4	3 3/4	2 1/2	6 3/4	2	8 3/4	5			
	1	4 1/4	2 1/2	7 1/4	2 1/4	9 1/2	5			
	1 1/4	4 1/2	2 3/4	8	2 1/2	10 1/2	5			
	1 1/2	4 3/4	3	9	2 3/4	11 3/4	5			
	2	5 3/4	4 1/4	10 1/4	3 1/2	13 3/4	6	4 3/4	6 1/8	13/16
	2 1/2	6 1/2	4 1/2	11 1/2	3 1/2	15	6 3/4	5 1/4	6 1/8	13/16
	3	7	5	12 3/4	4	16 3/4	7 1/4	5 3/4	6 1/2	7/8
	3 1/2	7 1/2	5 1/2	14	4 1/2	18 1/2	7 3/4	6 1/2	6 1/2	7/8
	4	8 1/2	6	16 1/2	4 1/2	21	8 3/4	7	7 1/2	1
	5	10	7	19 1/2	6	25 1/2	10 1/4	8 1/4	10	1 1/4
	6	11	7 1/2	21	6 1/2	27 1/2	11 1/4	9	10	1 1/4
	8	13	8 1/2	24 1/2	7	31 1/2	13 1/4	11	12 1/2	1 7/16
	10	15 1/2	9 1/2	29 1/2	8	37 1/2	15 3/4	12 1/2	12 1/2	1 7/16
	12	16 1/2	10	31 1/2	8 1/2	40	16 3/4	13 1/4	15	1 5/8
	14	17 1/2	10 3/4	34 1/4	9	43 1/4	17 3/4	14 3/4	15	1 5/8
	16	19 1/2	11 3/4	38 1/2	10	48 1/2	19 3/4	16	15	1 5/8
	18	21 1/2	12 1/4	42	10 1/2	52 1/2	21 3/4			
	20	23 1/2	13	45 1/2	11	56 1/2	23 3/4			
	24	27 1/2	14 3/4	53	13	66	27 3/4			
900 Pound	3	7 1/2	5 1/2	14 1/2	4 1/2	19	7 3/4	5 3/4	6 1/2	7/8
	4	9	6 1/2	17 1/2	5 1/2	23	9 1/4	7	7 1/2	1
	5	11	7 1/2	21	6 1/2	27 1/2	11 1/4	8 1/4	10	1 1/4
	6	12	8	22 1/2	6 1/2	29	12 1/4	9	10	1 1/4
	8	14 1/2	9	27 1/2	7 1/2	35	14 3/4	11	12 1/2	1 7/16
	10	16 1/2	10	31 1/2	8 1/2	40	16 3/4	12 1/2	12 1/2	1 7/16
	12	19	11	34 1/2	9	43 1/2	17 3/4	13 1/4	15	1 5/8
	14	20 1/4	11 1/2	36 1/2	9 1/2	46	19	14 3/4	15	1 5/8
	16	22 1/4	12 1/2	40 3/4	10 1/2	51 1/4	21	16	15	1 5/8
	18	24	13 1/4	45 1/2	12	57 1/2	24 1/2			
	20	26	14 1/2	50 1/4	13	63 1/4	26 1/2			
	24	30 1/2	18	60	15 1/2	75 1/2	30 1/2			
1500 Pound	1/2	4 1/4	3							
	3/4	4 1/2	3 1/4							
	1	5	3 1/2	9	2 1/2	11 1/2	5			
	1 1/4	5 1/2	4	10	3	13	5 3/4			
	1 1/2	6	4 1/4	11	3 1/2	14 1/2	6 1/4			
	2	7 1/4	4 3/4	13 1/4	4	17 1/4	7 1/4	5 1/2	6 1/2	7/8
	2 1/2	8 1/4	5 1/4	15 1/4	4 1/2	19 3/4	8 1/4	6	6 1/2	7/8
	3	9 1/4	5 3/4	17 1/4	5	22 1/4	9 1/4	6 1/2	7 1/2	1
	4	10 3/4	7 1/4	19 1/4	6	25 1/4	10 3/4	7 3/4	10	1 1/4
	5	13 1/4	8 3/4	23 1/4	7 1/2	30 3/4	13 3/4	9	10	1 1/4
	6	13 7/8	9 3/8	24 7/8	8 1/8	33	14 1/2	9 3/4	12 1/2	1 7/16
	8	16 3/8	10 7/8	29 7/8	9 1/8	39	17	11 1/2	12 1/2	1 7/16
	10	19 1/2	12	36	10 1/4	46 1/4	20 1/4	13 3/4	15	1 5/8
	12	22 1/4	13 1/4	40 3/4	12	52 3/4	23	15 1/2	15	1 5/8
	14	24 3/4	14 1/4	44	12 1/2	56 1/2	25 3/4	17 1/4	17 1/2	1 7/8
	16	27 1/4	16 1/4	48 1/4	14 3/4	63	28 1/4	18 3/4	17 1/2	1 7/8
	18	30 1/4	17 3/4	53 1/4	16 1/2	69 3/4	31 1/2			
	20	32 3/4	18 3/4	57 3/4	17 3/4	75 1/2	34			
	24	38 1/4	20 3/4	67 1/4	20 1/2	87 3/4	39 3/4			

Class	Size	A	C	D	E	F	G
2500 Pound	1/2	5 3/16					
	3/4	5 3/8					
	1	6 1/16	4				
	1 1/4	6 7/8	4 1/4				
	1 1/2	7 9/16	4 3/4				
	2	8 7/8	5 3/4	15 1/4	5 1/4	20 1/2	9 1/2
	2 1/2	10	6 1/4	17 1/4	5 3/4	23	10 1/2
	3	11 3/8	7 1/4	19 3/4	6 3/4	26 1/2	11 3/4
	4	13 1/4	8 1/2	23	7 3/4	30 3/4	13 1/2
	5	15 5/8	10	27 1/4	9 1/4	36 1/2	15 3/4
	6	18	11 1/2	31 1/4	10 1/2	41 3/4	18
	8	20 1/8	12 3/4	35 1/4	11 3/4	47	20 1/2
	10	25	16	43 1/4	14 3/4	58	25 1/2
	12	28	17 3/4	49 1/4	16 1/4	65 1/2	29

Center to Face

The 150 and 300-Pound Fittings are regularly furnished with an American Standard 1/16-inch raised face on the end flanges; the 400, 600, 900, 1500, and 2500-Pound Fittings regularly have a 1/4-inch high large male facing. Center to face and face to face dimensions include the facing.

Special Angle Elbows

The center to face dimensions of 45° elbows are used for special angle elbows of 1° to 45°; for angles greater than 45° and up to 90°, use the center to face dimensions of 90° elbows.

Reducing Fittings

Center to face dimensions of reducing fittings correspond to those of straight fittings of the same size as the largest opening.

American Standard

Crane Cast Steel Flanged Fittings conform to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939, for their respective working pressures.

The American Standard does not include 1/2 and 3/4-inch 45° Laterals in the 1500-Pound pressure class.

Working pressures ..... *page 262*
List prices ..... *pages 264 and 265*
Description ..... *page 263*
Drilling templates ... *pages 441 to 443*
Flange dimensions ... *pages 441 to 443*
Special facings ..... *pages 448 to 451*

4000-Pound Pressure Class



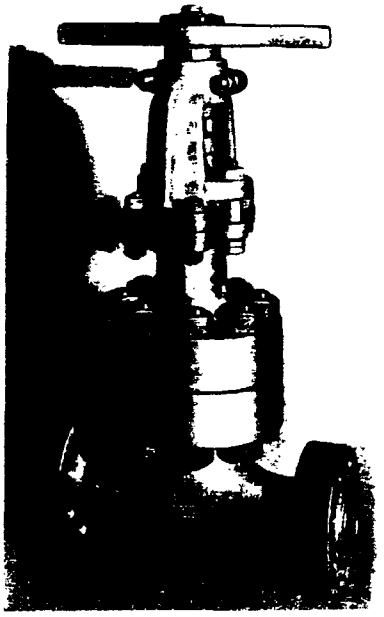
90° Elbow

For pressures and temperatures beyond the scope of the 1500 and 2500-Pound Pressure Classes, Crane is equipped to supply valves, fittings, and flanges in the 4000-Pound Pressure Class.

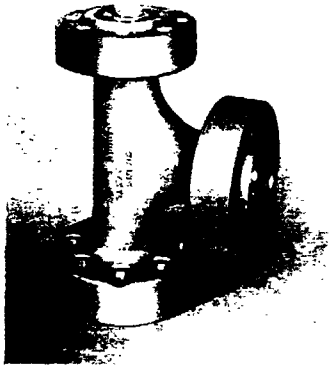
These products are generally made of Crane No. 5 Chrome-Molybdenum Alloy Cast Steel, and finished with ring joint facing. When so desired, they can be supplied in other alloys, such as Crane No 4 Carbon-Molybdenum Alloy Cast Steel, or furnished with other types of facings.

Inquiries should be accompanied by complete specifications including operating pressures and temperatures, and plans of proposed installation.

Prices, description, dimensions, and complete information furnished on application.

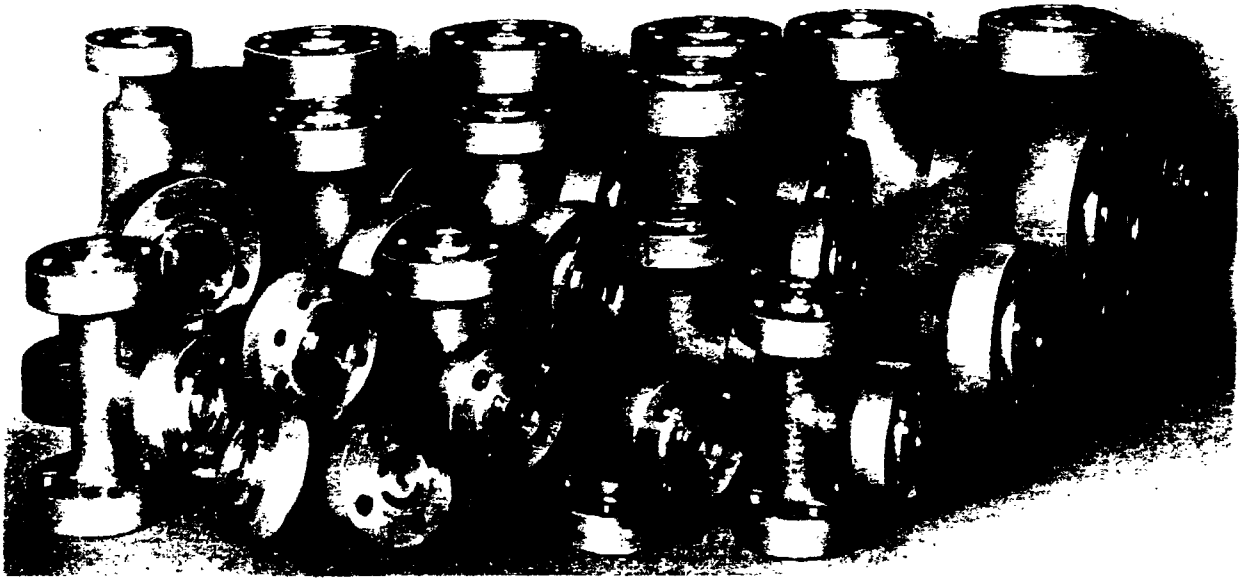


Globe Valve



Tee

The illustrations on this page are actual photographs of Crane Valves and Fittings with flanged ends and ring joint facing supplied for a 4000-Pound installation. They are made of Crane No. 5 Chrome-Molybdenum Alloy Cast Steel, and are recommended for operating service at 4000 pounds pressure at 900° F. temperature



Group of Fittings for 4000-Pound Pressure Class

Steel Welding Fittings

Socket-Welding Fittings
Description and Ratings . . . . . pages 270 and 272
List Prices . . . . . pages 271 and 272
Dimensions . . . . . pages 272 and 273
Reducer Inserts, List Prices and Dimensions . . . . . page 272

Bonney WeldOlets . . . . . page 281

Butt-Welding Fittings
For Use with Standard Pipe . . . . . pages 274 and 275
For Use with Extra Strong Pipe . . . . . pages 276 and 277
For Use with Schedule 160 Pipe . . . . . page 278
For Use with Double Extra Strong Pipe . . . . . page 278
Reducers, Welding Saddles, and Welding Sleeves . . . page 279
Dimensions . . . . . page 280
Pressure-Temperature Ratings . . . . . pages 282 and 283

The Crane line of Steel Welding Fittings — comprising two types, socket-welding and butt-welding — includes all of the popular kinds of fittings in a wide range of sizes, and in all regular, commercially available weights.

Wherever the user of welding fittings demands easy installation — wherever maintenance costs are carefully considered — wherever quality, completeness, and adaptability are of prime importance — Crane Steel Welding Fittings are chosen.

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Socket-Welding Fittings: Forged Steel Socket-Welding Fittings (see pages 270 to 273) are ideal when welding fittings are wanted for use in small pipe lines.

The fittings are of high quality throughout; they are forged solid from high grade steel or are machined from bar stock, depending upon the type of fitting; the openings are drilled and the ends are bored to slip over pipe.

Butt-Welding Fittings: Butt-Welding Fittings (see pages 274 to 280), recommended for general all-around welding service, are designed to combine serviceability with ease of installation; the use of these fittings reduces the welder's task to its simplest form — that of making circumferential butt-welds. The materials from which the fittings are made are especially selected to assure strength, resistance to piping strains and temperature, and easy weldability.

Crane Steel Butt-Welding Fittings are fully as strong as or stronger than Grade A Seamless Steel Pipe of corresponding thickness. They can be used for any pressure or temperature for which the pipe is used, with equal safety; see pages 282 and 283.

The fittings have a uniform circular section of full diameter, uniform center to end dimensions, and accurately beveled, true, round ends.

Other welding end products: Crane supplies a complete welding line—not the fittings only! Real advantages accrue to the user by being able to secure welding valves and other accessories for welded piping, as well as fittings and flanges, from one reliable source—and all of the highest quality. A uniformly satisfactory installation is within reach when Crane welding materials are used.

Forged Steel Flanges—Welding Neck, Slip-On Welding, and Cranelap (for use with Cranelap Stub Ends) —are available in a full range of sizes in all pressure classes; see pages 285 to 292. Steel Gate, Globe, Angle, and Check Valves with welding ends also are available in a complete range of sizes and in all pressure classes; see pages 209 to 254.

In addition, Crane Fabricating Shops are unusually well equipped, as explained on pages 496 and 497, to supply pre-fabricated piping, assembled in units for final erection with a minimum of field effort.

American Standard: Crane Steel Butt-Welding Fittings conform to the American Standard for Steel Butt-Welding Fittings, B16.9-1940. This Standard includes the following types and sizes of fittings:

90° Elbows, sizes 1 to 12-inch
45° Elbows, sizes 1 to 12-inch
Tees, sizes 1 to 12-inch — Center to end of run only for straight sizes and for reductions on outlet to one size less than half the run size.
Caps, sizes 1 to 24-inch
Reducers, sizes 12-inch and smaller — For reductions to one size less than half the run size.
Return Bends, in the following sizes:

1 x 3"	2 x 6"	3½ x 10½"	6 x 18"
1¼ x 3¾	2½ x 7½	4 x 12	8 x 24
1½ x 4½	3 x 9	5 x 15	10 x 30
			12 x 36

Lapped Joint Stub Ends (Cranelap Stub Ends), sizes 1 to 24-inch.

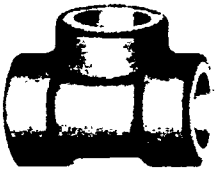
Forged Steel Socket-Welding Fittings

2000, 3000, 4000, and 6000-Pound W.O.G.

For list prices, see the opposite page.



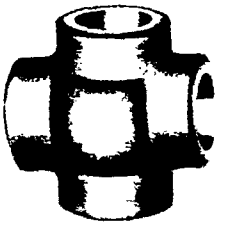
90° Elbow
No. 1240, 2000-Lb WOG
No. 1380, 3000-Lb. WOG
No. 1460, 4000-Lb. WOG
No. 1660, 6000-Lb WOG



Tee
No. 1241, 2000-Lb WOG
No. 1381, 3000-Lb WOG
No. 1461, 4000-Lb. WOG
No. 1661, 6000-Lb. WOG



45° Elbow
No. 1242, 2000-Lb WOG
No. 1382, 3000-Lb. WOG
No. 1462, 4000-Lb WOG
No. 1662, 6000-Lb. WOG



Cross
No. 1243, 2000-Lb WOG
No. 1383, 3000-Lb WOG
No. 1463, 4000-Lb. WOG
No. 1663, 6000-Lb. WOG

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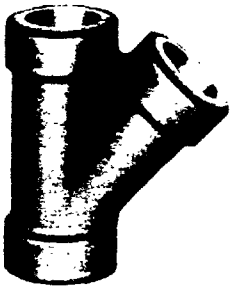


45° Y-Bend
No. 1245, 2000-Lb. WOG
No. 1385, 3000-Lb. WOG
No. 1465, 4000-Lb WOG
No. 1665, 6000-Lb. WOG



Coupling
No. 1246, 2000-Lb WOG
No. 1386, 3000-Lb. WOG
No. 1466, 4000-Lb. WOG
No. 1666, 6000-Lb. WOG



Reducer
No. 1247, 2000-Lb. WOG
No. 1387, 3000-Lb. WOG
No. 1467, 4000-Lb. WOG
No. 1667, 6000-Lb. WOG



Cap
No. 1249, 2000-Lb WOG
No. 1389, 3000-Lb. WOG
No. 1469, 4000-Lb WOG
No. 1669, 6000-Lb. WOG

2000-Pound W.O.G. Fittings are for use with Schedule 40 or Standard Pipe.
3000-Pound W.O.G. Fittings are for use with Schedule 80 or Extra Strong Pipe.
4000-Pound W.O.G. Fittings are for use with Schedule 160 Pipe.
6000-Pound W.O.G. Fittings are for use with Double Extra Strong Pipe.

These unusually rugged, durable fittings are ideally suited for small (up to and including 4-inch size) welded lines on relatively low pressure service, or for high pressure hydraulic lines and high pressure-temperature service.

Design and construction: Elbows, tees, crosses, and Y-bends are forged solid; reducer inserts (illustrated on page 272), couplings, reducers, and caps are machined from solid steel. All openings are drilled, and the ends are bored to slip over pipe.

Elbows, tees, crosses, and Y-bends have each opening reinforced with a wide band. It completely surrounds the socket chamber, extending well beyond the back of the socket, and complies with recognized requirements for socket weld dimensions.

WORKING PRESSURES
Pounds, Non-Shock
For Steam, Water, Oil, Oil Vapor, Gas, or Air

Temp.	Carbon Steel Fittings				Carbon-Molybdenum Steel Fittings			
Deg. F.	2000 Pound W.O.G.	3000 Pound W.O.G.	4000 Pound W.O.G.	6000 Pound W.O.G.	2000 Pound W.O.G.	3000 Pound W.O.G.	4000 Pound W.O.G.	6000 Pound W.O.G.
100	2000	3000	4000	6000	2000	3000	4000	6000
150	1980	2960	3960	5915	1980	2960	3960	5915
200	1950	2920	3890	5830	1950	2920	3890	5830
250	1920	2880	3840	5750	1920	2880	3840	5750
300	1900	2840	3800	5690	1900	2840	3800	5690
350	1880	2820	3760	5625	1880	2820	3760	5625
400	1850	2780	3700	5550	1850	2780	3700	5550
450	1830	2740	3660	5490	1830	2740	3660	5490
500	1740	2600	3480	5210	1740	2600	3480	5210
550	1640	2460	3290	4925	1640	2460	3290	4925
600	1550	2310	3090	4620	1550	2310	3090	4620
650	1440	2150	2880	4300	1440	2150	2880	4300
700	1320	1960	2620	3920	1320	1960	2620	3920
750	1190	1775	2370	3550	1190	1775	2370	3550
800	1020	1525	2040	3050	1045	1560	2090	312[illegible]
850	835	1250	1670	2500	975	1460	1950	29[illegible]
900	585	875	1170	1750	900	1350	1800	2700
950	460	690	920	1375	835	1250	1670	2500
1000	335	500	665	1000	650	975	1300	1950

Materials: The fittings are made from high grade carbon steel, having unusual strength and toughness. It is particularly suitable for fusion welding.

American Standard: These fittings conform to the American Standard for Steel Socket-Welding Fittings (B16.11-1946). This Standard include elbows, tees, crosses, and couplings in sizes ⅛ to 3 inches for use with Schedule 40 and 80 Pipe and in sizes ½ to 3 inches for use with Schedule 160 Pipe.

The Standard specifies that the fittings may be used for the same pressure-temperature ratings as the pipe of the indicated schedule number.

Reducer Inserts **page 272**

Dimensions **page 273**

Forged Steel Socket-Welding Fittings

2000, 3000, 4000, and 6000-Pound W.O.G.

For working pressures and description, see the opposite page.

List Prices, Each—Carbon Steel Fittings

Type of Fittings	Size Inches	90° Elbows	Tees	45° Elbows	Crosses	45° Y-Bends	Couplings	Reducers	Caps
2000-Pound W.O.G. Fittings *For use with Schedule 40 or Standard Pipe*		No. 1240	No. 1241	No. 1242	No. 1243	No. 1245	No. 1246	No. 1247	No. 1249
	⅛	.55	.80	.68	1.10		.40		.35
	¼	.55	.80	.68	1.10	1.40	.40	.55	.35
	⅜	.55	.80	.68	1.10	1.85	.40	.55	.35
	½	.65	.95	.78	1.30	2.00	.40	.70	.45
	¾	.75	1.10	.90	1.50	2.50	.45	1.00	.65
	1	.90	1.35	1.08	1.90	3.00	.55	1.20	.90
	1¼	1.20	1.75	1.44	2.80	3.75	.70	1.35	1.00
	1½	1.50	2.30	1.80	3.50	4.75	.85	1.60	1.30
	2	1.90	2.90	2.28	5.00	5.80	1.15	1.85	2.00
	2½	2.90	4.40	3.48	7.30		1.60	2.75	3.65
	3	5.00	7.50	6.00	10.00		2.75	3.75	4.35
	4	12.50	17.00	14.00	23.00		4.80	6.75	13.00
3000-Pound W.O.G. Fittings *For use with Schedule 80 or Extra Strong Pipe*	Size Inches	No. 1380	No. 1381	No. 1382	No. 1383	No. 1385	No. 1386	No. 1387	No. 1389
	¼	.55	.80	.68	1.10	1.40	.40	.55	.35
	⅜	.55	.80	.68	1.10	1.85	.40	.55	.35
	½	.65	.95	.78	1.30	2.00	.40	.70	.45
	¾	.75	1.10	.90	1.50	2.50	.45	1.00	.65
	1	.90	1.35	1.08	1.90	3.00	.55	1.20	.90
	1¼	1.20	1.75	1.44	2.80	3.75	.70	1.35	1.00
	1½	1.50	2.30	1.80	3.50	4.75	.85	1.60	1.30
	2	1.90	2.90	2.28	5.00	5.80	1.15	1.85	2.00
	2½	2.90	4.40	3.48	7.30		1.60	2.75	3.65
	3	5.00	7.50	6.00	10.00		2.75	3.75	4.35
	4	12.50	17.00	14.00	23.00		4.80	6.75	13.00
4000-Pound W.O.G. Fittings *For use with Schedule 160 Pipe*	Size Inches	No. 1460	No. 1461	No. 1462	No. 1463	No. 1465	No. 1466	No. 1467	No. 1469
	½	.75	1.10	.90	1.50	2.50	.60	.90	.65
	¾	.90	1.35	1.08	1.90	3.00	.65	1.25	.90
	1	1.20	1.75	1.44	2.80	3.75	.85	1.50	1.00
	1¼	1.50	2.30	1.80	3.50	4.75	1.05	1.70	1.30
	1½	1.90	2.90	2.28	5.00	5.80	1.30	2.10	2.00
	2	2.90	4.40	3.48	7.30		1.75	2.50	3.65
	2½	5.00	7.50	6.00	10.00		2.40	3.60	4.35
	3	12.50	17.00	14.00	23.00		4.75	5.75	5.45
	4	18.00	25.00	21.00	31.50		10.90	11.75	18.00
6000-Pound W.O.G. Fittings *For use with Double Extra Strong Pipe*	Size Inches	No. 1660	No. 1661	No. 1662	No. 1663	No. 1665	No. 1666	No. 1667	No. 1669
	⅜	.65	.95	.78	1.30	2.00	.60	.75	.45
	½	.75	1.10	.90	1.50	2.50	.60	.90	.65
	¾	.90	1.35	1.08	1.90	3.00	.65	1.25	.90
	1	1.20	1.75	1.44	2.80	3.75	.85	1.50	1.00
	1¼	1.50	2.30	1.80	3.50	4.75	1.05	1.70	1.30
	1½	1.90	2.90	2.28	5.00	5.80	1.30	2.10	2.00
	2	2.90	4.40	3.48	7.30		1.75	2.50	3.65
	2½	5.00	7.50	6.00	10.00		2.40	3.60	4.35
	3	12.50	17.00	14.00	23.00		4.75	5.75	5.45
	4	18.00	25.00	21.00	31.50		10.90	11.75	18.00

Reducing fittings: Reducing fittings can be made in any reduction from straight size forging blanks; see the Crane Discount Sheet for prices.

Alloy steel fittings: Fittings of Carbon-Molybdenum Steel or of stainless steel, Type 347, can be made to order; prices are furnished on application.

Reducer Inserts . . . . page 272

Sleeve and half couplings: Unless otherwise specified, the socket-end type listed above are furnished when couplings are ordered. Sleeve couplings, made without the internal shoulder, and half couplings can be furnished when ordered; they use the same list prices as regular couplings. See the Crane Discount Sheet for prices.

Dimensions . . . page 273

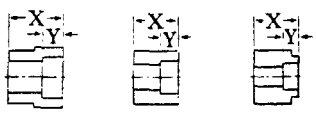
Steel Socket-Welding Reducer Inserts



Reducer Insert

No. 1250
For use with Standard or Schedule 40 Pipe

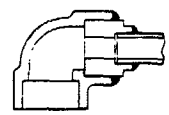
No. 1390
For use with Extra Strong or Schedule 80 Pipe



Type No. 1 Type No. 2 Type No. 3

Socket-Welding Reducer Inserts serve the same purpose as threaded bushings used with screwed fittings. They simplify the problem of making reductions in the sizes of pipe in socket-welded lines and avoid the delays and extra costs involved in procuring reducing fittings. By carrying an assorted stock of Reducer Inserts, the user can make up many combinations of reducing sizes in any type of fitting in the least amount of time and at low cost.

The illustration at the right shows one of these fittings inserted in a straight size 90° elbow to make a reducing size. The Insert is placed in the end of the fitting and fillet welded; the smaller size pipe is then inserted in the smaller pipe end of the Reducer Insert and welded.



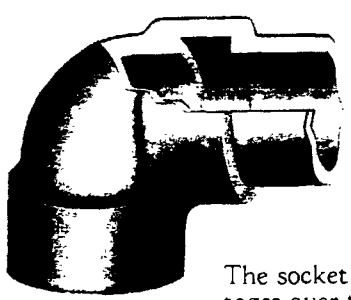
Illustrating the application of a Socket-Welding Reducer Insert to a Socket-Welding 90° Elbow.

Reducer Inserts are available in 1, 1¼, 1½, and 2-inch sizes, the No. 1250 being made for use with Standard or Schedule 40 Pipe and the No. 1390 being made for use with Extra Strong or Schedule 80 Pipe. Regularly supplied of Carbon Steel, they can be furnished made of Carbon-Molybdenum Steel; prices on application. The fittings are made in three types, depending on the size, as illustrated above.

List Prices, Carbon Steel, and Dimensions

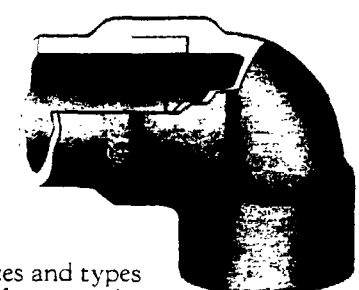
Size	List Prices, Each		Dimensions, in Inches		
Inches	No. 1250	No. 1390	Type No.	X	Y
1 ×¾	.45	.45	1	1½	9/16
×½			2	1 5/16	½
1¼×1	.55	.55	1	1 11/16	⅝
×¾			2	1⅜	9/16
×½			3	1⅜	½
1½×1¼	.70	.70	1	1⅞	11/16
×1			2	1 7/16	⅝
×¾			3	1 7/16	9/16
×½			3	1 7/16	½
2 ×1½	1.10	1.10	2	1 9/16	¾
×1¼			3	1 9/16	11/16
×1			3	1 9/16	⅝
×¾			3	1 9/16	9/16
×½			3	1 9/16	½

Advantages of Steel Socket-Welding Fittings



On installations where the pipe need not butt against the shoulder, the socket compensates for inaccuracies in measuring and cutting the pipe.

On installations where the pipe must butt against the shoulder, free, uninterrupted flow is assured. Fitting and pipe have the same inside diameter.



The socket type weld has advantages over the butt weld that recommend it strongly for fittings for small size pipe lines. The pipe used with it does not require beveling.

Since the pipe end slips into, and is supported by the socket, the joint is self-aligning; tack welding and special clamps to line up and hold the joint are unnecessary. Because the weld metal is deposited on the outer surface of the pipe, there is no danger of forming welding icicles which would clog the line and restrict flow.

These fittings have the same inside diameter as Standard or Schedule 40, Extra Strong or Schedule 80, Schedule 160, or Double Extra Strong Pipe, depending upon the weight of fitting ordered. On installations where the pipe is butted against the shoulder at the back of the socket, the fittings permit free, uninterrupted flow of the fluid in the line.

The fittings, in the sizes and types covered therein, conform to the American Standard, A.S.A. B16.11–1946, as explained on page 270. The bore diameter of the socket is the same for all fittings regardless of the pressure class.

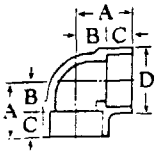
Size of Fitting	Bore Diameter of Socket (Minimum)
⅛"	0.420"
¼	0.555
⅜	0.690
½	0.855
¾	1.065
1	1.330
1¼	1.675
1½	1.915
2	2.406
2½	2.906
3	3.535
4	4.545

Forged Steel Socket-Welding Fittings have ample metal sections throughout; the long, low band forming the socket wall extends beyond the shoulder at the back of the bore, leaving no weak corner. Exhaustive tests show conclusively that the fittings are as strong as, or stronger than, pipe.

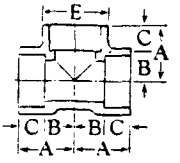
Being only slightly larger than pipe, the fittings, when welded in place, make an exceptionally neat appearing, workmanlike installation.

Forged Steel Socket-Welding Fittings

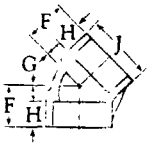
Dimensions, in Inches



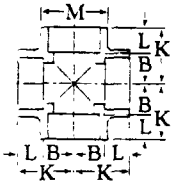
90° Elbow



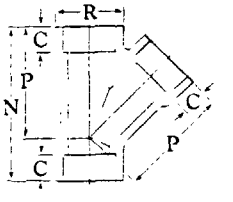
Tee



45° Elbow



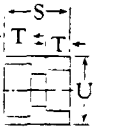
Cross



45° Y-Bend

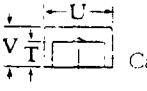


Coupling



Reducer

Dimensions of reducing sizes are the same as those of the straight size corresponding to the largest opening.



Cap

27

Size	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V
2000-Pound W.O.G. Fittings, for use with Schedule 40 or Standard Pipe																			
1/8	13/16	7/16	3/8	15/16	7/8	11/16	5/16	3/8	15/16	31/32	17/32	1				1	3/8	3/4	5/8
1/4	13/16	7/16	3/8	29/32	29/32	3/4	5/16	7/16	1 1/32	31/32	17/32	1	2 5/16	1 5/8	13/16	1	3/8	3/4	5/8
3/8	31/32	17/32	7/16	1 1/32	1 1/32	3/4	5/16	7/16	1 1/32	31/32	7/16	1	2 11/16	1 7/8	1	1 1/8	7/16	1	11/16
1/2	1 1/8	5/8	1/2	15/16	15/16	7/8	7/16	7/16	15/16	1 1/8	1/2	15/16	3	2 1/8	1 1/4	1 3/8	1/2	1 1/4	3/4
3/4	15/16	3/4	9/16	1 1/2	1 1/2	1	1/2	1/2	1 1/2	15/16	9/16	1 1/2	3 9/16	2 9/16	1 1/2	1 1/2	9/16	1 1/2	13/16
1	1 1/2	7/8	5/8	1 13/16	1 13/16	1 1/8	9/16	9/16	1 13/16	1 1/2	5/8	1 13/16	4 1/8	3	1 13/16	1 3/4	5/8	1 3/4	1
1 1/4	1 3/4	1 1/16	1 1/16	2 7/32	2 7/32	1 5/16	1 1/16	5/8	2 7/32	1 3/4	1 1/16	2 3/16	4 13/16	3 1/2	2 3/16	1 7/8	1 1/16	2 1/4	1 1/16
1 1/2	2	1 1/4	3/4	2 15/32	2 15/32	1 7/16	1 3/16	5/8	2 15/32	2	3/4	2 7/16	5 3/8	3 15/16	2 7/16	2	3/4	2 1/2	1 3/16
2	2 3/8	1 1/2	7/8	3	3	1 11/16	1	1 1/16	3	2 3/8	7/8	2 31/32	6 7/16	4 3/4	2 31/32	2 1/2	7/8	3	1 3/8
2 1/2	3	1 5/8	1 3/8	3 5/8	3 5/8	2 1/16	1 1/8	1 5/16	4	3 1/4	1 5/8	4				2 1/2	7/8	3 5/8	1 1/2
3	3 3/8	2 1/4	1 1/8	4 5/16	4 5/16	2 1/2	1 1/4	1 1/4	4 5/8	3 3/8	1 1/8	4 5/8				2 3/4	1	4 1/8	1 5/8
4	4 3/16	2 5/8	1 9/16	5 3/4	5 3/4	3 1/8	1 5/8	1 1/2	5 3/4	4 3/16	1 9/16	5 3/4				3	1 1/8	5 1/4	1 7/8
3000-Pound W.O.G. Fittings, for use with Schedule 80 or Extra Strong Pipe																			
1/4	13/16	7/16	3/8	29/32	29/32	3/4	5/16	7/16	1 1/32	31/32	17/32	1	2 5/16	1 5/8	13/16	1	3/8	7/8	1 11/16
3/8	31/32	17/32	7/16	1 1/32	1 1/32	3/4	5/16	7/16	1 1/32	31/32	7/16	1	2 11/16	1 7/8	1	1 1/8	7/16	1	3/4
1/2	1 1/8	5/8	1/2	15/16	15/16	7/8	7/16	7/16	15/16	1 1/8	1/2	15/16	3	2 1/8	1 1/4	1 3/8	1/2	1 1/4	7/8
3/4	15/16	3/4	9/16	1 1/2	1 1/2	1	1/2	1/2	1 1/2	15/16	9/16	1 1/2	3 9/16	2 9/16	1 1/2	1 1/2	9/16	1 1/2	1
1	1 1/2	7/8	5/8	1 13/16	1 13/16	1 1/8	9/16	9/16	1 13/16	1 1/2	5/8	1 13/16	4 1/8	3	1 13/16	1 3/4	5/8	1 3/4	1 1/16
1 1/4	1 3/4	1 1/16	1 1/16	2 7/32	2 7/32	1 5/16	1 1/16	5/8	2 7/32	1 3/4	1 1/16	2 3/16	4 13/16	3 1/2	2 3/16	1 7/8	1 1/16	2 1/4	1 3/16
1 1/2	2	1 1/4	3/4	2 15/32	2 15/32	1 7/16	1 3/16	5/8	2 15/32	2	3/4	2 7/16	5 3/8	3 15/16	2 7/16	2	3/4	2 1/2	1 1/4
2	2 3/8	1 1/2	7/8	3	3	1 11/16	1	1 1/16	3	2 3/8	7/8	2 31/32	6 7/16	4 3/4	2 31/32	2 1/2	7/8	3	1 1/2
2 1/2	3	1 5/8	1 3/8	3 5/8	3 5/8	2 1/16	1 1/8	1 5/16	4	3 1/4	1 5/8	4				2 1/2	7/8	3 5/8	1 1/2
3	3 3/8	2 1/4	1 1/8	4 5/16	4 5/16	2 1/2	1 1/4	1 1/4	4 5/8	3 3/8	1 1/8	4 5/8				2 3/4	1	4 1/4	1 3/4
4	4 3/16	2 5/8	1 9/16	5 3/4	5 3/4	3 1/8	1 5/8	1 1/2	5 3/4	4 3/16	1 9/16	5 3/4				3	1 1/8	5 1/2	1 7/8
4000-Pound W.O.G. Fittings, for use with Schedule 160 Pipe																			
1/2	15/16	3/4	9/16	1 1/2	1 1/2	1	1/2	1/2	1 1/2	15/16	9/16	1 1/2	3 9/16	2 9/16	1 1/2	1 3/8	1/2	1 1/2	7/8
3/4	1 1/2	7/8	5/8	1 13/16	1 13/16	1 1/8	9/16	9/16	1 13/16	1 1/2	5/8	1 13/16	4 1/8	3	1 13/16	1 1/2	9/16	1 3/4	15/16
1	1 3/4	1 1/16	1 1/16	2 3/16	2 3/16	1 5/16	1 1/16	5/8	2 3/16	1 3/4	1 1/16	2 3/16	4 13/16	3 1/2	2 3/16	1 3/4	5/8	2 1/4	1 1/8
1 1/4	2	1 1/4	3/4	2 7/16	2 7/16	1 11/32	1 3/16	17/32	2 7/16	2	3/4	2 7/16	5 3/8	3 15/16	2 7/16	1 7/8	1 1/16	2 1/2	1 3/16
1 1/2	2 3/8	1 1/2	7/8	2 31/32	2 31/32	1 11/16	1	1 1/16	2 31/32	2 3/8	7/8	2 31/32	6 7/16	4 3/4	2 31/32	2	3/4	3	1 3/8
2	2 1/2	1 5/8	7/8	3 5/16	3 5/16	1 23/32	1 1/8	1 9/32	3 5/16	2 1/2	7/8	3 5/16				2 1/2	7/8	3 5/8	1 1/2
2 1/2	3 1/4	2 1/4	1	4	4	2 1/16	1 1/4	1 3/16	4	3 1/4	1	4				2 1/2	7/8	4 1/8	1 5/8
3	3 3/4	2 1/2	1 1/4	4 3/4	4 3/4	2 1/2	1 3/8	1 1/8	4 5/8	3 3/8	7/8	4 5/8				2 3/4	1	4 5/8	1 3/4
4	4 3/16	2 5/8	1 9/16	5 3/4	5 3/4	3 1/8	1 5/8	1 1/2	5 3/4	4 3/16	1 9/16	5 3/4				3	1 1/8	6	2
6000-Pound W.O.G. Fittings, for use with Double Extra Strong Pipe																			
3/8	1 1/8	17/32	19/32	15/16	15/16	7/8	3/8	1/2	15/16	1 1/8	19/32	15/16	3	2 1/8	1 1/4	1 1/8	7/16	15/16	15/16
1/2	15/16	5/8	11/16	1 1/2	1 1/2	1	3/8	5/8	1 1/2	15/16	11/16	1 1/2	3 9/16	2 9/16	1 1/2	1 3/8	1/2	1 1/2	1
3/4	1 1/2	3/4	3/4	1 13/16	1 13/16	1 1/8	7/16	11/16	1 13/16	1 1/2	3/4	1 13/16	4 1/8	3	1 13/16	1 1/2	9/16	1 3/4	1 11/16
1	1 3/4	7/8	7/8	2 3/16	2 3/16	1 5/16	1/2	13/16	2 3/16	1 3/4	7/8	2 3/16	4 13/16	3 1/2	2 3/16	1 3/4	5/8	2 1/4	1 1/4
1 1/4	2	1 1/16	15/16	2 7/16	2 7/16	1 11/32	5/8	23/32	2 7/16	2	15/16	2 7/16	5 3/8	3 15/16	2 7/16	1 7/8	1 1/16	2 1/2	1 5/16
1 1/2	2 3/8	1 1/4	1 1/8	2 31/32	2 31/32	1 11/16	19/32	1 3/32	2 31/32	2 3/8	1 1/8	2 31/32	6 7/16	4 3/4	2 31/32	2	3/4	3	1 3/8
2	2 1/2	1 1/2	1	3 5/16	3 5/16	1 23/32	7/8	1 27/32	3 5/16	2 1/2	1	3 5/16				2 1/2	7/8	3 5/8	1 5/8
2 1/2	3 1/4	1 3/4	1 1/2	4	4	2 1/16	1	1 1/16	4	3 1/4	1 1/2	4				2 1/2	7/8	4 1/4	1 5/8
3	3 3/4	2 1/8	1 5/8	4 3/4	4 3/4	2 1/2	1 1/4	1 1/4	4 5/8	3 3/8	1 1/4	4 5/8				2 3/4	1	5	1 7/8
4	4 1/2	2 5/8	1 7/8	6	6	3 1/8	1 5/8	1 1/2	5 3/4	4 3/16	1 9/16	5 3/4				3	1 1/8	6 1/4	2 1/8

Description, prices, and ratings . . . pages 270 to 272 ***Reducer Inserts . page 272***

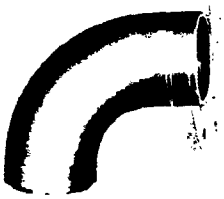
Steel Butt-Welding Fittings
For Use With Standard Pipe



No. 352 E
90° Elbow
Long Radius



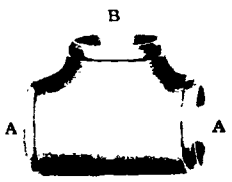
No. 331 E
90° Elbow
Short Radius



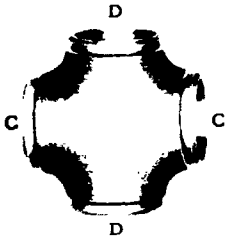
No. 335 E
90° Long Radius Elbow
with Long Tangent
On One End



No. 354 E
45° Long Radius Elbow



No. 353 E, Tee



No. 336 E, Cross

For pressure-temperature ratings, see pages 282 and 283.
For list prices, see the following page.

Thickness: Standard fittings in sizes 12-inch and smaller are made for use with Standard pipe (the heaviest weight on 8, 10, and 12-inch sizes); and in sizes 14-inch and larger, for use with O.D. pipe 3/8-inch thick.

Materials: Unless otherwise specified, all butt-welding fittings will be Grade A Carbon Steel. Backing Rings, also, are regularly made of carbon steel.

Butt-welding fittings made of Grade B Carbon Steel, genuine wrought iron, stainless steel, or other materials can be furnished when ordered; prices on application.

American Standard: These fittings, in the sizes and types included in the Standard, conform to the American Standard for Steel Butt-Welding Fittings, B16.9-1940; see page 269.

90° Elbow with long tangent: The No. 335 E 90° Long Radius Elbows have a long tangent on one end to permit welding on a slip-on welding flange. That end is not beveled; the other end is beveled.

Cranelap Stub Ends: Cranelap Stub Ends, made of Grade A Seamless Steel Pipe lapped to the full thickness of the pipe wall, and Cranelap Flanges (see page 288) afford an ideal method of installing flanged equipment in a welded line. The swivel flange eliminates the difficulty of aligning bolt holes and permits installing the equipment at any angle.



No. 357 E
Cap

Shaped Nipples: Shaped Nipples eliminate the use of templates when saddling one pipe upon another; they save time and assure an accurate fit. Both ends are beveled for welding. When ordering, be sure to specify nominal size of header on which Nipple will be used.

List of Sizes of Reducing Fittings
(List prices, shown on the following page, apply only to these sizes.)

No. 352 E 90° Elbows		No. 353 E, Tees						No. 336 E, Crosses					
		A	B	A	B	A	B	C	D	C	D	C	D
2	×1½	1	×¾	3	×2½	6	×5	14×12	2	×1½	4×3½	8	×6
	×1¼	1¼×1			×2		×4	×10		×1¼	×3		×5
	×1		×¾		×1½		×3½	×8		×1	×2½		×4
2½×2		1½×1¼			×1¼		×3	×6		×¾	×2		×3½
	×1½		×1	3½×3			×2½	16×14	2½×2		×1½	10×8	
	×1¼		×¾		×2½	8	×6	×12		×1½	5×4		×6
3	×2½	2	×1½		×2		×5	×10		×1¼	×3½		×5
	×2		×1¼		×1½		×4	×8		×1	×3		×4
	×1½		×1	4	×3½		×3½	18×16	3	×2½	×2½	12×10	
3½×3		2½×2			×3	10×8		×14		×2	×2		×8
	×2½		×1½		×2½		×6	×12		×1½	6×5		×6
	×2		×1¼		×2		×5	×10		×1¼	×4		×5
4	×3½		×1		×1½		×4	20×18	3½×3		×3½		
	×3			5	×4	12×10		×16		×2½	×3		
	×2½				×3½		×8	×14		×2	×2½		
	×2				×3		×6	×12		×1½			
					×2½		×5	24×20					
					×2			×18					
								×16					

General description . . . page 269 *Dimensions . . . page 280*



Return Bend
No. 372 E, Short Radius
No. 373 E, Long Radius



No. 574
Cranelap Stub End



No. 350 E
Shaped Nipple
90° Type



No. 351 E
Shaped Nipple
45° Type



Reducer
See page 279



No. 374 E
Backing Ring
Nub Type

Steel Butt-Welding Fittings

For Use With Standard Pipe

List Prices, Each, Standard

Size of Pipe	90° Elbows				45° Elbows	Tees		Crosses		Caps
	No. 352 E Long Radius		No. 331E Short Radius	No. 335 E With Long Tangent One End	No. 354 E Long Radius	No. 353 E		No. 336 E		No. 357 E
Inches	Straight	*Reducing				Straight	*Reducing	Straight	*Reducing	
¾	1.00				.90	2.15				
1	1.20		1.20		1.08	2.15	2.70			1.70
1¼	1.40		1.40		1.26	2.90	3.60			1.70
1½	1.70		1.70	3.00	1.53	3.65	4.55			1.70
2	2.10	3.60	2.10	3.70	1.90	5.00	6.25	7.50	9.40	1.85
2½	3.40	5.80	3.40	5.95	3.05	7.30	9.10	10.95	13.65	2.00
3	4.90	8.35	4.90	8.60	4.40	9.50	11.85	14.25	17.80	2.40
3½	6.35	10.80	6.35	11.10	5.70	12.50	15.60	18.75	23.40	3.20
4	7.65	13.00	7.65	13.40	6.90	13.00	16.25	19.50	24.40	3.70
5	10.85	18.45	10.85	19.00	9.80	24.00	30.00	36.00	45.00	4.90
6	15.80	25.30	15.80	27.65	14.25	28.00	35.00	42.00	52.50	5.95
8	30.00	48.00	30.00	52.50	27.00	45.00	56.25	67.50	84.40	10.10
10	53.40	85.45	53.40	93.45	48.00	76.00	95.00	114.00	142.50	14.60
12	80.70	129.10	80.70	141.25	72.75	110.00	137.50	165.00	206.25	20.85
14	120.00		120.00	Prices above do not include Flange.	108.00	165.00	165.00			24.00
16	175.00		175.00		158.00	200.00	200.00			28.00
18	235.00		235.00		212.00	245.00	245.00			32.00
20	270.00		270.00		245.00	295.00	295.00			35.50
24	340.00		340.00		315.00	380.00	380.00			41.75

Size of Pipe	Return Bends				Cranelap Stub Ends	Shaped Nipples			Backing Rings	
	No. 372 E Short Radius		No. 373 E Long Radius		No. 574	Shaped to Fit Headers (Nominal Sizes)	No. 350 E 90° Type	No. 351E 45° Type	Number of Nubs	No. 374 E Nub Type
Inches	Center to center	List Price	Center to center	List Price						
¾			2¼"	2.20	3.55					
1	2"	2.65	3	2.65	3.55				3	.16
1¼	2½	3.10	3¾	3.10	4.00				3	.17
1½	3	3.75	4½	3.75	4.45				3	.18
2	4	4.65	6	4.65	5.75	2 to 16"	.95	1.05	3	.19
2½	5	7.50	7½	7.50	6.50	2½ to 16	1.20	1.35	3	.22
3	6	10.80	9	10.80	7.30	3 to 20	1.50	1.80	3	.24
3½	7	14.00	10½	14.00	8.10	3½ to 20	1.85	2.30	4	.26
4	8	17.00	12	17.00	9.30	4 to 24	2.20	2.75	4	.29
5	10	23.90	15	23.90	10.75	5 to 24	3.70	4.70	5	.33
6	12	34.80	18	34.80	12.75	6 to 24	4.50	6.00	6	.40
8	16	66.00	24	66.00	16.00	8 to 24	7.50	10.25	8	.53
10	20	117.50	30	117.50	22.75	10 to 24	12.00	17.00	8	.61
12	24	177.50	36	177.50	30.75	12 to 24	15.75	23.00	9	.66
14	28	264.00	42	264.00	53.00					
16	30	385.00	48	385.00	72.00					
18	33	517.00	54	517.00	92.00					
20	41	594.00	60	594.00	113.00					
24	44	748.00	72	748.00	138.00					

***Reducing fittings:** The prices of Reducing 90° Elbows, Tees, and Crosses shown above apply only to the list of sizes shown in the table on the opposite page. The price is determined by the size of the largest opening. When ordering reducing tees and crosses, specify the size of openings in the sequence of the letters shown on the illustrations in the lower left hand corner of the preceding page.

General description . . pages 269 and 274 *Dimensions . . page 280*

Steel Butt-Welding Fittings
For Use With Extra Strong Pipe

For pressure-temperature ratings, see pages 282 and 283.
For list prices, see the following page.



No. 452 E
90° Elbow
Long Radius

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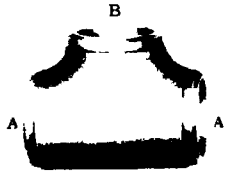
No. 431 E
90° Elbow
Short Radius



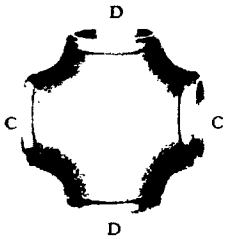
No. 458 E
90° Long Radius Elbow
with Long Tangent
On One End



No. 454 E
45° Long Radius Elbow



No. 453 E, Tee



No. 436 E, Cross

Thickness: Extra Strong fittings in sizes 12-inch and smaller are made for use with Extra Strong pipe, and is sizes 14-inch and larger, for use with O.D. pipe ½-inch thick.

Materials: Unless otherwise specified, all butt-welding fittings will be Grade A Carbon Steel. Backing Rings, also, are regularly made of carbon steel.

Butt-Welding fittings made of Grade B Carbon Steel, genuine wrought iron, stainless steel, or other materials can be furnished when ordered; prices on application.

American Standard: These fittings, in the sizes and types included in the Standard, conform to the American Standard for Steel Butt-Welding Fittings, B16.9-1940; see page 269.

90° Elbow with long tangent: The No. 458 E 90° Long Radius Elbows have a long tangent on one end to permit welding on a slip-on welding flange. That end is not beveled; the other end is beveled.

Cranelap Stub Ends: Cranelap Stub Ends, made of Grade A Seamless Steel Pipe lapped to the full thickness of the pipe wall, and Cranelap Flanges (see page 288) afford an ideal method of installing flanged equipment in a welded line. The swivel flange eliminates the difficulty of aligning bolt holes and permits installing the equipment at any angle. Cranelap Stub Ends can be made to order of heavier than Extra Strong Pipe; prices on application.



No. 457 E
Cap

Shaped Nipples: Shaped Nipples eliminate the use of templates when saddling one pipe upon another; they save time and assure an accurate fit. Both ends are beveled for welding. When ordering, be sure to specify nominal size of header on which Nipple will be used.

List of Sizes of Reducing Fittings
(List prices shown on the following page, apply only to these sizes.)

No. 452 E 90° Elbows		No. 453 E, Tees						No. 436 E, Crosses					
A	B	A	B	A	B	A	B	C	D	C	D	C	D
2	×1½	5	×4	1	×¾	3	×2½	6	×5	14	×12	2	×1½	4	×3½	8	×6
	×1¼		×3½	1¼	×1		×2		×4		×10		×1¼		×3		×5
	×1		×3		×¾		×1½		×3½		×8		×1		×2½		×4
2½	×2		×2½	1½	×1¼		×1¼		×3		×6		×¾		×2		×3½
	×1½	6	×5		×1	3½	×3		×2½	16	×14	2½	×2		×1½	10	×8
	×1¼		×4		×¾		×2½	8	×6		×12		×1½	5	×4		×6
3	×2½		×3½	2	×1½		×2		×5		×10		×1¼		×3½		×5
	×2		×3		×1¼		×1½		×4		×8		×1		×3		×4
	×1½	8	×6		×1	4	×3½		×3½	18	×16	3	×2½		×2½	12	×10
3½	×3		×5		×¾		×3	10	×8		×14		×2		×2		×8
	×2½		×4	2½	×1½		×2½		×6		×12		×1½	6	×5		×6
	×2	10	×8		×1¼		×2		×5		×10		×1¼		×4		×5
4	×3½		×6		×1		×1½		×4	20	×18	3½	×3		×3½		
	×3		×5	3	×2½	5	×4	12	×10		×16		×2½		×3		
	×2½	12	×10		×2		×3½		×8		×14		×2		×2½		
	×2		×8		×1¼		×3		×6		×12		×1½				
			×6		×1		×2½		×5	24	×20						
				4	×3½		×2		×4		×18						
					×3		×1½	12	×10		×16						
					×2½	5	×4		×8		×14						
					×2		×3½		×6		×12						
							×3		×5								
							×2½	20	×18								
							×2		×16								

General description page 269 *Dimensions page 280*



Return Bend
No. 472 E, Short Radius
No. 473 E, Long Radius



No. 497 E
Cranelap Stub End



No. 450 E
Shaped Nipple
90° Type



No. 451 E
Shaped Nipple
45° Type



Reducer
See page 279



No. 474 E
Backing Ring
Nub Type

Steel Butt-Welding Fittings

For Use With Extra Strong Pipe

List Prices, Each, Extra Strong

Size of Pipe	90° Elbows				45° Elbows	Tees		Crosses		Caps
	No. 452 E Long Radius		No. 431 E Short Radius	No. 458 E With Long Tangent One End	No. 454 E Long Radius	No. 453 E		No. 436 E		No. 457 E
Inches	Straight	*Reducing				Straight	*Reducing	Straight	*Reducing	
¾	1.50				1.35	2.15				
1	1.50				1.35	2.15	2.70			2.10
1¼	1.75				1.60	2.90	3.60			2.10
1½	2.15		2.15	3.90	1.95	3.65	4.55			2.10
2	2.65	4.50	2.65	4.65	2.40	5.00	6.25	7.50	9.40	2.25
2½	4.25	7.20	4.25	7.45	3.80	7.30	9.10	10.95	13.65	2.50
3	6.15	10.45	6.15	10.80	5.55	12.00	15.00	18.00	22.50	3.30
3½	7.95	13.50	7.95	14.00	7.15	16.00	20.00	24.00	30.00	4.25
4	9.55	16.25	9.55	16.70	8.60	17.00	21.25	25.50	31.90	4.90
5	13.55	23.05	13.55	23.70	12.20	30.00	37.50	45.00	56.25	5.85
6	19.75	31.60	19.75	34.50	17.80	35.00	43.75	52.50	65.65	7.50
8	37.50	60.00	37.50	65.50	33.75	58.00	72.50	87.00	108.75	12.20
10	67.00	107.20	67.00	117.00	60.50	97.00	120.00	145.00	180.00	18.50
12	101.00	161.60	101.00	177.00	91.00	135.00	168.00	202.50	252.00	25.00
14	150.00		150.00	Prices above do not include Flange.	135.00	205.00	205.00			30.00
16	219.00		219.00		197.00	255.00	255.00			34.50
18	294.00		294.00		265.00	320.00	320.00			38.50
20	340.00		340.00		310.00	355.00	355.00			45.00
24	410.00		410.00		370.00	490.00	490.00			49.00

Size of Pipe	Return Bends				Cranelap Stub Ends	Shaped Nipples			Backing Rings	
	No. 472 E Short Radius		No. 473 E Long Radius		No. 497 E	Shaped to Fit Headers (Nominal Sizes)	No. 450 E 90° Type	No. 451 E 45° Type	Number of Nubs	No. 474 E Nub Type
Inches	Center to center	List Price	Center to center	List Price						
¾					3.80					
1			3"	3.30	3.80				3	.19
1¼	2½"	3.85	3¾	3.85	4.25				3	.20
1½	3	4.75	4½	4.75	4.70				3	.21
2	4	5.85	6	5.85	6.25	2 to 16"	1.25	1.40	3	.22
2½	5	9.35	7½	9.35	7.15	2½ to 16	1.70	1.95	3	.26
3	6	13.55	9	13.55	8.25	3 to 20	2.25	2.65	3	.29
3½	7	17.60	10½	17.60	9.40	3½ to 20	2.50	3.10	4	.32
4	8	21.00	12	21.00	10.90	4 to 24	2.75	3.50	4	.34
5	10	29.70	15	29.70	13.50	5 to 24	5.00	6.40	5	.40
6	12	43.50	18	43.50	16.35	6 to 24	6.75	9.00	6	.48
8	16	82.50	24	82.50	24.00	8 to 24	11.50	15.50	8	.63
10	20	147.40	30	147.40	35.75	10 to 24	18.50	26.00	8	.73
12	24	222.20	36	222.20	48.75	12 to 24	23.50	35.00	9	.79
14	28	330.00	42	330.00	72.00					
16	30	482.00	48	482.00	93.00					
18	33	647.00	54	647.00	114.00					
20	41	748.00	60	748.00	136.00					
24	44	902.00	72	902.00	162.00					

***Reducing fittings:** The prices of Reducing 90° Elbows, Tees, and Crosses shown above apply only to the list of sizes shown in the table on the opposite page. The price is determined by the size of the largest opening. When ordering reducing tees and crosses, specify the size of openings in the sequence of the letters shown on the illustrations in the lower left hand corner of the preceding page.

General description . . . pages 269 and 276

Dimensions . . . page 280

Steel Butt-Welding Fittings

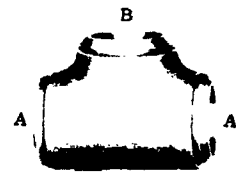
For Use With Schedule 160 or Double Extra Strong Pipe



90° Long Radius Elbow
No. 552 E, Schedule 160
No. 652 E, Double Extra Strong



45° Long Radius Elbow
No. 554 E, Schedule 160
No. 654 E, Double Extra Strong



Tee
No. 553 E, Schedule 160
No. 653 E, Double Extra Strong

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List Prices, Each

Size of Pipe	Schedule 160				Double Extra Strong			
	No. 552 E 90° Elbows Long Radius	No. 554 E 45° Elbows Long Radius	No. 553 E Tees		No. 652 E 90° Elbows Long Radius	No. 654 E 45° Elbows Long Radius	No. 653 E Tees	
Inches			Straight	*Reducing			Straight	*Reducing
1	4.00	4.00	5.00	5.00	4.50	4.50	7.00	7.00
1¼	5.00	4.50	6.00	6.00	5.50	5.00	9.00	9.00
1½	6.00	5.50	7.00	7.00	6.50	6.00	11.00	11.00
2	7.00	6.50	10.00	10.00	8.00	7.50	15.00	15.00
2½	11.00	10.00	20.00	20.00	13.00	12.00	22.00	22.00
3	16.00	14.50	35.00	35.00	18.50	17.00	60.00	60.00
4	27.00	24.50	60.00	60.00	29.00	26.00	85.00	85.00
5	38.00	35.50	110.00	110.00	41.00	37.00	150.00	150.00
6	57.00	52.00	126.00	126.00	60.00	54.00	175.00	175.00
8	125.00	113.00	240.00	240.00	125.00	113.00	240.00	240.00
10	190.00	171.00	420.00	420.00				
12	280.00	252.00	620.00	620.00				

Thickness: Schedule 160 Fittings are for use with Schedule 160 Pipe; Double Extra Strong Fittings are for use with Double Extra Strong Pipe. Fittings made for pipe thicknesses other than listed here or on the preceding four pages can be furnished when ordered; prices on application.

Materials: These fittings are regularly made of Grade A Carbon Steel. Fittings made of Grade B Carbon Steel or of other materials can be furnished when ordered; prices on application.

***Reducing Tees:** The prices of reducing tees shown above apply only to the list of sizes shown in the table at the right. The price is determined by the size of the largest opening. When ordering reducing tees, specify the size of openings in the sequence of the letters shown on the illustration above.

American Standard: These fittings, in the sizes and types included in the Standard, conform to the American Standard for Steel Butt-Welding Fittings, B16.9-1940; see page 269.

List of Sizes of Reducing Tees
(List prices shown above apply only to these sizes.)

No. 553 E Schedule 160				No. 653 E Double Extra Strong			
A	B	A	B	A	B	A	B
1	×¾	5	×4	1	×¾	4	×3
1¼	×1		×3	1¼	×1		×2½
	×¾		×2½		×¾		×2
1½	×1¼		×2	1½	×1¼		×1½
	×1	6	×5		×1	5	×4
	×¾		×4		×¾		×3
2	×1½		×3	2	×1½		×2½
	×1¼		×2½		×1¼		×2
	×1	8	×6		×1	6	×5
	×¾		×5		×¾		×4
2½	×2		×4	2½	×2		×3
	×1½	10	×8		×1½		×2½
	×1¼		×6		×1¼	8	×6
	×1		×5		×1		×5
3	×2½		×4	3	×2½		×4
	×2	12	×10		×2		
	×1½		×8		×1½		
	×1¼		×6		×1¼		
4	×3		×5				
	×2½						
	×2						
	×1½						

General description page 269 *Dimensions* page 280

Steel Butt-Welding Reducers

For Use With Standard or Extra Strong Pipe



Concentric Reducer
No. 359 E Standard
No. 459 E Extra Strong

For pressure-temperature ratings, see pages 282 and 283.

Standard Reducers in sizes 12-inch and smaller are made for use with Standard pipe (heaviest weight on 8, 10, and 12" sizes); and in sizes 14-inch and larger, for use with O.D. pipe 3/8-inch thick. Extra Strong Reducers in sizes 12-inch and smaller are made for use with Extra Strong pipe, and in sizes 14-inch and larger, for use with O.D. pipe 1/2-inch thick.

In the sizes covered by the Standard, these reducers conform to the American Standard for Steel Butt-Welding Fittings, B16.9-1940.



Eccentric Reducer
No. 360 E Standard
No. 460 E Extra Strong

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List Prices

Size of Pipe In.	Price, Each Concentric or Eccentric Standard	Extra Strong	Size of Pipe In.	Price, Each Concentric or Eccentric Standard	Extra Strong	Size of Pipe In.	Price, Each Concentric or Eccentric Standard	Extra Strong	Size of Pipe In.	Price, Each Concentric or Eccentric Standard	Extra Strong	Size of Pipe In.	Price, Each Concentric or Eccentric Standard	Extra Strong
3/4 ×1/2	1.25*	2.25*	3 ×2 1/2	3.00	5.25	5×4	6.00	10.50	10×8	18.00	40.00	18×16	85.00	148.00
1 ×3/4	1.50	2.75	×2	3.00	5.25	×3 1/2	6.50	11.50	×6	20.00	44.00	×14	85.00	148.00
×1/2	1.50	2.75	×1 1/2	3.25	5.70	×3	6.50	11.50	×5	26.00	48.00	×12	95.00	166.00
1 1/4×1	2.00	3.50	×1 1/4	3.25	5.70	×2 1/2	6.50	11.50	×4	26.00	48.00	×10	105.00	184.00
×3/4	2.00	3.50	×1	3.25*	5.70*	×2	6.50	11.50	×3	30.00*		20×18	90.00	157.50
×1/2	2.50	4.50	3 1/2×3	3.50	6.00	×1 1/2	7.50*		12×10	32.00	56.00	×16	90.00	157.50
1 1/2×1 1/4	2.00	3.50	×2 1/2	3.50	6.00	6×5	8.00	14.00	×8	36.00	63.00	×14	100.00	175.00
×1	2.00	3.50	×2	3.50	6.00	×4	8.00	14.00	×6	36.00	63.00	×12	100.00	175.00
×3/4	2.50	4.50	×1 1/2	3.75	6.50	×3 1/2	9.00	15.75	×5	40.00	70.00	24×20	140.00	245.00
×1/2	2.50	4.50	×1 1/4	3.75	6.50*	×3	9.00	15.75	14×12	40.00	70.00	×18	155.00	270.00
2 ×1 1/2	2.25	3.75	4 ×3 1/2	4.00	7.00	×2 1/2	9.00	15.75	×10	40.00	70.00	×16	170.00	295.00
×1 1/4	2.25	3.75	×3	4.00	7.00	×2	10.00*	17.50*	×8	45.00	78.75			
×1	2.25	3.75	×2 1/2	4.00	7.00	8×6	12.00	26.25	×6	50.00	87.50			
×3/4	2.75	4.75	×2	4.00	7.00	×5	15.00	30.60	16×14	70.00	105.00			
2 1/2×2	2.50	4.50	×1 1/2	4.50	8.00	×4	15.00	30.60	×12	70.00	105.00			
×1 1/2	2.75	5.00	×1 1/4	4.50*	8.00*	×3 1/2	15.00	30.60	×10	80.00	122.50			
×1 1/4	2.75	5.00	×1	4.50*		×3	18.00*	35.00*	×8	85.00	140.00			
×1	2.75	5.00	*Note: Prices with an asterisk indicate sizes made only in the Concentric style.											

General description of butt-welding fittings, page 269.

Dimensions, page 280.

Welding Saddles

List Prices

Size of Pipe (outlet) Inches	Shaped to Fit Headers (Nominal Sizes)	No. 358 E Reinforcing Welding Saddles Each
1	1 1/4 to 8"	4.90
1 1/4	1 1/2 to 8	4.90
1 1/2	1 1/2 to 12	4.90
2	2 to 24	4.90
2 1/2	2 1/2 to 24	5.35
3	3 to 24	5.85
3 1/2	3 1/2 to 24	6.80
4	4 to 24	7.80
5	5 to 24	10.75
6	6 to 24	13.65
8	8 to 24	21.50
10	10 to 24	27.25
12	12 to 24	31.00
14	14 to 24	36.00
16	16 to 24	43.00
18	18 to 24	50.00
20	20 to 24	58.00
24	24	70.00

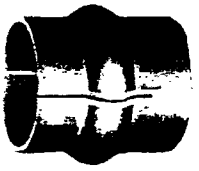


Reinforcing Welding Saddle. No. 358 E

Welding Saddles are used to reinforce 90° welded outlet connections on headers or pipes. They relieve the weld of the greater part of the tensile, bending, and shearing stresses to which it would otherwise be subjected.

Be sure to specify nominal size of header.

Welding Sleeves



Welding Sleeve No. 361 E

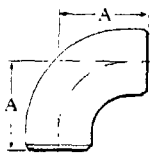
Welding Sleeves are ideal for reinforcing butt-welds in pipe lines. They relieve the weld of any bending stress and of much of the tensile stress to which it would otherwise be subjected.

The large transverse recess at the center provides more than ample space for the conventional type of butt-weld used between two lengths of pipe.

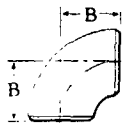
List Prices

Size of Pipe Inches	No. 361 E Welding Sleeve Each
1	4.00
1 1/4	4.00
1 1/2	4.00
2	4.00
2 1/2	4.60
3	5.00
3 1/2	5.50
4	6.20
5	7.25
6	8.30
8	11.40
10	15.75
12	20.40
14	23.70
16	28.60
18	34.50
20	41.50
24	57.00

Steel Butt-Welding Fittings



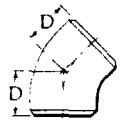
90° Long Radius Elbow
Straight and Reducing



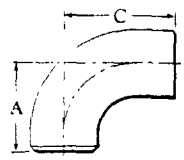
90° Short Radius Elbow

Dimensions, in Inches

For list prices and description, see pages 274 to 279.

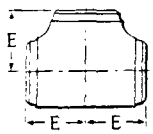


45° Long Radius Elbow

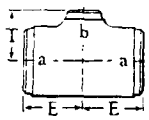


90° Long Radius Elbow
Long Tangent One End

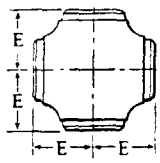
27



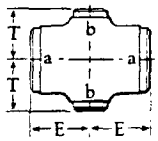
Straight Tee



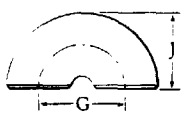
Reducing Tee



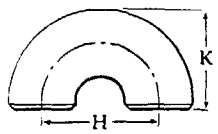
Straight Cross



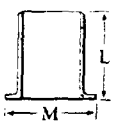
Reducing Cross



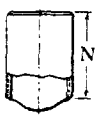
Short Radius
Return Bend



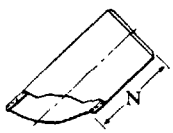
Long Radius
Return Bend



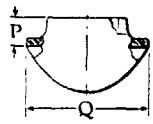
Cranelap Stub End



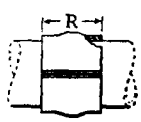
90° Type
Shaped Nipples



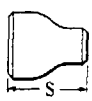
45° Type



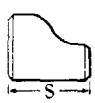
Reinforcing
Welding Saddle



Welding
Sleeve



Concentric
Reducer



Eccentric
Reducer



Cap

Size	A	B	‡C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	Pipe Schedule Numbers For Std. Ftgs.	Pipe Schedule Numbers For Extra Strong
¾	1⅛			¾	1⅛			2¼		1 11/16	4	1 11/16					2	40	80
1	1½	1		⅞	1½	1½	2	3	1⅝	2 3/16	4	2		1	4⅛	3	2	40	80
1¼	1⅞	1¼		1	1⅞	1½	2½	3¾	2 5/16	2¾	4	2½		1⅛	4¾	3	2	40	80
1½	2¼	1½		1⅛	2¼	1½	3	4½	2 11/16	3¼	4	2⅞		1⅛	5¼	3	2½	40	80
2	3	2	4¼	1⅜	2½	1½	4	6	3 7/16	4 3/16	6	3⅝	6	1⅛	5 15/16	3	3	40	80
2½	3¾	2½	5	1¾	3	1½	5	7½	3 15/16	5 3/16	6	4⅛	6	1⅛	6 7/16	3	3½	40	80
3	4½	3	5¾	2	3⅜	2	6	9	5	6¼	6	5	6	1⅛	7 9/16	3	3½	40	80
3½	5¼	3½		2¼	3¾	2½	7	10½	5½	7¼	6	5½	6	1¼	8 1/16	3½	4	40	80
4	6	4	7½	2½	4⅛	2½	8	12	6½	8¼	6	6 3/16	6	1⅜	8 9/16	4	4	40	80
5	7½	5	9	3⅛	4⅞	3	10	15	7¾	10 5/16	8	7 5/16	8	1⅜	9⅝	5	5	40	80
6	9	6	10¾	3¾	5⅝	3½	12	18	9 5/16	12 5/16	8	8½	8	1½	11¾	6	5½	40	80
8	12	8	13¾	5	7	4	16	24	12 5/16	16 5/16	8	10⅝	8	2	14¾	8	6	40	80
10	15	10	17	6¼	8½	5	20	30	15⅜	20⅜	10	12¾	10	2½	17⅞	10	7	40	60
12	18	12	20½	7½	10	6	24	36	18⅜	24⅜	10	15	10	2¾	20⅞	12	8		
14	21	16		7¾	11*	6½	28	42	21	28	12	16¼		3¼	22⅛	14	13	30	
16	24	18		8½	12*	7	30	48	23	32	12	18½		3½	24⅛	16	14	30	40
18	27	20		9½	†13½*	8	33	54	25½	36	12	21		4	26⅛	18	15		
20	30	20		12 7/16	†15*	9	41	60	30½	40	12	23		4	30⅛	20	20	20	30
24	36	24		14 15/16	†17*	10½	44	72	34	48	12	27¼		4	34⅛	24	20	20	

Reducing Tees and Crosses—Center to End of Outlet

Size a	Size b	T
1	×¾ *	1½
1¼	×1*	1⅞
	×¾*	1⅞
1½	×1¼*	2¼
	×1*	2¼
	×¾*	2¼
2	×1½	2⅜
	×1¼	2¼
	×1	2
	×¾	1¾
2½	×2	2¾
	×1½	2⅝
	×1¼	2½
	×1	2¼
3	×2½	3¼
	×2	3
	×1½	2⅞
	×1¼	2¾
3½	×3	3⅝
	×2½	3½
	×2	3¼
	×1½	3⅛
4	×3½	4
	×3	3⅞
	×2½	3¾
	×2	3½
	×1½	3⅜
5	×4	4⅝
	×3½	4½
	×3	4⅜
	×2½	4¼
	×2	4⅛
6	×5	5⅜
	×4	5⅛
	×3½	5
	×3	4⅞
	×2½	4¾
8	×6	6⅝
	×5	6⅜
	×4	6⅛
	×3½	6
10	×8	8
	×6	7⅝
	×5	7½
	×4	7¼
12	×10	9½
	×8	9
	×6	8⅝
	×5	8½
14	×12*	10⅝
	×10*	10⅛
	×8*	9⅝
	×6*	9¼
16	×14*	12
	×12*	11⅝
	×10*	11⅛
	×8*	10⅝
18	×16*	11¼
	×14*	11¼
	×12*	11¼
	×10*	11¼
20	×18*	12½
	×16*	12½
	×14*	12½
	×12*	12½
24	×20*	14¾
	×18*	14¾
	×16*	14¾

*Only Tees are made in these sizes

‡For No. 458 E only, dimensions for No. 335 E on application
†Straight size tees in these sizes have the same center to outlet as the reducing sizes, see the table at the left.

Standard, Extra Strong, Schedule 160, and Double Extra Strong have the same outside dimensions.

American Standard: These fittings, in the sizes and types included in the Standard, conform to the American Standard, B16.9-1940; see page 269.

Thickness: Standard Fittings in sizes 12-inch and smaller are made for use with Standard pipe (heaviest weight on 8, 10, and 12-inch sizes); and in sizes 14 inch and larger, for use with O.D. pipe ⅜-inch thick. Extra Strong Fittings in sizes 12-inch and smaller are made for use with Extra Strong pipe; and in sizes 14-inch and larger, for use with O.D. pipe ½ inch thick. Schedule 160 Fittings are made for use with Schedule 160 pipe; and Double Extra Strong Fittings, for use with Double Extra Strong pipe.

Bonney WeldOlets

Bonney WeldOlets are individual stock welding fittings. They are forged from steel of low carbon content, and are designed for making right-angle branch pipe outlets such as tees, crosses, side outlets, etc. by welding. They are made in three types: Welding Outlet, Threaded Outlet, and Socket Outlet.

They eliminate the preparation of preliminary layouts of the main and branch pipes. No templates are used, nor is it necessary to do complicated cutting, threading, forming, and fitting of the main pipe. Branch connections made with WeldOlets are strong, permanent, and leakproof.

Welding Outlets

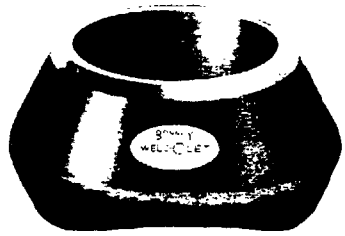
Size to Size Fittings

Run pipe size	Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12
Outlet size	Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	*8	*10	*12

Reducing Fittings

Run pipe size	Inches	⅜ to 12	⅜ to 12	¾ to 12	¾ to 12	1 to 12	1¼ to 12	1½ to 12	2 to 12	2½ to 12	3 to 12	3½ to 12	4 to 12	5 to 12	6 to 12	8 to 12	10 to 12	12 to 12
Outlet size	Inches	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	*8	*10

*Made from carbon steel castings.



27

A right-angle branch pipe outlet is made by welding a Bonney Welding Outlet to the main pipe, using an ordinary v-weld. The button may be removed as desired, either before or after the Welding Outlet is attached to the main pipe.

The junction is completed by welding the branch pipe to the outlet. Where the Welding Outlet saddles on the run pipe, it tapers at the proper angles, providing for a single bevel groove joint at the crotch section blending into a v-butt joint at the ear portion.

Threaded Outlets

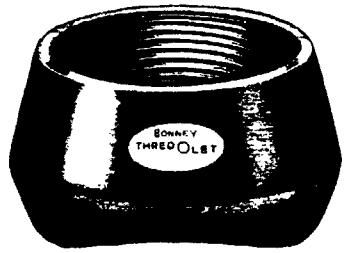
Size to Size Fittings

Run pipe size	Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
Outlet size	Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	*6

Reducing Fittings

Run pipe size	Inches	⅜ to 12	⅜ to 12	¾ to 12	¾ to 12	1 to 12	1¼ to 12	1½ to 12	2 to 12	2½ to 12	3 to 12	3½ to 12	4 to 12	5 to 12	6 to 12	8 to 12	10 to 12	12 to 12
Outlet size	Inches	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	*8	*10

*Made from carbon steel castings.



Threaded Outlets are installed on the main line in the same manner as Welding Outlets. A v-weld is used. The threaded branch pipe is screwed into position in the tapped outlet of the Threaded Outlet.

These Bonney Threaded Outlets are suitable for use as radiator take-offs and in other locations where it is desirable to make connections without disturbing the main pipe.

Socket Outlets

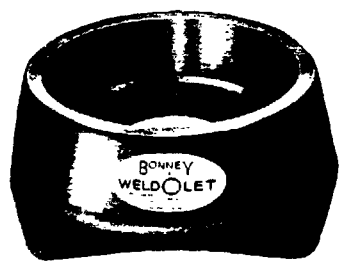
Size to Size Fittings

Run pipe size	Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
Outlet size	Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	*6

Reducing Fittings

Run pipe size	Inches	⅜ to 12	⅜ to 12	¾ to 12	¾ to 12	1 to 12	1¼ to 12	1½ to 12	2 to 12	2½ to 12	3 to 12	3½ to 12	4 to 12	5 to 12	6 to 12	8 to 12	10 to 12	12 to 12
Outlet size	Inches	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	*8	*10

*Made from carbon steel castings.



Bonney Socket Outlets are similar to Welding and Threaded Outlets except that their outlet is bored to accept standard outside pipe diameters.

They eliminate all beveling or threading of the branch pipe, and are installed on the main line in the same manner as Welding and Threaded Outlets

Prices on application

Steel Butt-Welding Fittings

Pressure-Temperature Ratings Based on the Code for Pressure Piping

When computing the thickness of pipe for a given service condition, it is the generally accepted practice among designers to use the formulas provided by the Code for Pressure Piping, the A.S.M.E. Boiler Construction Code, or such other codes as may apply.

For the convenience of users, Crane engineers have calculated the working pressures shown on this and the opposite page. They apply to Grade A Seamless Steel Pipe used in accordance with Section 1 and Section 3 of the Code for Pressure Piping. See the explanation below.

Crane Steel Butt-Welding Fittings, made for use with Standard or Extra Strong Pipe, are as strong as or stronger than Grade A Seamless Steel Pipe. They can, therefore, be used for any pressure or temperature for which Grade A Pipe of corresponding thickness is suitable, with equal safety.

Note: The pressure ratings given in the following tables do not necessarily comply with the rules given in the A.S.M.E. Boiler Construction Code. Where ratings are to comply with these rules, the formulas given in the A.S.M.E. Code should be used.

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* * * * * * * * * * * * *

Code for Pressure Piping: The Code for Pressure Piping, American Standard B31.1-1942, with 1944 Supplement No. 1 and 1947 Supplement No. 2, includes five sections on piping systems: Section 1, Power; Section 2, Gas and Air; Section 3, Oil; Section 4, District Heating; and Section 5, Refrigeration. The tables shown here apply to Power Piping (Section 1) and to Oil Piping (Section 3), the latter being further limited to "Within Refinery Limits".

The formula used for calculating the working pressures for Section 1, Power Piping is as follows:

$$P = \frac{2S\,(t - c)}{D - .8(t - c)}$$

and for Section 3, Oil Piping, the formula is:

$$P = \frac{2S\,(t - c)}{D}$$

Where: P = maximum working pressure, psi (gauge)
S = allowable stress for material, psi
t = minimum pipe wall thickness, inches
c = allowance for threading, mechanical strength, and for corrosion, inches
D = outside diameter of pipe, inches

"S" Value: The stresses permitted by the Code for Grade A Seamless Steel Pipe, A.S.T.M. Specification A 106, are shown in the table at the right.

Wall thickness: Wall thicknesses correspond to those used in Crane Steel Butt-Welding Fittings. To establish minimum thickness, "t", required by the formula, the nominal thickness was reduced 12½% to compensate for the tolerance required by pipe mills.

"C" Value: "C" value for plain end steel pipe is
Power Piping — ¾ and 1-inch sizes....0.05"
— 1¼-inch and larger...0.065"
Oil Piping — All sizes .....0.05"

"S" Values, Pounds per Square Inch

Temp. Fahr.	Power Piping	†Oil Piping	Temp. Fahr.	Power Piping	†Oil Piping
100°	12,240	18,000	600°	9,840	12,550
150°	12,000	17,450	650°	9,600	12,000
200°	11,760	16,900	700°	9,250	11,550
250°	11,520	16,350	750°	8,700	10,900
300°	11,280	15,800	800°	8,000	10,000
350°	11,040	15,300	850°	6,850	8,550
400°	10,800	14,700	900°	5,600	7,000
450°	10,560	14,150	950°	3,800	4,750
500°	10,320	13,600	1000°	2,000	2,500
550°	10,080	13,100			

†Values apply to Oil Piping Within Refinery Limits.

Other ratings: A simplified method for calculating other ratings is explained on pages 523 to 527.

Standard Grade A Seamless Steel Pipe
For Power Piping, Section 1, Code for Pressure Piping

Size of Pipe	*Wall Thickness	Temperature — Degrees Fahrenheit																		
		100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
		Working Pressures, Pounds per Square Inch																		
¾"	.113"	1185	1165	1140	1115	1095	1070	1050	1025	1000	980	955	930	895	845	775	665	545	370	195
1	.133	1285	1260	1235	1210	1185	1160	1135	1110	1085	1060	1035	1010	970	915	840	720	590	400	210
1¼	.140	870	850	835	820	800	785	765	750	735	715	700	680	655	620	570	485	400	270	140
1½	.145	820	805	790	770	755	740	725	710	690	675	660	645	620	585	535	460	375	255	135
2	.154	735	720	705	690	675	660	650	635	620	605	590	575	555	520	480	410	335	230	120
2½	.203	990	970	955	935	915	895	875	855	835	815	795	780	750	705	650	555	455	310	160
3	.216	895	875	860	840	825	805	790	770	755	735	720	700	675	635	585	500	410	275	145
3½	.226	830	815	800	785	765	750	735	720	700	685	670	655	630	590	545	465	380	260	135
4	.237	795	780	765	750	735	720	700	685	670	655	640	625	600	565	520	445	365	245	130
5	.258	720	710	695	680	665	650	635	625	610	595	580	565	545	515	470	405	330	225	120
6	.280	685	670	660	645	630	620	605	590	580	565	550	540	520	485	450	385	315	215	110
8	.322	625	610	600	590	575	565	550	540	525	515	500	490	470	445	410	350	285	195	100
10	.365	590	575	565	555	540	530	520	505	495	485	470	460	445	420	385	330	270	180	95
12	.375	515	505	495	485	475	465	455	445	435	425	415	405	390	365	335	290	235	160	85
14 OD	.375	465	455	445	440	430	420	410	400	390	385	375	365	350	330	305	260	215	145	75
16 OD	.375	405	395	390	380	370	365	355	350	340	335	325	315	305	285	265	225	185	125	65
18 OD	.375	365	360	355	345	340	330	325	315	310	300	295	290	280	260	240	205	170	115	60
20 OD	.375	330	325	320	310	305	300	290	285	280	270	265	260	250	235	215	185	150	105	55
24 OD	.375	270	265	260	255	250	245	240	230	225	220	215	210	205	190	175	150	125	85	45

*These are the nominal wall thicknesses they correspond to the thickness of Standard and Extra Strong Butt-Welding Fittings.

Extra Strong Grade A Seamless Steel Pipe
For Power Piping, Section 1, Code for Pressure Piping

Size of Pipe	*Wall Thickness	Temperature — Degrees Fahrenheit																		
		100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
		Working Pressures, Pounds per Square Inch																		
1"	.179"	2120	2075	2035	1990	1950	1910	1870	1825	1785	1745	1700	1660	1600	1505	1385	1185	970	655	345
1¼	.191	1580	1550	1515	1485	1455	1425	1395	1360	1330	1300	1270	1240	1195	1120	1030	885	720	490	260
1½	.200	1480	1450	1420	1395	1365	1335	1305	1280	1250	1220	1190	1160	1120	1055	970	830	680	460	240
2	.218	1360	1330	1305	1280	1250	1225	1200	1170	1145	1120	1090	1065	1025	965	890	760	620	420	220
2½	.276	1580	1550	1515	1485	1455	1425	1395	1360	1330	1300	1270	1240	1195	1120	1030	885	720	490	260
3	.300	1445	1415	1390	1360	1330	1305	1275	1245	1220	1190	1160	1135	1090	1025	945	810	660	450	235
3½	.318	1360	1330	1305	1280	1250	1225	1200	1170	1145	1120	1090	1065	1025	965	890	760	620	420	220
4	.337	1310	1285	1260	1230	1205	1180	1155	1130	1105	1080	1055	1025	990	930	855	735	600	405	215
5	.375	1200	1175	1150	1130	1105	1080	1060	1035	1010	990	965	940	905	855	785	670	550	370	195
6	.432	1200	1175	1150	1130	1105	1080	1060	1035	1010	990	965	940	905	855	785	670	550	370	195
8	.500	1090	1070	1045	1025	1005	985	960	940	920	895	875	855	825	775	710	610	500	340	180
10	.500	870	850	835	820	800	785	765	750	735	715	700	680	655	620	570	485	400	270	140
12	.500	735	720	705	690	675	660	650	635	620	605	590	575	555	520	480	410	335	230	120
14 OD	.500	660	650	635	620	610	595	585	570	555	545	530	520	500	470	430	370	300	205	110
16 OD	.500	575	565	550	540	530	520	510	495	485	475	460	450	435	410	375	320	265	180	95
18 OD	.500	515	505	495	485	475	465	455	435	425	425	415	405	390	365	335	290	235	160	85
20 OD	.500	465	455	445	440	430	420	410	400	390	385	375	365	350	330	305	260	215	145	75
24 OD	.500	380	370	365	355	350	340	335	325	320	310	305	300	285	270	250	210	175	120	60

Standard Grade A Seamless Steel Pipe
For Oil Piping Within Refinery Limits, Section 3, Code for Pressure Piping

Size of Pipe	*Wall Thickness	Temperature — Degrees Fahrenheit																		
		100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
		Working Pressures, Pounds per Square Inch																		
¾"	.113"	1675	1625	1570	1520	1470	1425	1365	1315	1265	1220	1165	1115	1075	1015	930	795	650	450	235
1	.133	1820	1760	1705	1650	1595	1545	1485	1430	1375	1325	1270	1210	1165	1100	1010	865	705	480	255
1¼	.140	1565	1520	1470	1420	1375	1330	1280	1230	1185	1140	1090	1045	1005	950	870	745	610	415	220
1½	.145	1460	1415	1370	1325	1280	1240	1190	1145	1100	1060	1015	970	935	885	810	695	565	385	205
2	.154	1280	1240	1200	1160	1120	1085	1045	1005	965	930	890	850	820	775	710	605	495	335	180
2½	.203	1600	1555	1505	1455	1405	1360	1310	1260	1210	1165	1115	1070	1030	970	890	780	625	425	225
3	.216	1420	1380	1335	1290	1250	1210	1160	1120	1075	1035	990	950	910	860	790	675	555	375	200
3½	.226	1330	1290	1255	1210	1170	1130	1090	1045	1005	970	930	890	855	805	740	635	520	350	185
4	.237	1260	1220	1185	1145	1105	1070	1030	990	950	915	880	840	810	765	700	600	490	335	175
5	.258	1135	1100	1065	1030	995	965	925	890	855	825	790	755	730	685	630	540	440	300	160
6	.280	1060	1030	995	965	930	905	865	835	800	775	740	710	680	645	590	505	415	280	150
8	.322	970	940	915	885	855	825	795	765	735	705	680	650	625	590	540	460	380	255	135
10	.365	900	875	845	820	790	765	735	710	680	655	630	600	580	545	500	430	350	240	125
12	.375	790	770	745	720	695	675	645	625	600	575	550	530	510	480	440	375	310	210	110
14 OD	.375	720	700	675	655	630	610	590	565	545	525	500	480	460	435	400	340	280	190	100
16 OD	.375	630	610	590	570	555	535	515	495	475	460	440	420	405	380	350	300	245	165	90
18 OD	.375	560	540	525	505	490	475	455	440	420	405	390	370	360	340	310	265	215	145	80
20 OD	.375	505	490	475	460	440	430	410	395	380	365	350	335	325	305	280	240	195	135	70
24 OD	.375	415	400	390	375	365	350	340	325	315	300	290	275	265	250	230	195	160	110	60

Extra Strong Grade A Seamless Steel Pipe
For Oil Piping Within Refinery Limits, Section 3, Code for Pressure Piping

Size of Pipe	*Wall Thickness	Temperature — Degrees Fahrenheit																		
		100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
		Working Pressures, Pounds per Square Inch																		
1"	.179"	2915	2825	2740	2650	2560	2480	2380	2290	2205	2120	2035	1945	1870	1765	1620	1385	1135	770	405
1¼	.191	2540	2460	2385	2305	2230	2155	2075	1995	1920	1845	1770	1690	1630	1535	1410	1205	985	670	355
1½	.200	2375	2305	2230	2160	2085	2020	1940	1870	1795	1730	1655	1585	1525	1440	1320	1130	925	625	330
2	.218	2140	2075	2010	1945	1880	1820	1750	1685	1620	1560	1495	1430	1375	1295	1190	1015	835	565	300
2½	.276	2395	2320	2250	2175	2100	2035	1955	1880	1810	1740	1670	1595	1535	1450	1330	1135	930	630	335
3	.300	2180	2110	2045	1980	1910	1850	1780	1710	1645	1585	1520	1450	1400	1320	1210	1035	845	575	305
3½	.318	2050	1990	1925	1865	1800	1745	1675	1615	1550	1495	1430	1370	1315	1245	1140	975	800	540	285
4	.337	1960	1900	1840	1780	1720	1670	1600	1540	1480	1430	1370	1310	1260	1190	1090	930	765	520	275
5	.375	1800	1745	1690	1635	1580	1530	1470	1415	1360	1310	1255	1200	1155	1090	1000	855	700	475	250
6	.432	1780	1730	1675	1620	1565	1515	1455	1400	1345	1295	1240	1190	1145	1080	990	845	695	470	245
8	.500	1620	1570	1520	1470	1420	1375	1325	1275	1225	1180	1130	1080	1040	980	900	770	630	430	225
10	.500	1295	1255	1215	1175	1140	1100	1060	1020	980	945	905	865	830	785	720	615	505	340	180
12	.500	1100	1065	1030	995	965	935	895	865	830	800	765	730	705	665	610	520	425	290	155
14 OD	.500	990	960	930	900	870	840	810	780	750	720	690	660	635	600	550	470	385	260	140
16 OD	.500	865	840	810	785	760	735	705	680	655	630	600	575	555	525	480	410	335	230	120
18 OD	.500	775	750	725	705	680	660	635	610	585	565	540	515	495	470	430	370	300	205	110
20 OD	.500	700	680	660	640	615	595	575	550	530	510	490	470	450	425	390	335	275	185	100
24 OD	.500	575	560	540	525	505	490	470	455	435	420	400	385	370	350	320	275	225	150	80

*These are the nominal wall thicknesses; they correspond to the thickness of Standard and Extra Strong Butt-Welding Fittings.

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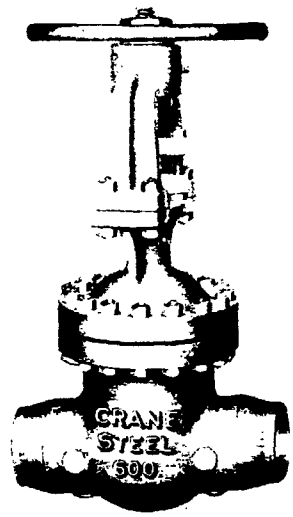
Other Products for Welding



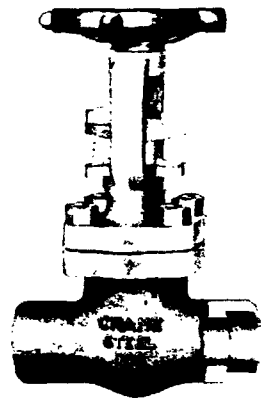
Butt-Welding Gate Valves

See pages 214 and 229.

In close association with the Crane line of Steel Butt-Welding and Socket-Welding Fittings shown on the preceding pages, is the wide variety of Butt-Welding and Socket-Welding Steel Valves and welding type Steel Flanges, available in a complete range of sizes and pressures.

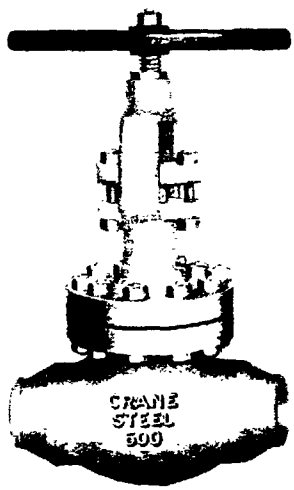
Included in the line offered by Crane are materials to satisfy the needs of every welded installation.

The butt-welding and socket-welding steel valves and the welding type steel flanges illustrated on this page are representative of the products that make up the complete Crane welding line. For prices, see the pages indicated below the illustrations.



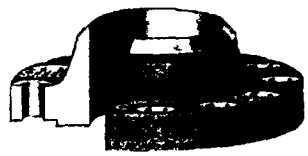
Socket-Welding Gate Valves

See pages 214, 223, and 225.



Butt-Welding Globe and Angle Valves

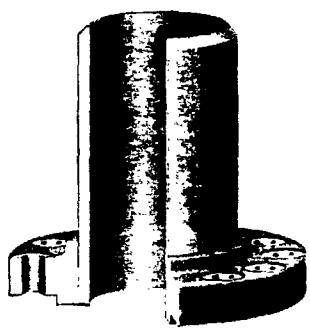
See pages 217 and 244.



Welding Neck Flanges



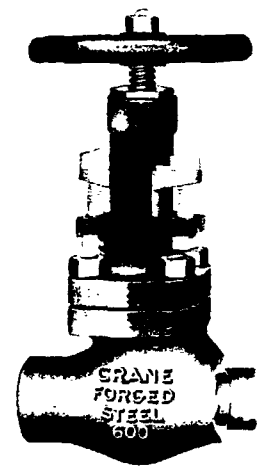
Slip-On Welding Flanges



Cranelap Flange with Stub End

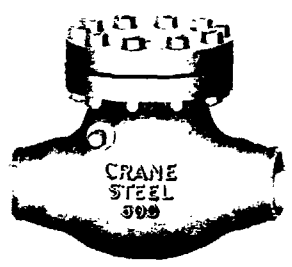
Welding Neck, Slip-On Welding, and Cranelap Flanges are shown on pages 285 to 292.

Stub Ends for use in combination with Cranelap Flanges are shown on pages 274 to 277.



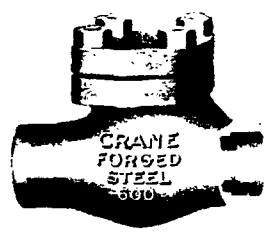
Socket-Welding Globe and Angle Valves

See pages 217 and 237.



Butt-Welding Swing Check Valves

See pages 250 to 253



Socket-Welding Lift Check Valves

See pages 248 and 249.

Forged Steel Flanges

The Crane line of Forged Steel Flanges includes a complete assortment of types in a wide range of straight and reducing sizes. The flanges are regularly manufactured for the 150, 300, 400, 600, 900, 1500, and 2500-Pound pressure classes. Special flanges can be made to order: flanges listed and described in this section include:

Screwed Flanges
Blind Flanges
Welding Neck Flanges
Reducing Screwed Flanges
Cranelap Flanges
Slip-On Welding Flanges
Reducing Slip-On Welding Flanges

Pressure-Temperature Ratings.....page 286
General Description.....page 287

List Prices
150 and 300-Pound.....page 288
400, 600, 900, and 1500-Pound.....page 289

Dimensions
150, 300, and 400-Pound.....page 290
600, 900, 1500, and 2500-Pound.....page 291

Boring of Welding Neck Flanges.....page 292

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The Forged Steel Flanges listed above comprise only a part of the complete line of Crane steel products.

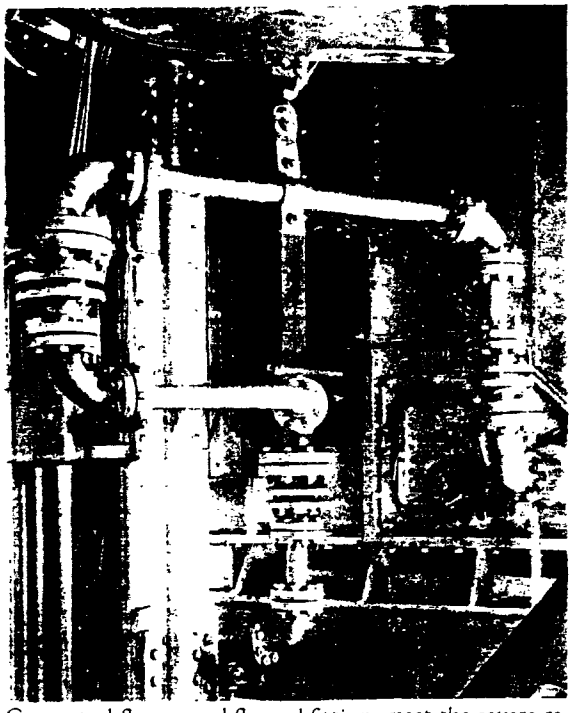
Other steel products are shown and described in detail in other sections of this catalog. Refer to the following pages:

Steel Welding Fittings.....pages 269 to 284
Steel Flanged Fittings.....pages 261 to 268
Steel Screwed Fittings.....pages 255 to 260
18-8 Mo. Flanges.....page 373

Steel Couplings.....page 172
Wrought Steel Nipples.....pages 170 and 171
Forged Steel Unions.....pages 183 and 184
Forged Steel Flange Unions.....pages 186 and 187

Steel Pressure-Seal Bonnet Valves.....pages 209 to 220
Steel Gate Valves.....pages 221 to 232
Steel Globe and Angle Valves.....pages 233 to 246
Steel Check Valves.....pages 247 to 254
Steel Stop-Check Valves.....pages 297 and 298

Steel Safety Valves.....page 314
Steel Relief Valves.....pages 323 to 325
Steel Sediment Separators.....page 342
Fabricated Piping.....pages 477 to 504



Crane steel flanges and flanged fittings meet the severe requirements of high pressure, high temperature service.

Forged Steel Flanges

Working Pressures, Pounds per Square Inch, Non-Shock
For Flanges Shown on pages 287 to 292

For Steam, Water, Oil, Oil Vapor, Gas, or Air

Temp.	Carbon Steel							No. 4 Carbon-Molybdenum Alloy Steel						[2]No. 5 Chrome-Molybdenum Alloy Steel (Made to order)					
Deg. F.	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
	[1]Flanges with Standard Facings Other Than Ring Joint																		
100	230	600	800	1200	1800	3000	5000												
150	220	590	785	1180	1770	2950	4915												
200	210	580	770	1160	1740	2900	4830												
250	200	570	760	1140	1710	2850	4750												
300	190	560	740	1120	1680	2800	4660												
350	180	550	725	1095	1645	2740	4565												
400	170	540	710	1075	1615	2690	4475	For temperatures up to 750° F., these ratings are the same as those for Carbon Steel Flanges, shown at the left.						For temperatures up to 750° F., these ratings are the same as those for Carbon Steel Flanges. For temperatures up to 900° F., the ratings are the same as those for No. 4 Carbon-Molybdenum Alloy Steel Flanges. (See ratings at left)					
450	160	525	700	1050	1580	2630	4380												
500	**150**	500	665	1000	1500	2500	4165												
550	140	475	630	950	1420	2370	3950												
600	130	445	590	890	1330	2220	3700												
650	120	415	550	830	1240	2070	3450												
700	110	380	500	760	1140	1900	3160												
750	100	340	450	680	1020	1700	2830	360	475	720	1080	1800	2995						
800	92	**300**	**400**	**600**	**900**	**1500**	**2500**	340	450	680	1020	1700	2830						
850	82	245	330	490	740	1230	2050	320	425	640	960	1600	2665						
900	[2]70	[2]210	[2]280	[2]420	[2]630	[2]1050	[2]1750	**300**	**400**	**600**	**900**	**1500**	**2500**	310	410	620	930	1550	258
950	[2]55	[2]165	[2]220	[2]330	[2]495	[2] 825	[2]1375	[2]265	[2]350	[2]530	[2]795	[2]1325	[2]2205	**300**	**400**	**600**	**900**	**1500**	**250**
1000	[2]40	[2]120	[2]160	[2]240	[2]360	[2] 600	[2]1000	[2]190	[2]250	[2]380	[2]570	[2] 950	[2]1580	200	275	400	600	1000	167
1050														135	180	270	405	675	112
1100														90	120	180	270	450	75
	Flanges with Ring Joint Facing																		
100	275	720	960	1440	2160	3600	6000												
150	255	710	945	1420	2130	3550	5915												
200	240	700	930	1400	2100	3500	5830												
250	225	690	920	1380	2070	3450	5750												
300	210	680	910	1365	2050	3415	5690												
350	195	675	900	1350	2025	3375	5625												
400	180	665	890	1330	2000	3330	5550	For temperatures up to 800° F., these ratings are the same as those for Carbon Steel Flanges, shown at the left.											
450	165	660	875	1320	1975	3295	5490												
500	**150**	625	835	1250	1875	3125	5210												
550	140	590	790	1180	1775	2955	4925												
600	130	555	740	1110	1660	2770	4620												
650	120	515	690	1030	1550	2580	4300												
700	110	470	635	940	1410	2350	3920												
750	100	425	575	850	1275	2125	3550												
800	92	365	490	730	1100	1830	3050	375	500	750	1125	1875	3125	400	525	800	1200	2000	33
850	82	**300**	**400**	**600**	**900**	**1500**	**2500**	350	475	700	1050	1750	2925	375	500	750	1125	1875	31
900	[2]70	[2]210	[2]280	[2]420	[2]630	[2]1050	[2]1750	325	425	650	975	1625	2700	350	475	700	1050	1750	29
950	[2]55	[2]165	[2]220	[2]330	[2]495	[2] 825	[2]1375	**300**	**400**	**600**	**900**	**1500**	**2500**	325	425	650	975	1625	27
1000	[2]40	[2]120	[2]160	[2]240	[2]360	[2] 600	[2]1000	[2]230	[2]310	[2]470	[2]700	[2]1170	[2]1950	**300**	**400**	**600**	**900**	**1500**	**25**
1050								[2]135	[2]180	[2]270	[2]405	[2] 675	[2]1125	225	275	425	650	1075	17
1100								[2] 90	[2]120	[2]180	[2]270	[2] 450	[2] 750	150	200	275	425	700	11

[1]When raised face, lapped, and large male and female facings are used with solid metal gaskets, the above pressure-temperature ratings are permitted only when the gasket contact area is not greater than the large tongue and groove gasket contact area and the I D of the gasket is not less than the I D of the large tongue and groove gasket.

[2]These ratings apply only to oil or oil vapor service.

Flange facings: Unless otherwise ordered, 150 and 300-Pound Flanges regularly are furnished with a 1/16-inch raised face, and 400-Pound and higher pressure flanges, with a 1/4-inch male face or a 3/16-inch female face, as ordered.

Cold service: For temperatures between 0° and 100° F. the ratings for 100° F apply. For sub-zero service materials with suitable impact resistance must be used; recommendations given on request

Cranelap Flanges and Joints: These ratings do not apply to Cranelap Flanges, the rating being dependent upon the type of facing applied to the lapped pipe end. Ratings for Cranelap Joints are contingent upon the use of pipe of proper material having an equal or higher rating.

Standards: Crane pressure-temperature ratings agree with those in Supplement No. 1 (ASA B16e-1949) to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939. The higher ratings that are shown above for products made of No. 5 Chrome-Molybdenum Alloy Steel are taken from ASA B31.1-1942 (Code for Pressure Piping)

Forged Steel Flanges

For working pressures, see page 286.

A complete line: The Crane line of Forged Steel Flanges includes a complete assortment of types in a wide range of straight and reducing sizes for seven different pressure classes (150, 300, 400, 600, 900, 1500, and 2500-Pound). The flanges are made in a variety of materials and with various flange facings, providing flanges for every service requirement.

Materials: Flanges made of Crane Forged Carbon Steel will be furnished unless otherwise ordered. List prices are shown on the two pages following (list prices of 2500-Pound Flanges are furnished on application).

Flanges in 300-Pound and higher pressure classes, made of Crane No. 4 Carbon-Molybdenum or Crane No. 5 Chrome-Molybdenum Forged Steel, can be furnished when orders so specify. See the Crane Discount Sheet for prices.

When so ordered, 150 and 300-Pound Forged Carbon Steel Flanges can be furnished heat treated (normalized or annealed) to conform to A.S.T.M. Specification A 105; prices on request.

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Drilling: Flanges of each pressure class are furnished faced, drilled, and spot faced (F.D. & S.F.) unless otherwise ordered. List prices include drilling to the corresponding pressure class of the American Standard. No deduction is made if flanges are ordered faced only.

Flange facings: The 150 and 300-Pound Forged Steel Screwed, Slip-On Welding, Welding Neck, and Blind Flanges are regularly furnished with an American Standard 1/16-inch raised face.

In the 400, 600, 900, 1500, and 2500-Pound pressure classes, these flanges are regularly furnished with an American Standard 1/4-inch male face (large male) or an American Standard 3/16-inch female face (large female); orders must specify which facing is wanted.

When so ordered, the flanges can be furnished with other types of facing, such as ring joint, tongue, groove, etc. See the Crane Discount Sheet for prices.

Finish of flange faces: The 1/16-inch raised faces and the 1/4-inch large male faces are finished with concentric grooves, approximately 32 grooves per inch, known as a "serrated" finish.

Large female faces have a smooth finish.

A smooth finish can be furnished on the raised or male faces, when so specified. See the Crane Discount Sheet for prices.

List prices of reducing flanges: The list prices of Reducing Screwed and Reducing Slip-On Welding Flanges apply to any reduction. The price is governed by the outside diameter of the flange.

Ordering reducing flanges: When ordering reducing flanges, the reduced size should be designated first, and then the outside diameter of the flange. For example, a 600-Pound Flange to connect a 6-inch pipe to a 10-inch valve or fitting (O.D. of flange, 20 inches) should be ordered,

6" x 20" Reducing Flange.

Reducing Welding Neck Flanges: Reducing Welding Neck Flanges can be made to order. For prices, see the Crane Discount Sheet.

Eccentric Reducing Flanges: Forged Steel Eccentric Reducing Screwed and Slip-On Welding Flanges can be made to order. For prices, see the Crane Discount Sheet.

American Standard: The dimensions and drilling of all flanges conform to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939, for their respective pressure class.

The American Standard does not include 400, 600, 900, or 1500-Pound Slip-On Welding Flanges. Crane flanges of this type have the same dimensions as American Standard Steel Screwed Flanges, being bored instead of threaded.

The American Standard has increased slightly the thickness of 150-Pound loose flanges in sizes 1 to 3 1/2-inch; see pages 290 and 291 for dimensions.

3-inch 300 and 600-Pound Cranelap Joints: When 3-inch 300 or 600-Pound Flanges with ring joint facing are to be bolted to Cranelap joints, orders must so specify; they require a groove of special pitch diameter. See page 450 for dimensions.

List prices pages 288 and 289
Dimensions pages 290 and 291

Description of materials . . pages 1 to 9
Templates for drilling pages 441 to 443

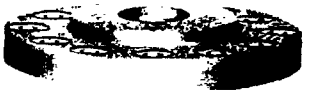
Forged Steel Flanges

For working pressures and description, see the preceding two pages.



Screwed Flange

No. 556, 150-Pound
No. 291 E, 300-Pound
No. 651 E, 400-Pound
No. 856 E, 600-Pound
No. 1266 E, 900-Pound
No. 1556 E, 1500-Pound



Reducing Screwed Flange
(See "Ordering Reducing Flanges", page 289.)

No. 558½, 150-Pound
No. 292 E, 300-Pound
No. 658 E, 400-Pound
No. 857 E, 600-Pound
No. 1263 E, 900-Pound
No. 1558 E, 1500-Pound



Blind Flange

No. 556½, 150-Pound
No. 297 E, 300-Pound
No. 657 E, 400-Pound
No. 858 E, 600-Pound
No. 1267 E, 900-Pound
No. 1557 E, 1500-Pound

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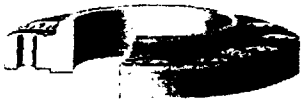
Cranelap Flange

No. 572, 150-Pound
No. 496 E, 300-Pound
No. 664 E, 400-Pound
No. 862 E, 600-Pound
No. 1262 E, 900-Pound
No. 1562 E, 1500-Pound



Slip-On Welding Flange

No. 554, 150-Pound
No. 294 E, 300-Pound
No. 694 E, 400-Pound
No. 854 E, 600-Pound
No. 1294 E, 900-Pound
No. 1594 E, 1500-Pound



Reducing Slip-On Welding Flange
(See "Ordering Reducing Flanges", page 289.)

No. 554½, 150-Pound
No. 290 E, 300-Pound
No. 693 E, 400-Pound
No. 853 E, 600-Pound
No. 1295 E, 900-Pound
No. 1595 E, 1500-Pound



Welding Neck Flange
(For boring, see page 292.)

No. 568, 150-Pound
No. 296 E, 300-Pound
No. 656 E, 400-Pound
No. 855 E, 600-Pound
No. 1265 E, 900-Pound
No. 1565 E, 1500-Pound

List Prices, Each—Faced, Drilled, and Spot Faced

Class	Size of Pipe	Straight Size Flanges			Reducing Flanges	
		Screwed, Cranelap, or Slip-On Welding	Welding Neck (For boring, see page 292.)	Blind	Outside Diameter of Flange	Screwed or Slip-On Welding
	Inches				Inches	
150 Pound	½	8.00	11.00	11.50		
	¾	8.00	11.00	11.50		
	1	8.00	11.00	11.50	4¼	16.00
	1¼	9.00	11.00	11.50	4⅝	18.00
	1½	10.00	11.00	11.50	5	20.00
	2	11.00	11.00	12.60	6	21.00
	2½	13.00	13.00	14.70	7	24.50
	3	15.00	15.00	17.05	7½	28.00
	3½	19.00	19.00	21.65	8½	35.00
	4	20.00	20.00	23.70	9	37.00
	5	24.00	24.00	28.20	10	44.00
	6	27.00	27.00	31.60	11	49.00
	8	35.00	44.00	42.00	13½	63.00
	10	48.00	62.00	58.00	16	86.00
	12	60.00	96.00	76.00	19	108.00
	14	80.00	130.00	126.00	21	144.00
	16	100.00	165.00	147.00	23½	180.00
	18	125.00	220.00	210.00	25	225.00
	20	150.00	290.00	252.00	27½	270.00
	24	240.00	380.00	320.00	32	380.00
300 Pound	½	8.00	11.00	11.50		
	¾	8.00	11.00	11.50		
	1	8.00	11.00	11.50	4⅞	16.00
	1¼	9.00	11.00	11.50	5¼	18.00
	1½	10.00	11.00	11.50	6⅛	20.00
	2	11.00	11.00	12.60	6½	21.00
	2½	13.00	13.00	14.70	7½	24.50
	*3	15.00	15.00	17.05	8¼	28.00
	3½	19.00	19.00	21.65	9	35.00
	4	20.00	20.00	23.70	10	37.00
	5	24.00	24.00	28.20	11	44.00
	6	27.00	27.00	31.60	12½	49.00
	8	35.00	44.00	42.00	15	63.00
	10	48.00	62.00	58.00	17½	86.00
	12	60.00	96.00	76.00	20½	108.00
	14	80.00	130.00	126.00	23	144.00
	16	100.00	165.00	147.00	25½	180.00
	18	125.00	220.00	210.00	28	225.00
	20	150.00	290.00	252.00	30½	270.00
	24	240.00	380.00	320.00	36	380.00

*3" 300-Pound flanges with ring joint facing to bolt against a Cranelap joint must be specially ordered, they require a groove of special pitch diameter. See page 450 for dimensions.

(Continued on the following page)

Forged Steel Flanges

List Prices, Each—Faced, Drilled, and Spot Faced (Cont.)

Class	Size of Pipe Inches	Straight Size Flanges: Screwed, Cranelap, or Slip-On Welding	Straight Size Flanges: Welding Neck (For boring see page 292.)	Straight Size Flanges: Blind	Reducing Flanges: Outside Diameter of Flange Inches	Reducing Flanges: Screwed or Slip-On Welding
400 Pound — For smaller sizes, use 600 Pound.	4	20.00	20.00	23.70	10	37.00
	5	24.00	24.00	28.20	11	44.00
	6	27.00	27.00	31.60	12½	49.00
	8	35.00	44.00	42.00	15	63.00
	10	48.00	62.00	58.00	17½	86.00
	12	60.00	96.00	76.00	20½	108.00
	14	80.00	130.00	126.00	23	144.00
	16	100.00	165.00	147.00	25½	180.00
	18	125.00	220.00	210.00	28	225.00
	20	150.00	290.00	252.00	30½	270.00
	24	240.00	380.00	320.00	36	380.00
600 Pound	½	9.50	16.30	11.50		
	¾	9.50	16.30	11.50		
	1	10.00	16.30	11.50	4⅞	16.00
	1¼	10.75	16.30	11.50	5¼	18.00
	1½	11.75	16.30	11.50	6⅛	20.00
	2	13.00	16.30	12.60	6½	21.00
	2½	15.00	19.00	14.70	7½	24.50
	*3	18.50	23.00	17.05	8¼	28.00
	3½	22.50	29.00	21.65	9	35.00
	4	33.00	39.00	40.00	10¾	57.00
	5	46.00	53.50	56.00	13	79.00
	6	55.00	63.50	66.00	14	94.00
	8	80.00	90.00	96.00	16½	136.00
	10	125.00	138.00	150.00	20	212.50
	12	150.00	188.00	180.00	22	255.00
	14	180.00	200.00	216.00	23¾	306.00
	16	240.00	270.00	288.00	27	408.00
	18	300.00	330.00	360.00	29¼	510.00
	20	360.00	400.00	432.00	32	612.00
	24	540.00	590.00	648.00	37	918.00
900 Pound — For smaller sizes, use 1500 Pound.	3	29.00	35.00	35.00	9½	48.00
	4	51.00	62.00	62.00	11½	81.00
	5	71.00	85.00	85.00	13¾	113.00
	6	86.00	104.00	104.00	15	137.00
	8	155.00	190.00	190.00	18½	245.00
	10	225.00	270.00	270.00	21½	360.00
	12	300.00	360.00	360.00	24	480.00
	14	380.00	560.00	455.00	25¼	610.00
	16	460.00	690.00	555.00	27¾	740.00
	18	650.00	925.00	780.00	31	1040.00
	20	795.00	1160.00	955.00	33¾	1275.00
	24	1500.00	2100.00	1800.00	41	2400.00
1500 Pound — (Prices of 14-inch Flanges on request)	½	14.00	27.00	17.00		
	¾	14.00	27.00	17.00		
	1	14.00	27.00	17.00	5⅞	22.00
	1¼	14.00	27.00	17.00	6¼	22.00
	1½	16.00	27.00	19.00	7	26.00
	2	22.00	27.00	27.00	8½	35.00
	2½	29.00	35.00	35.00	9⅝	48.00
	3	38.00	46.00	46.00	10½	60.00
	4	60.00	72.00	72.00	12¼	96.00
	5	105.00	125.00	125.00	14¾	170.00
	6	132.00	160.00	160.00	15½	210.00
	8	220.00	265.00	265.00	19	350.00
	10	365.00	440.00	440.00	23	565.00
	12	550.00	660.00	660.00	26½	800.00

Dimensions . . . pages 290 and 291 *Description . . . page 287*

Ordering Reducing Flanges

When ordering reducing flanges, the reduced size should be designated first, and then the outside diameter of the flange. For example, a 600-Pound Flange to connect a 6-inch pipe to a 10-inch valve or fitting (O D of flange, 20 inches) should be ordered,

6" x 20" Reducing Flange.

Facings

Screwed, Slip-On Welding, Welding Neck, and Blind Flanges in the 400, 600, 900, and 1500-Pound pressure classes are furnished with either a ¼-inch large male or 3/16-inch large female face; ***orders should specify which facing is wanted.*** In the 150 and 300-Pound pressure classes, the flanges are regularly furnished with a 1/16-inch raised face.

Other flange facings such as ring joint, tongue, groove, etc., can be furnished on order; see the Crane Discount Sheet for prices.

Welding Neck Flanges

For information on boring of Welding Neck Flanges, see page 292.

Cranelap Flanges

For information on complete Cranelap Joints, see page 487. Cranelap Flanges also are recommended for use in combination with Cranelap Stub Ends; see pages 274 to 277.

*3-inch Cranelap Joints (300 or 600-Pound)

When 3-inch 300 or 600-Pound Flanges with ring joint facing are to be bolted to Cranelap joints, orders must so specify; they require a groove of special pitch diameter. See page 450 for dimensions.

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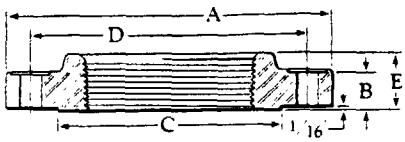
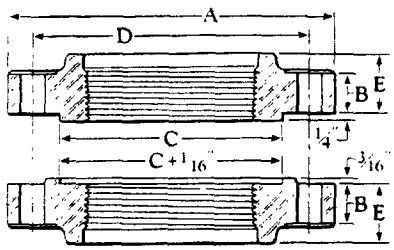
Forged Steel Flanges

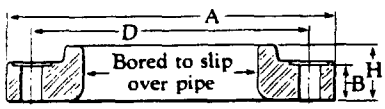
Dimensions, in Inches



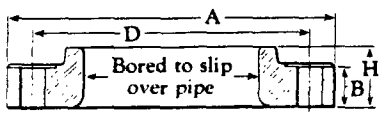
Screwed Flange
150 and 300-Pound



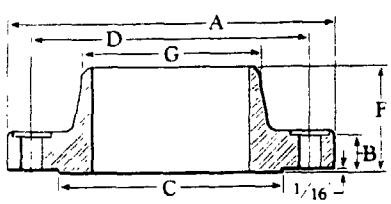
Screwed Flanges
400, 600, 900, 1500, and 2500-Pound



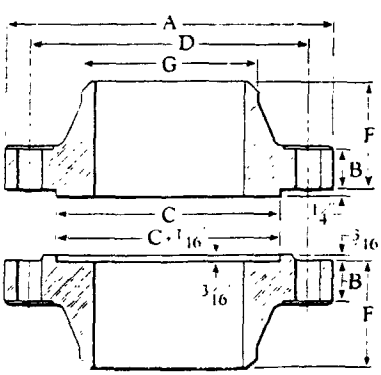
Cranelap Flange
150 and 300-Pound



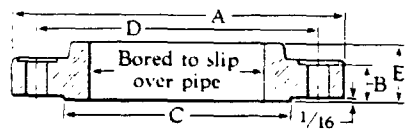
Cranelap Flange
400, 600, 900, 1500, and 2500-Pound



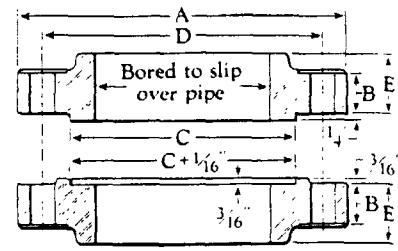
Welding Neck Flange
150 and 300-Pound
For boring, see page 292.



Welding Neck Flanges
400, 600, 900, 1500, and 2500-Pound
For boring, see page 292.



Slip-On Welding Flange
150 and 300-Pound



Slip-On Welding Flanges
400, 600, 900, and 1500-Pound

Class	Pipe Size	A	B	C	D	Bolts No.	Bolts Dia.	E	F	G	H
150 Pound	1/2	3 1/2	7/16	1 3/8	2 3/8	4	1/2	5/8	1 7/8	0.84	5/8
	3/4	3 7/8	1/2	1 11/16	2 3/4	4	1/2	5/8	2 1/16	1.05	5/8
	1	4 1/4	9/16	2	3 1/8	4	1/2	11/16	2 3/16	1.32	11/16
	1 1/4	4 5/8	5/8	2 1/2	3 1/2	4	1/2	13/16	2 1/4	1.66	13/16
	1 1/2	5	11/16	2 7/8	3 7/8	4	1/2	7/8	2 7/16	1.90	7/8
	2	6	3/4	3 5/8	4 3/4	4	5/8	1	2 1/2	2.38	1
	2 1/2	7	7/8	4 1/8	5 1/2	4	5/8	1 1/8	2 3/4	2.88	1 1/8
	3	7 1/2	15/16	5	6	4	5/8	1 3/16	2 3/4	3.50	1 3/16
	3 1/2	8 1/2	15/16	5 1/2	7	8	5/8	1 1/4	2 13/16	4.00	1 1/4
	4	9	15/16	6 3/16	7 1/2	8	5/8	1 5/16	3	4.50	1 5/16
	5	10	15/16	7 5/16	8 1/2	8	3/4	1 7/16	3 1/2	5.56	1 7/16
	6	11	1	8 1/2	9 1/2	8	3/4	1 9/16	3 1/2	6.63	1 9/16
	8	13 1/2	1 1/8	10 5/8	11 3/4	8	3/4	1 3/4	4	8.63	1 3/4
	10	16	1 3/16	12 3/4	14 1/4	12	7/8	1 15/16	4	10.75	1 15/16
	12	19	1 1/4	15	17	12	7/8	2 3/16	4 1/2	12.75	2 3/16
	14	21	1 3/8	16 1/4	18 3/4	12	1	2 1/4	5	14.00	3 1/8
	16	23 1/2	1 7/16	18 1/2	21 1/4	16	1	2 1/2	5	16.00	3 7/16
	18	25	1 9/16	21	22 3/4	16	1 1/8	2 11/16	5 1/2	18.00	3 13/16
	20	27 1/2	1 11/16	23	25	20	1 1/8	2 7/8	5 11/16	20.00	4 1/16
	24	32	1 7/8	27 1/4	29 1/2	20	1 1/4	3 1/4	6	24.00	4 3/8
300 Pound	1/2	3 3/4	9/16	1 3/8	2 5/8	4	1/2	7/8	2 1/16	0.84	7/8
	3/4	4 5/8	5/8	1 11/16	3 1/4	4	5/8	1	2 1/4	1.05	1
	1	4 7/8	11/16	2	3 1/2	4	5/8	1 1/16	2 7/16	1.32	1 1/16
	1 1/4	5 1/4	3/4	2 1/2	3 7/8	4	5/8	1 1/16	2 9/16	1.66	1 1/16
	1 1/2	6 1/8	13/16	2 7/8	4 1/2	4	3/4	1 3/16	2 11/16	1.90	1 3/16
	2	6 1/2	7/8	3 5/8	5	8	5/8	1 5/16	2 3/4	2.38	1 5/16
	2 1/2	7 1/2	1	4 1/8	5 7/8	8	3/4	1 1/2	3	2.88	1 1/2
	3	8 1/4	1 1/8	5	6 5/8	8	3/4	1 11/16	3 1/8	3.50	1 11/16
	3 1/2	9	1 3/16	5 1/2	7 1/4	8	3/4	1 3/4	3 3/16	4.00	1 3/4
	4	10	1 1/4	6 3/16	7 7/8	8	3/4	1 7/8	3 3/8	4.50	1 7/8
	5	11	1 3/8	7 5/16	9 1/4	8	3/4	2	3 7/8	5.56	2
	6	12 1/2	1 7/16	8 1/2	10 5/8	12	3/4	2 1/16	3 7/8	6.63	2 1/16
	8	15	1 5/8	10 5/8	13	12	7/8	2 7/16	4 3/8	8.63	2 7/16
	10	17 1/2	1 7/8	12 3/4	15 1/4	16	1	2 5/8	4 5/8	10.75	3 3/4
	12	20 1/2	2	15	17 3/4	16	1 1/8	2 7/8	5 1/8	12.75	4
	14	23	2 1/8	16 1/4	20 1/4	20	1 1/8	3	5 5/8	14.00	4 3/8
	16	25 1/2	2 1/4	18 1/2	22 1/2	20	1 1/4	3 1/4	5 3/4	16.00	4 3/4
	18	28	2 3/8	21	24 3/4	24	1 1/4	3 1/2	6 1/4	18.00	5 1/8
	20	30 1/2	2 1/2	23	27	24	1 1/4	3 3/4	6 3/8	20.00	5 1/2
	24	36	2 3/4	27 1/4	32	24	1 1/2	4 3/16	6 5/8	24.00	6
400 Pound	4	10	1 3/8	6 3/16	7 7/8	8	7/8	2	3 1/2	4.50	2
	5	11	1 1/2	7 5/16	9 1/4	8	7/8	2 1/8	4	5.56	2 1/8
	6	12 1/2	1 5/8	8 1/2	10 5/8	12	7/8	2 1/4	4 1/16	6.63	2 1/4
	8	15	1 7/8	10 5/8	13	12	1	2 11/16	4 5/8	8.63	2 11/16
	10	17 1/2	2 1/8	12 3/4	15 1/4	16	1 1/8	2 7/8	4 7/8	10.75	4
	12	20 1/2	2 1/4	15	17 3/4	16	1 1/4	3 1/8	5 3/8	12.75	4 1/4
	14	23	2 3/8	16 1/4	20 1/4	20	1 1/4	3 5/16	5 7/8	14.00	4 5/8
	16	25 1/2	2 1/2	18 1/2	22 1/2	20	1 3/8	3 11/16	6	16.00	5
	18	28	2 5/8	21	24 3/4	24	1 3/8	3 7/8	6 1/2	18.00	5 3/8
	20	30 1/2	2 3/4	23	27	24	1 1/2	4	6 5/8	20.00	5 3/4
	24	36	3	27 1/4	32	24	1 3/4	4 1/2	6 7/8	24.00	6 1/4

Dimensions, in Inches (Cont.)

Class	Pipe Size	A	B	C	D	Bolts No.	Bolts Dia.	E	F	G	H
600 Pound	1/2	3 3/4	9/16	1 3/8	2 5/8	4	1/2	7/8	2 1/16	0.84	7/8
	3/4	4 5/8	5/8	1 11/16	3 1/4	4	5/8	1	2 1/4	1.05	1
	1	4 7/8	11/16	2	3 1/2	4	5/8	1 1/16	2 7/16	1.32	1 1/16
	1 1/4	5 1/4	13/16	2 1/2	3 7/8	4	5/8	1 1/8	2 5/8	1.66	1 1/8
	1 1/2	6 1/8	7/8	2 7/8	4 1/2	4	3/4	1 1/4	2 3/4	1.90	1 1/4
	2	6 1/2	1	3 5/8	5	8	5/8	1 7/16	2 7/8	2.38	1 7/16
	2 1/2	7 1/2	1 1/8	4 1/8	5 7/8	8	3/4	1 5/8	3 1/8	2.88	1 5/8
	3	8 1/4	1 1/4	5	6 5/8	8	3/4	1 13/16	3 1/4	3.50	1 13/16
	3 1/2	9	1 3/8	5 1/2	7 1/4	8	7/8	1 15/16	3 3/8	4.00	1 15/16
	4	10 3/4	1 1/2	6 3/16	8 1/2	8	7/8	2 1/8	4	4.50	2 1/8
	5	13	1 3/4	7 5/16	10 1/2	8	1	2 3/8	4 1/2	5.56	2 3/8
	6	14	1 7/8	8 1/2	11 1/2	12	1	2 5/8	4 5/8	6.63	2 5/8
	8	16 1/2	2 3/16	10 5/8	13 3/4	12	1 1/8	3	5 1/4	8.63	3
	10	20	2 1/2	12 3/4	17	16	1 1/4	3 3/8	6	10.75	4 3/8
	12	22	2 5/8	15	19 1/4	20	1 1/4	3 5/8	6 1/8	12.75	4 5/8
	14	23 3/4	2 3/4	16 1/4	20 3/4	20	1 3/8	3 11/16	6 1/2	14.00	5
	16	27	3	18 1/2	23 3/4	20	1 1/2	4 3/16	7	16.00	5 1/2
	18	29 1/4	3 1/4	21	25 3/4	20	1 5/8	4 5/8	7 1/4	18.00	6
	20	32	3 1/2	23	28 1/2	24	1 5/8	5	7 1/2	20.00	6 1/2
	24	37	4	27 1/4	33	24	1 7/8	5 1/2	8	24.00	7 1/4
900 Pound	3	9 1/2	1 1/2	5	7 1/2	8	7/8	2 1/8	4	3.50	2 1/8
	4	11 1/2	1 3/4	6 3/16	9 1/4	8	1 1/8	2 3/4	4 1/2	4.50	2 3/4
	5	13 3/4	2	7 5/16	11	8	1 1/4	3 1/8	5	5.56	3 1/8
	6	15	2 3/16	8 1/2	12 1/2	12	1 1/8	3 3/8	5 1/2	6.63	3 3/8
	8	18 1/2	2 1/2	10 5/8	15 1/2	12	1 3/8	4	6 3/8	8.63	4 1/2
	10	21 1/2	2 3/4	12 3/4	18 1/2	16	1 3/8	4 1/4	7 1/4	10.75	5
	12	24	3 1/8	15	21	20	1 3/8	4 5/8	7 7/8	12.75	5 5/8
	14	25 1/4	3 3/8	16 1/4	22	20	1 1/2	5 1/8	8 3/8	14.00	6 1/8
	16	27 3/4	3 1/2	18 1/2	24 1/4	20	1 5/8	5 1/4	8 1/2	16.00	6 1/2
	18	31	4	21	27	20	1 7/8	6	9	18.00	7 1/2
	20	33 3/4	4 1/4	23	29 1/2	20	2	6 1/4	9 3/4	20.00	8 1/4
	24	41	5 1/2	27 1/4	35 1/2	20	2 1/2	8	11 1/2	24.00	10 1/2
1500 Pound	1/2	4 3/4	7/8	1 3/8	3 1/4	4	3/4	1 1/4	2 3/8	0.84	1 1/4
	3/4	5 1/8	1	1 11/16	3 1/2	4	3/4	1 3/8	2 3/4	1.05	1 3/8
	1	5 7/8	1 1/8	2	4	4	7/8	1 5/8	2 7/8	1.32	1 5/8
	1 1/4	6 1/4	1 1/8	2 1/2	4 3/8	4	7/8	1 5/8	2 7/8	1.66	1 5/8
	1 1/2	7	1 1/4	2 7/8	4 7/8	4	1	1 3/4	3 1/4	1.90	1 3/4
	2	8 1/2	1 1/2	3 5/8	6 1/2	8	7/8	2 1/4	4	2.38	2 1/4
	2 1/2	9 5/8	1 5/8	4 1/8	7 1/2	8	1	2 1/2	4 1/8	2.88	2 1/2
	3	10 1/2	1 7/8	5	8	8	1 1/8	2 7/8	4 5/8	3.50	2 7/8
	4	12 1/4	2 1/8	6 3/16	9 1/2	8	1 1/4	3 9/16	4 7/8	4.50	3 9/16
	5	14 3/4	2 7/8	7 5/16	11 1/2	8	1 1/2	4 1/8	6 1/8	5.56	4 1/8
	6	15 1/2	3 1/4	8 1/2	12 1/2	12	1 3/8	4 11/16	6 3/4	6.63	4 11/16
	8	19	3 5/8	10 5/8	15 1/2	12	1 5/8	5 5/8	8 3/8	8.63	5 5/8
	10	23	4 1/4	12 3/4	19	12	1 7/8	6 1/4	10	10.75	7
	12	26 1/2	4 7/8	15	22 1/2	16	2	7 1/8	11 1/8	12.75	8 5/8
	14	29 1/2	5 1/4	16 1/4	25	16	2 1/4		11 3/4	14.00	9 1/2
2500 Pound	1/2	5 1/4	13/16	1 3/8	3 1/2	4	3/4	1 9/16	2 7/8	0.84	1 9/16
	3/4	5 1/2	1 1/4	1 11/16	3 3/4	4	3/4	1 11/16	3 1/8	1.05	1 11/16
	1	6 1/4	1 3/8	2	4 1/4	4	7/8	1 7/8	3 1/2	1.32	1 7/8
	1 1/4	7 1/4	1 1/2	2 1/2	5 1/8	4	1	2 1/16	3 3/4	1.66	2 1/16
	1 1/2	8	1 3/4	2 7/8	5 3/4	4	1 1/8	2 3/8	4 3/8	1.90	2 3/8
	2	9 1/4	2	3 5/8	6 3/4	8	1	2 3/4	5	2.38	2 3/4
	2 1/2	10 1/2	2 1/4	4 1/8	7 3/4	8	1 1/8	3 1/8	5 5/8	2.88	3 1/8
	3	12	2 5/8	5	9	8	1 1/4	3 5/8	6 5/8	3.50	3 5/8
	4	14	3	6 3/16	10 3/4	8	1 1/2	4 1/4	7 1/2	4.50	4 1/4
	5	16 1/2	3 5/8	7 5/16	12 3/4	8	1 3/4	5 1/8	9	5.56	5 1/8
	6	19	4 1/4	8 1/2	14 1/2	8	2	6	10 3/4	6.63	6
	8	21 3/4	5	10 5/8	17 1/4	12	2	7	12 1/2	8.63	7
	10	26 1/2	6 1/2	12 3/4	21 1/4	12	2 1/2	9	16 1/2	10.75	9
	12	30	7 1/4	15	24 3/8	12	2 3/4	10	18 1/4	12.75	10

List prices . . . pages 288 and 289 *Description . . . page 287*

Facings: Screwed, Blind, Slip-On Welding, and Welding Neck Flanges are regularly furnished with a 1/16-inch high raised face in the 150 and 300-Pound pressure classes, and with either large male or large female facing, as ordered, in the 400, 600, 900, 1500 and 2500-Pound pressure classes.

Cranelap joints: Complete dimensions of Cranelap joints (except 2500-Pound) are shown on page 490.

Complete dimensions of 2500-Pound Cranelap Joints will be furnished on application. Requests should be accompanied by detailed specifications, including the thickness of the pipe, the kind of lap, and the type of facing required on the lap.

American Standard: The dimensions and drilling of flanges conform to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939, for their respective pressure class.

The American Standard does not include 400, 600, 900, or 1500-Pound Slip-On Welding Flanges. Crane flanges of this type have the same dimensions as American Standard Steel Screwed Flanges, being bored instead of threaded.

The Standard has increased slightly the thickness of 150-Pound loose flanges in sizes 1 to 3 1/2-inch. The table at the right shows the new and old thicknesses, the latter being taken from the former issue of the American Standard, B16e-1932.

Comparison of New and Old Flange Thicknesses (150-Pound)

Size	New	Old
1	9/16	7/16
1 1/4	5/8	1/2
1 1/2	11/16	9/16
2	3/4	5/8
2 1/2	7/8	11/16
3	15/16	3/4
3 1/2	15/16	13/16

Templates for drilling . . . pages 441 to 443
Special facings. pages 448 to 451
Boring of Welding Neck Flanges page 292

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Boring of Welding Neck Flanges

Unless otherwise specified, Crane Forged Steel Welding Neck Flanges are regularly bored to match the inside diameter of the pipe listed in the table below:

Size of Pipe Inches	No. 568 150-Pound Flanges	No. 296 E 300-Pound Flanges	No. 656 E 400-Pound Flanges	No. 855 E 600-Pound Flanges	No. 1265 E 900-Pound Flanges	No. 1565 E 1500-Pound Flanges	Equivalent A.S.A. Schedule Numbers	
							For Standard Pipe	For Extra Strong Pipe
½	*Standard Pipe (Heaviest weight on 8, 10, and 12-inch sizes)		*Extra Strong Pipe		†Orders must specify diameter of bore. (900 and 1500-Pound Flanges not listed in 3½-inch size.)		Schedule 40	Schedule 80
¾								
1								
1¼								
1½								
2								
2½								
3								
3½								
4								
5								
6								
8								
10								Schedule 60
12							None	None
14	*O.D. Pipe ⅜-inch Thick		*O.D. Pipe ½-inch Thick	†Orders must specify diameter of bore.			‡	§ None
16							Schedule 30	Schedule 40
18							‡ None	§ None
20							Schedule 20	Schedule 30
24								None

*An extra charge is made if any other bore is specified.

†An extra charge is made if a bore smaller than that listed in the left hand portion of the table below is specified.

‡This is O.D. Pipe, ⅜-inch thick. §This is O.D. Pipe, ½-inch thick.

All Dimensions Are In Inches

Size of Pipe Inches	***Smallest diameter to which Crane Welding Neck Flanges can be bored.						Inside Diameter of Pipe (Included for convenient reference)											
	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	"S"	"X"	"XX"	A.S.A. Schedule Numbers 10	20	30	40	60	80	100	120	140	160
½	**	**	.....	**	.....	**	.622	.546	.252				.622		.546				
¾	**	**	.....	**	.....	**	.824	.742	.434				.824		.742				
1	.91	.95	.....	.95	.....	**	1.049	.957	.599				1.049		.957				
1¼	1.25	1.27	.....	1.27	.....	**	1.380	1.278	.896				1.380		1.278				
1½	1.50	1.46	.....	1.46	.....	**	1.610	1.500	1.100				1.610		1.500				
2	1.93	1.91	.....	1.91	.....	1.46	2.067	1.939	1.503				2.067		1.939				
2½	2.31	2.28	.....	2.31	.....	1.72	2.469	2.323	1.771				2.469		2.323				
3	2.84	2.84	.....	2.87	2.59	2.22	3.068	2.900	2.300				3.068		2.900				
3½	3.28	3.28	.....	3.28	.....	.....	3.548	3.364					3.548		3.364				
4	3.78	3.68	3.81	3.78	3.41	3.03	4.026	3.826	3.152				4.026		3.826		3.626		
5	4.78	4.72	4.81	4.72	4.22	4.06	5.047	4.813	4.063				5.047		4.813		4.563		
6	5.75	5.72	5.72	5.75	5.12	4.84	6.065	5.761	4.897				6.065		5.761		5.501		
8	7.59	7.56	7.59	7.62	7.12	6.81	7.981	7.625	6.875		8.125	8.071	7.981	7.813	7.625	7.439	7.189	7.001	
10	9.75	9.72	9.56	9.56	8.96	8.25	10.020	9.750			10.250	10.136	10.020	9.750	9.564	9.314	9.064	8.750	
12	11.75	11.59	11.37	11.34	10.75	10.12	12.000	11.750			12.250	12.090	11.938	11.626	11.376	11.064	10.750	10.500	
14	12.96	13.00	13.00	12.12	13.00	.....	13.250	13.000		13.500	13.376	13.250	13.126	12.814	12.500	12.126	11.814	11.500	
16	14.96	15.00	15.00	13.93	15.00	.....	15.250	15.000		15.500	15.376	15.250	15.000	14.688	14.314	13.938	13.564	13.126	
18	17.00	16.87	16.87	16.50	17.00	.....	17.250	17.000		17.500	17.376	17.126	16.876	16.500	16.125	15.688	15.250	14.876	
20	19.00	18.81	18.81	18.50	19.00	.....	19.250	19.000		19.500	19.250	19.000	18.814	18.376	17.938	17.438	17.000	16.500	
24	23.00	23.00	22.50	22.50	23.00	....	23.250	23.000		23.500	23.250	22.876	22.626	22.064	21.564	20.938	20.376	19.876	

"S" indicates Standard Pipe (heaviest weight on 8, 10, and 12-inch sizes and ⅜-inch thick O.D. Pipe on 14-inch and larger.)

"X" indicates Extra Strong Pipe (½-inch thick O.D. Pipe on sizes 14-inch and larger).

"XX" indicates Double Extra Strong Pipe.

**These flanges are forged solid. ***Flanges suitable for pipe with smaller inside diameter are entirely special, prices on application

Note: The actual diameter of bore in Crane Forged Steel Welding Neck Flanges is subject to the following tolerances as defined by the American Standard B16e-1939: sizes 10-inch and smaller plus or minus 1/32-inch; sizes 12 to 18-inch, inclusive plus or minus 1/16-inch; and 20 and 24-inch sizes plus 1/8-inch minus 1/16-inch.

List prices of flanges . . . . ***pages 288 and 28***
Dimensions of flanges . . . . ***pages 290 and 29***
Pressure-temperature ratings . . . ***page 28***

Stop-Check, Pulp Stock, Lubricated Plug, Back Pressure, Blow-Off, and Float Valves

Stop-Check Valves
- Service and General Description....page 294
- Installation....page 295
- Features....page 295
- 250-Pound Ferrosteel....page 296
- 300-Pound Cast Steel....page 297
- 400-Pound Cast Steel....page 298
- 600-Pound Cast Steel....page 298

Pulp Stock Valves....page 299
Back Pressure Valves....pages 302 and 303
Exhaust Relief Valves....page 302
Blow-Off Valves....page 304
Pressure Relief Valves....page 303

Clayton Valves and Controls....pages 306 to 308
Klipfel Tank Float and Lever Valves....page 305
Nordstrom Lubricated Plug Valves....pages 300 and 301

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For Stop-Check Valves for Higher Pressures, Use the new Crane Pressure-Seal Bonnet Valves; see pages 218 and 219.

Nearly every piping installation requires the use of at least a few items which are generally called "specialties", or more specifically "special duty valves"—valves which are designed for only one particular service or which automatically perform a special function. The Crane line of such valves includes a wide assortment of types and sizes to fill all normal requirements, and all of these are characteristically high in quality.

For greater convenience in catalog use, the Crane line of special duty valves and of specialties has been divided into several groups. In addition to those indexed above, the line includes the following:

Safety and Relief Valves....pages 309 to 325
Pressure Regulators and Pressure Reducing Valves....pages 328 to 334
Steam Traps....pages 335 to 337
Steam and Oil Separators; Sediment Separators....pages 340 to 343
Expansion Joints....pages 346 to 348

Water Gauges and Accessories....pages 350 and 351
Whistles and Fusible Plugs....page 352
Sanitary Water Hydrants....page 353
Flexible Joints....pages 354 and 355
Gauges and Recorders....pages 356 and 357
Lubricators; Oilers; Injectors; Ejectors; Boiler Controls....pages 362 to 364

Brass Lever-Operated Quick-Opening Valves....pages 54 to 56
Brass Chronometer Valves....page 387
Brass Butterfly and Throttle Valves....page 57
Iron Butterfly Valves....page 115

Ferrosteel and Cast Steel Stop-Check Valves

Boiler Service and Fundamental Duties

Stop-Check Valves are as essential to the safe operation of a boiler plant as are the safety valves or other safety devices attached to the boiler. They should be installed in the pipe line between each boiler and the main steam header, when more than one boiler is connected to the same header. These valves should always be placed so that the pressure in the boiler is under the disc.

The Stop-Check Valve is intended to perform four important functions in boiler steam piping:

First: To act as an automatic non-return valve, preventing a back flow of steam from the main steam header to the boiler to which it is connected, in the event of a failure in that boiler.

Second: To assist, when ceasing to fire, in cutting out a boiler. In this case the disc will close automatically and prevent header pressure from entering the boiler.

Third: To assist in bringing a boiler into service after it has been shut down. This operation requires considerable care when performed manually, but the Stop-Check Valve performs this function automatically, without pressure fluctuations or disturbance of the water level.

Fourth: To act as a "safety first" valve in preventing back flow of steam from the header into a boiler which has been shut down for inspection or repair, should an attendant accidentally open the valve.

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General Description

Construction: In design and construction, these valves are unusually simple, strong, and rugged. Made with but one moving part, the disc, and embodying only carefully selected materials, they are exceptionally durable and give long and reliable service.

Simplicity of design: Because of the simplicity of design, all internal parts are easily accessible, and when the occasion arises, replacements can be made without removing the valve from the line.

Manual operation: These valves are equipped with a handwheel which permits them to be closed while under pressure, or if they are already closed automatically, to hold the disc in the closed position. No mechanical connection is made between the disc and the stem, and when the stem is raised by the handwheel, only the boiler pressure can lift the disc.

This equipment for manual operation of the valves is of the outside screw and yoke type, wherein the stem threads are not directly exposed to the high temperature of the steam.

Bonnet joint: The 250-Pound Ferrosteel and 300-Pound Cast Steel Valves have a male and female bonnet joint, bolted with studs driven into the body. The 250-Pound Valves are fitted with a Cranite gasket, and the 300-Pound Valves, with a corrugated soft iron gasket.

The 400 and 600-Pound Cast Steel Valves have ring joint bonnet facing, a soft steel ring joint gasket, and Crane Templex Steel through type bolt-studs. Tightness and liberal strength are assured.

Body seat ring: The body seat ring is of the shoulder seated type. It is held in place by the removable liner in Ferrosteel Valves and is screwed into the body in Cast Steel Valves.

Piston type disc: The piston type disc, operating in the removable liner, is the only pressure actuated part in the valve; see the following page for features and full description of the internal parts of the valve.

Stuffing box: All Cast Steel Valves have a lantern type stuffing box, equipped with a bronze ball type gland and a malleable iron gland flange. Packing above and below the lantern assures tight sealing. The lantern provides space for a cooling chamber, which is tapped and fitted with a steel plug.

The 250-Pound Ferrosteel Valves have an exceptionally deep stuffing box, filled with a high grade packing, and fitted with a brass gland and a malleable iron gland flange.

Repacking: All Stop-Check Valves, when the stem is in the wide open position, can be repacked while under pressure.

Code requirements: Crane Ferrosteel and Steel Stop-Check Valves conform to the A.S.M.E. Boiler Construction Code for Non-Return Stop Valves.

Closing tight against boiler test pressures: All of these Crane Stop-Check Valves can be closed tight against boiler test pressure (one and one-half times the recommended working pressure). For this purpose, 8 and 10-inch 250-Pound Ferrosteel and 300-Pound Steel, 8, 10, and 12-inch 400-Pound Steel, and 6, 8, 10, and 12-inch 600-Pound Steel Valves are regularly equipped with a hammer-blow handwheel

List Prices and Dimensions
250-Pound Ferrosteel Stop-Check Valves . . . see page 296
300-Pound Cast Steel Stop-Check Valves . . . see page 297
400-Pound Cast Steel Stop-Check Valves . . see page 298
600-Pound Cast Steel Stop-Check Valves . . see page 298

Ferrosteel and Cast Steel Stop-Check Valves

Features of the Crane Stop-Check Valve

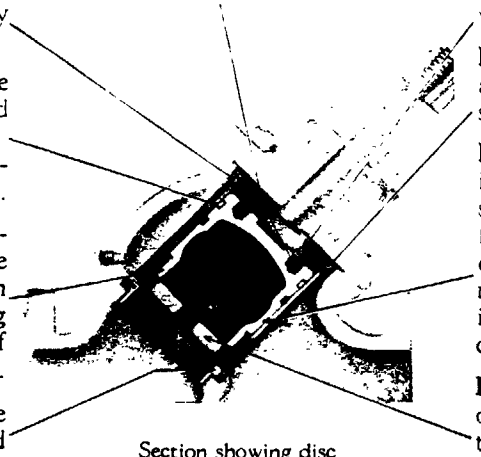
Liner: The liner guides the disc throughout the full travel. It is quickly removable and, being entirely independent of the body, is not subject to distortion by expansion strains.

Piston ring: Contributes to the dashpot effectiveness to avoid rapid disc movements. For conditions of extremely severe pulsations two rings may be installed.

Throttling lip: The long throttling lip on the disc retards the flow when the seating position is approached. Disc chattering is prevented and wiredrawing of the seating surfaces is reduced.

Seat: Flat seats facilitate true seating; they are readily removed and can be easily reconditioned.

Regrinding: Tapped bosses on top of the disc enable nipples or eyebolts to be inserted to facilitate removal of the disc and regrinding.



Section showing disc in partly opened position

Dashpot: Self-contained in liner. An effective cushion for the disc to prevent pipe line vibrations, or hammering on the seat, at low velocities or on pulsating loads.

Dashpot vent: The vent acts as a governor to control the disc speed and assure smooth action.

Disc: The one moving part. Made in one piece and cylindrical in shape it has ample guiding surface. It is light in weight and especially designed to produce a maximum lift at minimum velocities. Free of wing guides which cause "spinning" and rapid wear.

Ports: Large port areas produce only a minimum of pressure drop through the valve. They assure unrestricted movement of the disc.

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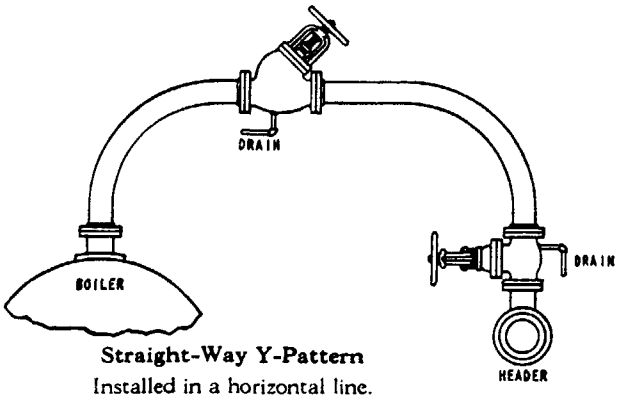
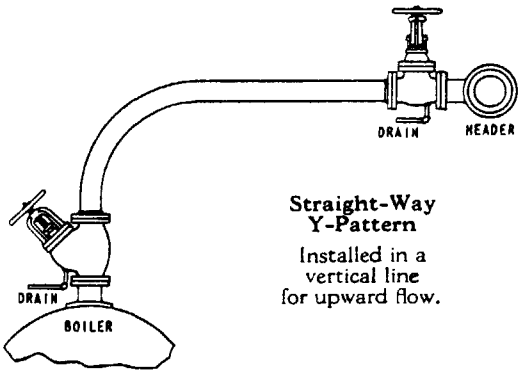
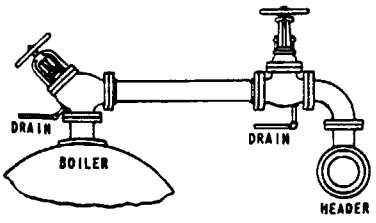
Recommendations for Installation



Straight-Way Y-Pattern
Installed in a horizontal line.



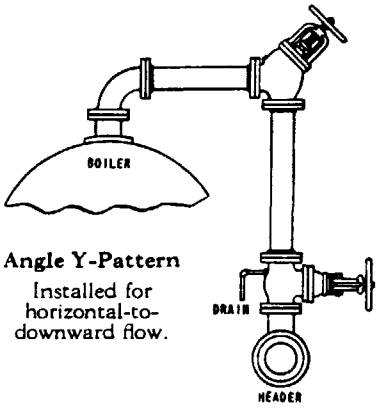
Straight-Way Y-Pattern
Installed in a vertical line for upward flow.



Angle Y-Pattern
Installed for upward-to-horizontal flow.

Crane 250-Pound Ferrosteel and 300-Pound Cast Steel Stop-Check Valves are available in two styles, the Straight-Way Y-Pattern and the Angle Y-Pattern. Each style can be used in two positions in a boiler installation as illustrated in the diagrams.

The proper method for draining is shown for each of the four positions.



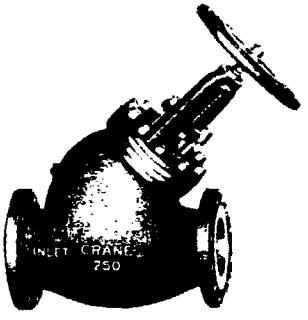
Angle Y-Pattern
Installed for horizontal-to-downward flow.

Selecting Size of Crane Stop-Check Valves **page 563**

250-Pound Ferrosteel Stop-Check Valves

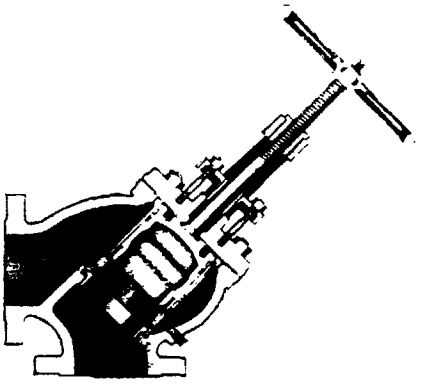
WORKING PRESSURE
250 pounds steam, 450° F. maximum temperature

TEST PRESSURES
Shell test — 500 pounds hydrostatic
Seat test — 375 pounds hydrostatic



No. 28 E
Straight-Way Y-Pattern

Important
The size of a Stop-Check Valve should be based on the boiler capacity, rather than on the size of the boiler outlet or existing piping. See "Selecting Size of Stop-Check Valve" on page 563.



Cross Section
No. 30 E
Angle Y-Pattern

29

List Prices

Size		Inches	2½	3	4	5	6	8	10
Flanged, F. & D.	No. 28 E	Each	169.00	188.00	225.00	300.00	356.00	544.00	900.00
	No. 30 E	Each	169.00	188.00	225.00	300.00	356.00	544.00	900.00

Service recommendations: Crane Stop-Check Valves are recommended for use in the pipe line between each boiler and the main steam header, when more than one boiler supplies the same header. For complete explanation of this service, see page 294.

In addition, these valves render excellent service in discharge lines from boiler feed pumps or from other high pressure pumps where a high quality check valve is desired.

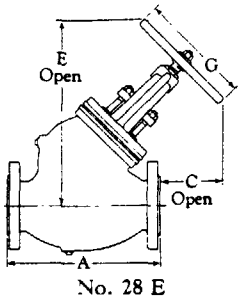
Straight-Way Valves may be used in horizontal lines or in vertical lines for upward flow. Angle Valves are suited for horizontal-to-downward flow or for upward-to-horizontal flow. For recommendations on installation, see page 295.

Materials and construction: These valves have a Ferrosteel body, bonnet, and yoke; the renewable liner is made of cast iron; the disc is brass on sizes 5-inch and smaller and iron with a large brass seating face on sizes 6-inch and larger; the seat ring is brass; and the stem is of cold rolled steel, nickel-plated. 8 and 10-inch sizes have a hammer-blow handwheel.

Flange dimensions and drilling: The end flanges on these valves conform to the American Cast Iron Flange Standard, Class 250 (B16b-1944). They are furnished faced and drilled unless otherwise ordered.

List prices include facing and drilling to this standard, and no deduction is made if valves are ordered faced only.

Flange facing: The valves are regularly furnished with an American Standard 1/16-inch raised face on the end flanges, finished with concentric grooves, approximately 16 grooves per inch, known as a "serrated" finish.

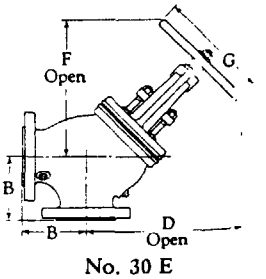


No. 28 E

Dimensions, in Inches

Size	2½	3	4	5	6	8	10
*A	13	14¾	17	19	21½	26	30
*B	5¾	6¼	7	7⅞	8¾	10½	12¼
C	6½	7½	8	10½	12	16½	18
D	14½	16½	18½	22	26	33	38
E	17½	19½	21½	25½	29½	37	42½
F	13	14½	16	19½	22	28	33
G	9	10	10	14	16	20	20

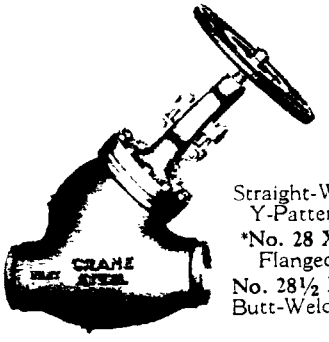
*Dimensions "A" and "B" include the 1/16-inch raised face on the end flanges.



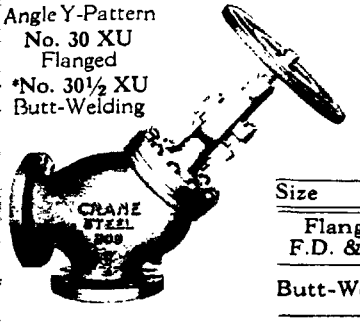
No. 30 E

General description and features . pages 294 and 295
Dimensions of end flanges page 440
Templates for drilling page 410

300-Pound Cast Steel Stop-Check Valves



Straight-Way Y-Pattern
*No. 28 XU Flanged
No. 28½ XU Butt-Welding



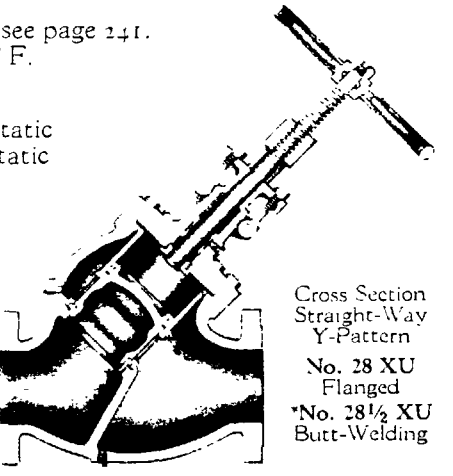
Angle Y-Pattern
No. 30 XU Flanged
*No. 30½ XU Butt-Welding

WORKING PRESSURES
Same as Steel Globe and Angle Valves; see page 241.
Maximum Temperature 850° F.

TEST PRESSURES
Shell test — 900 pounds hydrostatic
Seat test — 450 pounds hydrostatic
100 pounds air-under-water

Valves suitable for 1000° F. maximum temperature can be made to order; prices on application.

Important
The size of a Stop-Check Valve should be based on the boiler capacity, rather than on the size of the boiler outlet or existing piping. See "Selecting Size of Stop-Check Valve" on page 563.



Cross Section Straight-Way Y-Pattern
No. 28 XU Flanged
*No. 28½ XU Butt-Welding

*Asterisk indicates valve is not illustrated.

29

List Prices

Size		Inches	2½	†3	4	5	6	8	10
Flanged, F.D. & S.F.	No. 28 XU	Each	428.00	523.00	700.00	855.00	1070.00	1607.00	2417.00
	No. 30 XU	Each	428.00	523.00	700.00	855.00	1070.00	1607.00	2417.00
Butt-Welding	No. 28½ XU	Each	428.00	523.00	700.00	855.00	1070.00	1607.00	2417.00
	No. 30½ XU	Each	428.00	523.00	700.00	855.00	1070.00	1607.00	2417.00

Service recommendations: Crane 300-Pound Cast Steel Stop-Check Valves perform all the duties of a non-return boiler stop valve efficiently and completely. For explanation, see page 294.

Wherever check valves of outstanding quality are desired, such as in discharge lines from boiler feed pumps or from other high pressure pumps, these valves render excellent service.

Straight-Way Valves may be used in horizontal lines or in vertical lines for upward flow. Angle Valves may be used for upward-horizontal flow or for horizontal-downward flow. See page 295 for installation.

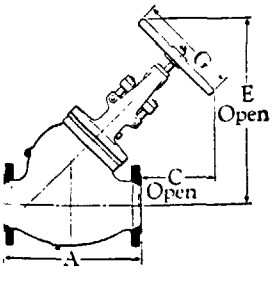
Materials and construction: These valves have high quality materials throughout. The body, bonnet, and removable liner are Crane No. 4 Carbon-Molybdenum Alloy Steel; the stem and the seat ring are Exelloy; the disc is Stellite faced No. 4 Steel; and the yoke bushing is cast manganese bronze. Triplex Steel studs equip the bonnet joint; 8 and 10-inch sizes have a hammer-blow handwheel.

Flanged valves: The end flanges on flanged valves conform to the American Standard for 300-Pound Steel Pipe Flanges and Flanged Fittings, B16e-1939. They are furnished faced, drilled, and spot faced (F.D. & S.F.), having an American Standard 1/16-inch raised face, finished with concentric grooves, approximately 32 grooves per inch, known as a "serrated" finish.

A smooth finish on the 1/16-inch raised face or ring joint, male, female, or other types of facing can be furnished when so ordered; see the Crane Discount Sheet for prices.

†3-inch Cranelap Joints: When 3-inch 300-Pound Valves with ring joint facing are to be bolted to Cranelap Joints, orders must so specify; they require a groove of special diameter. See page 450 for dimensions.

Butt-welding valves: Butt-welding valves have the ends bored to match the inside diameter of Standard pipe (heaviest weight on 8 and 10-inch sizes).



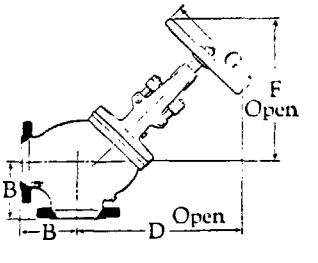
Straight-Way Y-Pattern
Flanged or Butt-Welding

Dimensions, in Inches

Size	2½	3	4	5	6	8	10
‡A	13	14¾	17	19	21½	26	30
‡B	5¾	6¼	7	7⅞	8¾	10½	12¼
C	9½	9½	12½	13½	16	20	23
D	17½	18½	23	25	29½	36½	43
E	20½	21½	26½	29	33½	40½	47½
F	16	16½	21	22½	26½	32	38
G	10	10	14	16	18	20	20

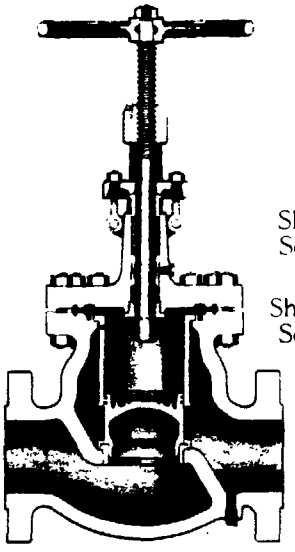
‡"A" and "B" include the 1/16 inch raised face on the end flanges.

General description and features ..... ***pages 294 and 295***
Dimensions of end flanges ..... ***page 441***
Templates for drilling ..... ***page 441***



Angle Y-Pattern
Flanged or Butt-Welding

400 and 600-Pound
Cast Steel Stop-Check Valves



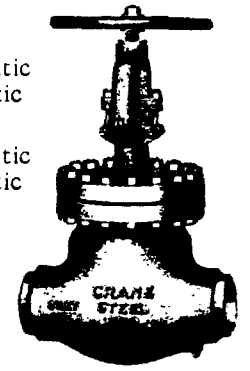
Cross Section, Globe Pattern
400-Pound
No. 164 U, Flanged
*No. 164½ U, Butt-Welding
600-Pound
No. 179 U, Flanged
*No. 179½ U, Butt-Welding

WORKING PRESSURES
Same as Steel Globe and Angle Valves, see page 241.
Maximum Temperature, 950° F.

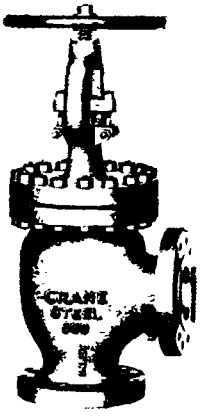
TEST PRESSURES
400-Pound Valves
Shell test — 1200 pounds hydrostatic
Seat test — 600 pounds hydrostatic
600-Pound Valves
Shell test — 1800 pounds hydrostatic
Seat test — 900 pounds hydrostatic
All valves are tested
100 pounds air-under-water

Important
The size of a Stop-Check Valve should be based upon the boiler capacity, rather than on the size of the boiler outlet or existing piping. See "Selecting Size of Stop-Check Valve" on page 563.

For proper operation, valves must be installed with the stem in a vertical position.



400-Pound Globe Pattern
*No. 164 U, Flanged
*No. 164½ U, Butt-Welding
600-Pound Globe Pattern
*No. 179 U, Flanged
No. 179½ U, Butt-Welding



400-Pound Angle Pattern
*No. 166 U, Flanged
*No. 166½ U, Butt-Welding
600-Pound Angle Pattern
No. 180 U, Flanged
*No. 180½ U, Butt-Welding

*Asterisk indicates valve is not illustrated

List Prices, Each, and Dimensions

Size		Inches	2½	†3	4	5	6	8	10	12
Flanged, F.D. & S.F.	Nos. 164 U or 166 U, 400-Pound				803.00	1056.00	1228.00	1802.00	2907.00	4790.00
	Nos. 179 U or 180 U, 600-Pound		532.00	606.00	983.00	1294.00	1507.00	2227.00	4037.00	5977.00
Butt-Welding	Nos. 164½ U or 166½ U, 400-Pound				803.00	1056.00	1228.00	1802.00	2907.00	4790.00
	Nos. 179½ U or 180½ U, 600-Pound		532.00	606.00	983.00	1294.00	1507.00	2227.00	4037.00	5977.00
Dimensions, in Inches	Globe	‡Face to face, or end to end	13	14	18	20½	23	28	32½	42
		Center to top, open	24	26¼	28¾	33	37½	47½	56½	66¾
	Angle	‡Center to face, or center to end	6½	7	9	10¼	11½	14	16¼	21
		Center to top, open	23¾	26	28	32	36	44¾	53½	63½
	Diameter of wheel		10	12	14	16	20	26	30	30

‡Face to face and center to face dimensions include the ¼-inch male face on the end flanges.

Materials and construction: The materials from which the parts of these valves are made are of exceptionally high quality. Crane No. 4 Carbon-Molybdenum Alloy Steel body, bonnet, and liner; Stellite faced No. 4 Alloy seat and disc; and Exelloy stem. The bonnet joint utilizes a soft steel ring joint gasket and Crane Templex Steel bolt-studs.

The general construction of these valves follows those described on pages 294 and 295, except for the stem position, the bonnet joint, and the materials. 400-Pound Valves 8-inch and larger and 600-Pound Valves 6-inch and larger have a hammer-blow handwheel.

Flanged valves: The end flanges on 400 and 600-Pound Flanged Valves conform respectively to the 400 and 600-Pound American Standards for Steel Pipe Flanges and Flanged Fittings, B16e-1939. The valves are furnished faced, drilled, and spot faced (F.D. & S.F.), and have an American Standard ¼-inch male face (large male) on the end flanges, finished with concentric grooves, approximately 33 grooves per inch, known as a "serrated" finish.

A smooth finish or ring joint, female, or other types of facing can be furnished; see the Crane Discount Sheet for prices.

†3-inch Cranelap Joints: When 3-inch 600-Pound Valves with ring joint facing are to be bolted to Cranelap Joints, orders must specify; they require a groove of special diameter; dimensions on page 450.

Butt-welding valves: Orders for butt-welding valves must specify the inside diameter of the pipe or its wall thickness so that the valve ends can be bored to match the pipe.

900 and 1500-Pound Pressure-Seal Bonnet Alloy Cast Steel Stop-Check Valves

For higher pressures, Crane has developed a new Pressure-Seal Bonnet Valve. For complete description, see pages 218 and 219.

General description and features ***pages 294 and 295***
Templates for drilling ***page 442***
Dimensions of end flanges ***page 442***

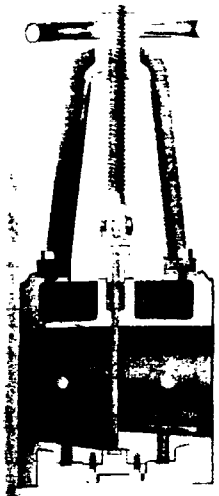
Iron Body Pulp Stock Valves

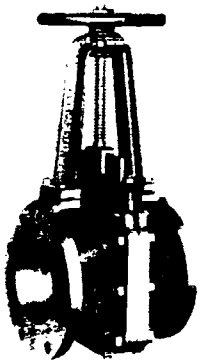
Brass Trimmed or All-Iron

Outside Screw, Rising Stem

Patented

Quick Opening





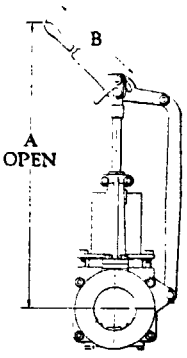
No. 1425, Flanged Brass Trimmed

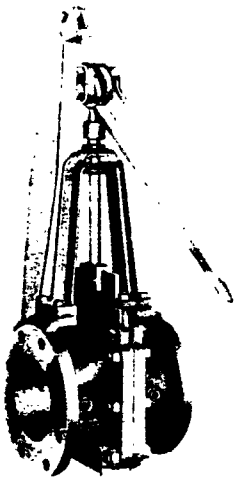
No. 1427, Flanged All-Iron

60 pounds
water working pressure

FEATURES
Self-Cleaning—Non-Clogging
Easy Operating
Full Port Area
Tapped Openings
for Flushing Cleanout

Iron Body Pulp Stock Valves are especially designed for lines carrying pulp stock in pulp and paper mills. All-iron valves are for use where the liquids would corrode brass but not iron.





No. 1429, Flanged Brass Trimmed

No. 1431, Flanged All-Iron

29

List Prices, and Dimensions, in Inches

Size Inches		4	6	8	10	12	14	16	18	20	24
Price, Each F. & D.	No. 1425, Brass Trimmed	195.00	235.00	315.00	410.00	520.00	655.00	815.00	1100.00	1730.00	2450.00
	No. 1427, All-Iron	215.00	260.00	345.00	450.00	570.00	715.00	900.00	1200.00	1900.00	2700.00
	No. 1429, Brass Trimmed	215.00	265.00	355.00	460.00	580.00	735.00	920.00			
	No. 1431, All-Iron	235.00	290.00	385.00	500.00	630.00	795.00	1000.00			
Face to face		9	10½	11½	13	14	15	16	17	18	20
O. S. & Y.	Center to top, open	22¼	27½	34⅞	41	47¾	52⅝	58¼	64	72	85¼
	Diameter of wheel	10	10	12	14	16	16	18	20	20	30
Quick Opening	A	33¼	43¼	57	68¾	80¾	90½	95			
	B	12	23	29	41	41	41	41			
Size of six tapped openings		½	½	¾	¾	¾	¾	¾	¾	¾	¾
Diameter of flanges		9	11	13½	16	19	21	23½	25	27½	32
Thickness of flanges		15/16	1	1⅛	1 3/16	1¼	1⅜	1 7/16	1 9/16	1 11/16	1⅞
Diameter of bolt circle		7½	9½	11¾	14¼	17	18¾	21¼	22¾	25	29½
No. and diameter of bolts		8-⅝	8-¾	8-¾	12-⅞	12- ⅞	12-1	16-1	16-1⅛	20-1⅛	20-1¼

Body: The cast iron body is divided on the vertical centerline and bolted together. A special gasket in the joint prevents leakage. Circular end ports and rectangular shape at the center assure full area flow.

Disc: In brass trimmed valves, the disc is brass; in all-iron valves, it is Exelloy. Made in a rectangular shape with a sharp cutting edge at the bottom, the disc is fully guided by machined slots in the body.

Stem: The stem in all these valves is made of Crane Cast Manganese Bronze. It does not come in contact with the fluid in the line.

Seat: A lead filler in the bottom of the valve acts as a seat and protects the cutting edge of the disc at the point of closing.

Self-cleaning: The lower portion of the outlet half of the body has a series of notches which entrap small units of the pulp stock; large single accumulations are avoided in closing the valve, and the cutting edge of the disc easily shears the successive small units and also any stock lodged at the seat.

Cleanout: The disc-stop holder, which carries the lead seat, is fastened to the valve with cap screws. This holder can be removed to clean out the valve.

Tapped openings: Six tapped and plugged openings on each valve body facilitate flushing the valve and pipe line when changing pulp stock.

Stuffing box: A rectangular shaped stuffing box, with a brass gland, completely surrounds the valve disc. It is unusually deep and is filled with a special packing which minimizes friction.

End flanges: End flanges conform to the American Cast Iron Flange Standard, Class 125 (B16.1-1948). Flanges are plain faced, with a smooth finish. Prices include facing and drilling. No deduction is made for valves ordered faced only.

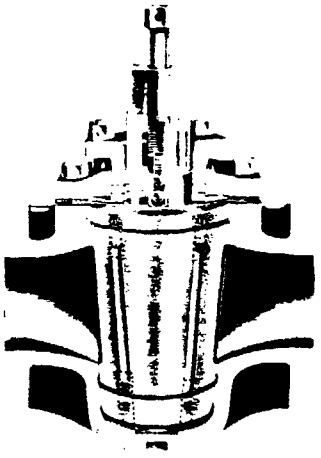
Face to face: These valves also conform to the American Standard for Face to Face Dimensions of Ferrous Flanged Valves (B16.10-1939). They will replace 125-Pound Wedge Gate Valves used on pulp stock lines without necessitating piping changes.

Gears, to facilitate operation of large size outside screw valves, can be made to order; prices on application.

Chain Wheels . page 138 *Motor Operators . . pages 129 and 132 to 135* *Floor Stands . . page 126*

Nordstrom Lubricated Plug Valves

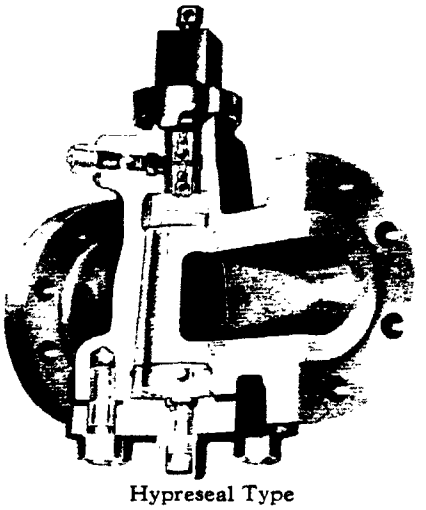
Pressure Lubricated



Standard Type

Nordstrom lubricated plug valves meet the demands of the piping industry, particularly in the petroleum, refining, gas, and chemical fields. Made in sizes from ½ to 30-inch and for pressures up to 15,000-pound test.

The functions of pressure lubrication in Nordstrom valves are: (1) hydraulic action, keeping plug in free working condition; (2) maintain positive seal against internal and external leakage; (3) free turning, even of the largest sizes and against heavy differential pressure; (4) protection of working surfaces from wear and corrosion.



Hypreseal Type

Standard Type: This valve is for industrial services in working pressures of 200 pound psi and higher.

Available with bolted gland for 4-inch sizes and larger in semi-steel and Nordco steel; with screwed gland in sizes 4-inch and smaller; screwed or flanged ends; wrench or gear operation; and Regular, Venturi, Gate Valve Replacement, or Multiport patterns.

Hypreseal Type: This valve has an inverted, full-floating plug, with separate adjusting and rotating members located at opposite ends of the plug. The stem is independent of the plug, except that the two parts are coupled as to rotation by a floating equalizer ring. A plastic packing, injected under pressure, applies a plastic seal on stem threads. This valve can be repacked under full working pressure.



No. 142



No. 143



*No. 143



*No. 149



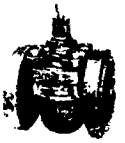
No. 114



No. 115



No. 167



No. 305



No. 524



No. 525

Features

Non-Sticking Plug: In all Nordstrom valves, lubricant forced in under pressure produces a momentary unseating movement of the plug, which overcomes any adhesion and, because of the taper, creates space for a lubricant film between plug and body. The unseating occurs only at the time of lubrication; therefore, the seat is not exposed to line fluid.

The tapered form of plug and seat provides an intimate fit, regardless of the absence of a lubricant or of the thickness of lubricant film.

Positive Rotary Action: These valves are built on the tapered rotary principle. The taper of the plug and seat maintains an intimate working contact between the two parts at all times. Since the valve is opened and closed by rotation only, and not by raising and lowering the movable valve member, the vital seating surfaces are self-protecting and self-cleaning

Semi-Steel Valves

No.	Size Inches	Ends	Working Pressure Pounds SWP	Working Pressure Pounds WOG	Test Pressure Pounds	Operation
142	1 to 4	Screwed		175	350	Wrench
143	1 to 4	Flanged		175	350	Wrench
*143	6 to 12	Flanged	125	200	400	Wrench
*149	6 to 12	Flanged	125	200	400	Worm Gear
114	½ to 3	Screwed	125	200	400	Wrench
115	1 to 4	Flanged	125	200	400	Wrench
167	4 to 12	Flanged	125	200	400	Spur Gear
167	14 and 16	Flanged	125	175	350	Worm Gear
214	½ to 3	Screwed	250	400	800	Wrench
305	2 to 4	Flanged	250	400	800	Wrench
524	½ to 4	Screwed	250	500	1000	Wrench
824	½ to 4	Screwed		800	1600	Wrench
†2815	1 to 3	Flanged		150	300	Wrench
†2965	4 and 6	Flanged		250	500	Wrench
23141	2 to 4	Dresser		175	350	Wrench
24191	6 and 8	Dresser		200	400	Wrench

*Short Venturi Pattern. †Steam-Jacketed.

Prices on application

Nordstrom Lubricated Plug Valves (Cont.)


No. 824


No. 2815


No. 2965


No. 23141


No. 24191


No. 1924


No. 1925

Steel Valves

No.	Size, Inches	Ends	Steel	A.S.A. Rating	Operation
1924	2 to 4	Screwed	Carbon	150	Wrench
1925	1 to 4	Flanged	Carbon	150	Wrench
1985	6 and 8	Flanged	Carbon	150	Wrench
1989	6 to 12	Flanged	Carbon	150	Worm Gear
*4169	10 to 24	Flanged	Carbon	150	Worm Gear
2024	½ to 4	Screwed	Carbon	300	Wrench
2025	1 to 4	Flanged	Carbon	300	Wrench
†1945	2 to 6	Flanged	Carbon	150	Wrench
†1949	6 to 12	Flanged	Carbon	150	Worm Gear
*†4249	10 to 16	Flanged	Carbon	300	Worm Gear

*Venturi Pattern. †Hypreseal.


No. 1985


No. 1989


No. 4169


No. 2024

29

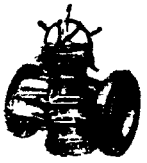
Semi-Steel Multiport Valves

No.	Size Inches	Ends	Working Pressure Pounds SWP	Working Pressure Pounds WOG	Test Pressure Pounds	Port	Operation
3402	½ to 2½	Screwed	125	200	400	3-way, 2-port	Wrench
3412	½ to 2½	Screwed	125	200	400	3-way, 3-port	Wrench
3422	½ to 2½	Screwed	125	200	400	4-way	Wrench
3403	1½ to 2½	Flanged	125	200	400	3-way, 3-port	Wrench
3413	1½ to 2½	Flanged	125	200	400	3-way, 3-port	Wrench
3423	1½ to 2½	Flanged	125	200	400	4-way	Wrench
3469	6 to 12	Flanged	125	200	400	3-way, 2-port	Worm Gear
	16	Flanged	125	175	350	3-way, 2-port	Worm Gear
3479	6 to 12	Flanged	125	200	400	3-way, 3-port	Worm Gear
	16	Flanged	125	175	350	3-way, 3-port	Worm Gear
3489	6 to 12	Flanged	125	200	400	4-way	Worm Gear
	16	Flanged	125	175	350	4-way	Worm Gear


No. 2025


No. 1945


No. 1949


No. 4249

Carbon Steel Multiport Valves

No.	Size, Inches	Ends	A.S.A. Rating	Port	Operation
4802	½ to 2½	Screwed	300	3-way, 2-port	Wrench
4812	½ to 2½	Screwed	300	3-way, 3-port	Wrench
4822	½ to 2½	Screwed	300	4-way	Wrench
4803	1½ to 2½	Flanged	300	3-way, 2-port	Wrench
4813	1½ to 2½	Flanged	300	3-way, 3-port	Wrench
4823	1½ to 2½	Flanged	300	4-way	Wrench


No. 3402
No. 3412
No. 3422


No. 3403
No. 3413
No. 3423

Air, Meter, Gauge, and Service Cocks

No.	Type	Size Inches	Ends	Working Pressure Pounds WOG	Operation
1018	Meter & Air Cocks	½, ¾, 1	Screwed	125	Wrench
1004	Service Cocks	¾ to 1½	Screwed	40	Wrench
1036	Service Cocks	¾ to 2	Dresser	40	Wrench
2222	Gauge Cocks	¼, ⅜, ½	Screwed	2000	Wrench


No. 3469
No. 3479
No. 3489


No. 4802
No. 4812
No. 4822


No. 1018


No. 1004


No. 1036


No. 2222

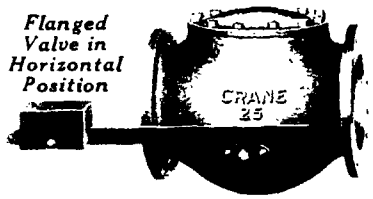
Merchrome Coated Valves: For extreme conditions of temperature, corrosion and abrasion, Merchrome process is used to apply a hard, corrosion-resisting coating to the plug and body seating surfaces. This coating offers the lowest co-efficient of friction, and prevents galling and scoring. These coated valves handle temperatures up to 1000° F. Merchrome coating is also applied to stainless steel valves to prevent galling.

Nordcoseal Valve Lubricants: To insure best operation of Nordstrom valves, special Nordcoseal lubricants have been developed for various services. Lubricant recommendations for each service will be given upon request.

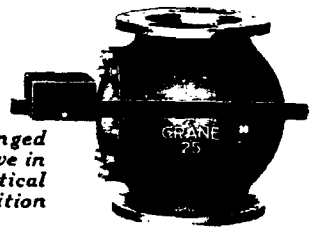
Prices on application

Iron Body Back Pressure Valves

Weighted for back pressures up to 5 pounds



Flanged Valve in Horizontal Position



Flanged Valve in Vertical Position

29

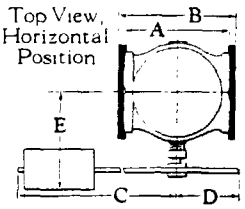
No. 384, Screwed (Not Illustrated)
No. 385, Flanged (Illustrated)

Screwed valves are used only in a vertical position. Flanged valves can be used in a horizontal or vertical position (the vertical position is preferred because wear is reduced).

Service recommendations: These valves are ideal for use on non-condensing engine installations, where the exhaust steam is largely used for heating, and where the valve, therefore, is not called upon to operate frequently. For vacuum service, use Spring Loaded Valves shown below.

Construction: The valves have an iron body, cap, and weight, and a brass seat and disc or disc face. The lever, made of malleable iron, and an adjustable weight are mounted on the cap on screwed valves (not illustrated) and on the side of the valve body on flanged valves.

Dimensions of end flanges conform to the American Cast Iron Flange Standard, Class 125 (B16.1-1948). Flanges are plain faced, with a smooth finish. Prices of flanged valves include facing and drilling to the 25-Pound American Tentative Cast Iron Flange Standard. No deduction is made for valves ordered faced only.



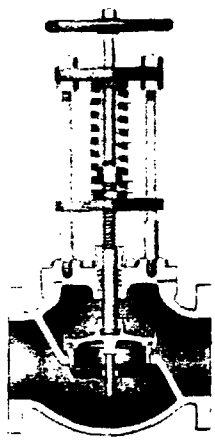
Same dimensions apply for vertical position.

List Prices, Each, and Dimensions

Size	Inches	2	2½	3	4	5	6	8
No. 384, Screwed		40.50	47.50	55.00				
No. 385, Flanged, F. & D.					95.00	135.00	172.00	328.00
Dimensions in Inches	A	6½	7	8				
	B				11½	13	14	19½
	C	12½	14¼	16¼	18¾	20½	24	26¼
	D	4	4½	5¼	7	7½	7½	9¼
	E	6½	6¾	7¾	9½	10½	11¾	14

Spring Loaded
Iron Body Relief and Back Pressure Valves

Service recommendations: These valves are used as back pressure valves between the exhaust from auxiliary engines and condensers, and as exhaust relief valves on condensers to protect the equipment if the vacuum is lost. Although they are primarily intended for marine service, they are also suitable for stationary plants.



Cross Section
No. 4387, Horizontal

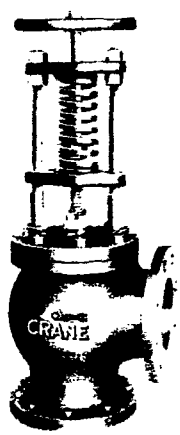
Materials: The body and bonnet are cast iron; the seat, disc, stem, gland, and stem hole bushing are brass.

Features of design: These valves have a deep stuffing box, an adjustable popping chamber which assures a high lift disc, large discharging capacity, and definite opening and closing pressures. The blow-down of pressure can be regulated without dismantling the valve.

When desired, the valves can be manually opened and left in that position; turning the handwheel to the left gradually releases the spring tension, and when the spring is no longer under compression, the disc is lifted from its seat.

Pressure setting: When relieving to atmosphere, the valves are set at any specified pressure from 10 to 35 pounds gauge. They can be used for discharging into a vacuum but are then set at a lower gauge pressure of from 1 to 20 pounds to compensate for the vacuum on the outlet side.

Information required: Orders and inquiries should specify the pressure on the inlet side, the pressure or inches of vacuum on the outlet, and the back pressure to be maintained. Capacities furnished on application.



No. 4389, Angle

List Prices and Dimensions

Size	Inches	2½	3	4	5	6	8
No. 4387 or No. 4389, F. & D.	Each	255.00	285.00	370.00	505.00	600.00	900.00
Center to face	Inches	4¼	4¾	5¾	6½	7	9¾
Center to top, open	Inches	14	16	21	25½	28	34
Diameter of wheel	Inches	6	7	9	10	10	12

Templates for drilling . . page 439

Flange dimensions and facing: The dimensions and drilling of end flanges conform to the American Cast Iron Flange Standard, Class 125 (B16.1-1948). Flanges are plain faced, with a smooth finish.

McAlear
Back Pressure and Atmospheric Relief Valves
Weight Loaded

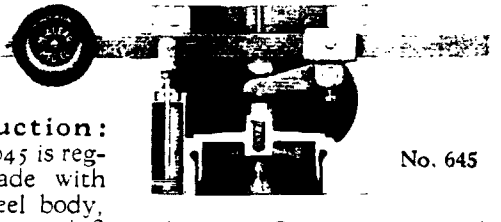
Service recommendations: The No. 645 Back Pressure Valve is of the single-seated vertical type, and is recommended for operation with condensing and non-condensing engines.

When used in connection with condensing engines, the valve will be equipped with water sealed, vacuum-tight seat rings.

When used with non-condensing engines, it will maintain automatically, within the pressure limits indicated below, any desired back pressure on the exhaust line so that the steam may be used for heating or any other low pressure service.

This valve also operates dependably as an atmospheric relief valve. When specified for this service, the valve is furnished with scale weights, in addition to the ball weight. These scale weights are placed on the opposite end of the lever so that the valve will open automatically and permit the exhaust steam to escape to atmosphere.

Operating pressures: The body of this valve will withstand steam working pressures up to 125 pounds. In sizes 2 to 8 inches it will maintain a back pressure up to 10 pounds; larger sizes, up to 6 pounds.



No. 645

Construction: The No. 645 is regularly made with a semi-steel body, brass trim, and flanged ends. Sizes 2 to 24-inch are available (12 to 24-inch with flanged door only).

Noiseless, steadied operation upon closing is assured by an outside oil dashpot.

When ordering: Specify the catalog number and size; whether the valve is for use in connection with condensing or non-condensing engines and whether for back pressure or atmospheric relief. If for back pressure, specify the pressure to be maintained and the service for which the exhaust steam is to be used.

Companion flanges are extra and are furnished only when ordered.

29

Face to Face, in Inches

Size	2	2½	3	4	6	8	10	12	14	16
Face to face	7½	7½	8½	8¾	10¼	12¼	15	15	17¼	18

Fisher Pressure Relief Valves
Spring Loaded

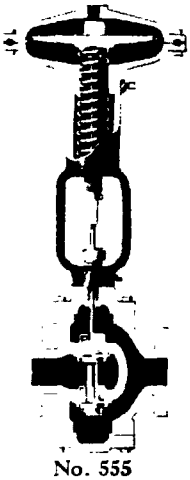
Service recommendations: The No. 555 Pressure Relief Valve is used to automatically maintain a constant upstream or back pressure. It is designed for throttling relief service on water, oil, steam, air, gas, and other fluids. A wide range of diaphragm sizes and springs allows adaptation to many back pressure installations.

Construction: The double port and balanced inner valve has beveled ground seats and is connected to the valve stem by a patented "Flexaline" connection.

Single seated bodies with either a composition disc, or with a bevel seated inner valve are also available.

The extra heavy enclosed yoke protects the spring from dirt and weather. A long, high quality steel spring assures freedom from any change in the control point.

The diaphragm can be installed either above or below the pipe line. The inner valve is inverted; the body can be easily turned over for conversion to a reducing valve.



No. 555

Body and Trimming Available, Range of Sizes, and Ratings

Body and Trimming Available			Range of Sizes	Working Pressures * Psi	Deg. F.	Psi	Deg. F.
Bronze or High-Tensile Iron Body With Bronze or Stainless Steel Trim	Screwed		½ to 2-inch	250	410°	400	100°
	Flanged	125-Pound	1 to 5-inch	125	360°	175	100°
			6 to 10-inch	100	340°	175	100°
		250-Pound	1 to 10-inch	250	410°	400	100°
Cast Steel Body with Stainless Steel Trim	Screwed		½ to 2-inch	600	750°	1000	100°
	Flanged	150-Pound	1 to 10-inch	150	500°	230	100°
		300-Pound	1 to 10-inch	300	750°	500	100°
		400-Pound	1 to 10-inch	400	750°	670	100°
		600-Pound	1 to 10-inch	600	750°	1000	100°

Relief Pressure Ranges

Nominally Standard

½ to 3 psi
2 to 5 psi
3 to 10 psi
5 to 15 psi
10 to 30 psi
20 to 55 psi
30 to 85 psi
40 to 100 psi

Prices on application

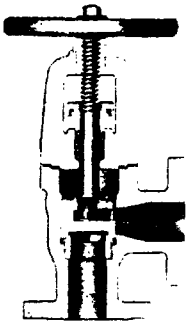
250-Pound Ferrosteel Blow-Off Valves

WORKING PRESSURE
250 pounds boiler blow-off service

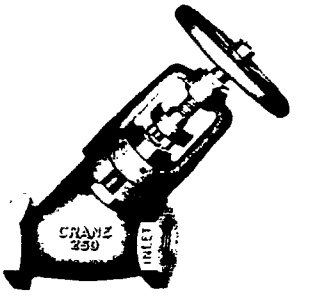
HYDROSTATIC TEST PRESSURES
550 pounds seat — 800 pounds shell

BOILER CODE REQUIREMENTS

Nos. 393 and 393½ Y-Pattern Valves do not comply with the requirements of the 1946 edition of the A.S.M.E. Boiler Code. Nos. 390 and 391 Valves comply with the Code for bottom blow-off, except that the maximum allowable working pressure under the Code is 200 pounds instead of 250.



Angle
No. 390, Screwed
No. 391, Flanged



Y-Pattern
No. 393, Screwed
No. 393½, Flanged

List Prices, Each

Size		Inches	1½	2	2½
Angle	No. 390, Screwed		36.50	45.50	61.00
	No. 391, Flanged, F. & D.		40.00	50.00	67.00
Y-Pattern	No. 393, Screwed		36.50	45.50	61.00
	No. 393½, Flanged, F. & D.		40.00	50.00	67.00
Replacement Parts	Body Seat Ring		2.00	2.70	3.50
	Disc		4.40	5.20	6.00

29

Service recommendations: These valves have been particularly designed for boiler blow-off service, but are also well suited for blow-off service on tanks or receivers where dirty, gritty water is to be handled.

Features of construction: The valves are made with renewable seat and a slip-on disc, in order to permit quick repair. Contrary to ordinary globe valve construction, the seating surface in these valves is on the outside of the seat ring where it is protected from the cutting effect of the water passing the seat.

The bonnet is held to the body with two bolts, which facilitates dismantling the valve for inspection and repair. The outside screw and yoke construction keeps the stem threads outside the flow of water; it improves the life of the stem threads and prevents the valves from becoming inoperative due to scale and foreign matter jamming the threads. All parts of these valves are sturdily constructed.

The stuffing box is unusually deep and holds ample high grade packing, eliminating frequent repacking.

Materials: The body and bonnet are Ferrosteel, an exceptionally high grade cast iron; the disc and body seat ring are of cast iron, which has proven very satisfactory for blow-off service; the stem and packing gland are brass and the gland flange is malleable iron.

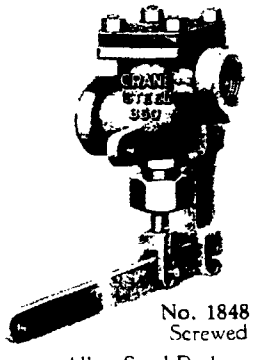
Flange dimensions and drilling: The end flanges on flanged valves conform to the American Cast Iron Flange Standard, Class 250 (No. B16b-1944). They have a 1/16-inch raised face, and are furnished faced and drilled (F. & D.).

Dimensions, in Inches

Size		1½	2	2½	Size		1½	2	2½
Angle Valves	Center to end, No. 390	4	4½	5	Y-Pattern Valves	End to end, No. 393	7¼	8	9½
	Center to face, No. 391	4½	5	5¾		Face to face, No. 393½	9⅞	11	12¼
	Center to top, open	12½	13¾	15½		Center to rim of wheel, open	12¾	14	15¾
	Diameter of wheel	8	9	10		Diameter of wheel	8	9	10

Templates for drilling and flange dimensions . . . page 440

Sliding Stem Alloy Steel Blow-Off Valve



No. 1848
Screwed

Alloy Steel Body
Excelloy Seat—Alloy Steel Stem
Stellite Faced Alloy Steel Disc

WORKING PRESSURE
350 pounds saturated steam

The No. 1848 Valve is recommended for blow-off lines on high pressure oil or gas field boilers such as are used for deep well drilling operations.

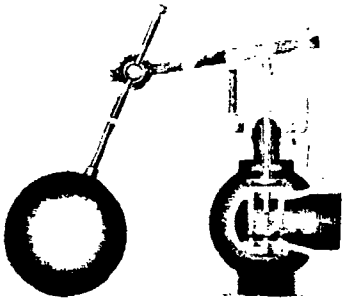
The long lever and sliding stem construction enable the user to open the valve quickly and easily. The valve closes automatically with the pressure when the lever is released. The body is Crane No. 4 Carbon-Molybdenum Alloy Cast Steel. The body seat ring is Excelloy and is renewable.

The disc and stem are made in one-piece and are alloy steel, the disc being faced with Stellite

List Price and Dimensions

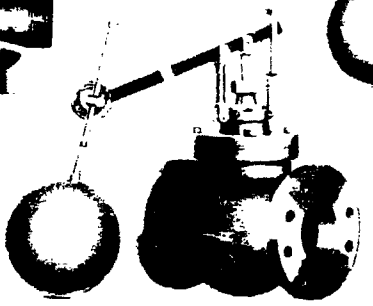
Size	Inches	2
No. 1848, Screwed	Each	146.00
End to end	Inches	6⅝
Center of stem to end of lever	Inches	17⅛

Klipfel
Tank Float Valves and Lever Valves

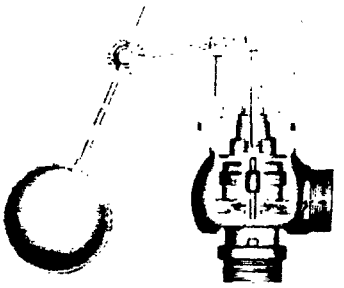


Cross Section
No. 27, Angle
Balanced

Balanced Type

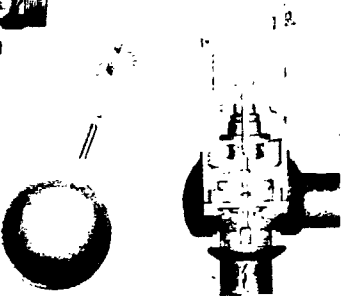


No. 27, Globe
Balanced



Cross Section
No. 7, Angle
Single Seated

Single Seated Type



Cross Section
No. 77, Angle
Single Seated

29

Available Sizes, in Inches

No. 27, Globe or Angle	Screwed Ends	½	¾	1	1¼	1½	2	2½	3						
	125-Pound Standard Flanged F. & D.						2	2½	3	4	5	6	8	10	12
No. 7, Globe or Angle	Screwed Ends		¾	1	1¼	1½	2								
No. 77, Globe or Angle	Screwed Ends						2	2½	3						
	125-Pound Standard Flanged F. & D.						2	2½	3	4	5	6	8		

Service recommendations: ***Balanced float valves*** are recommended to control the flow of hot or cold water to open tanks where a perfectly tight seating valve is not required.

Single seated float valves are designed to maintain the water level in open tanks where a tight closing valve is needed to prevent waste and overflow.

Construction: The internal construction of the No. 27 Valves embodies two beveled discs, closing on corresponding beveled seats, thus providing a practically balanced construction. Sizes 1½-inch and smaller have integral seats. Larger sizes have renewable screwed-in seats.

Single seated valves, No. 7 and No. 77, have an internal piston, disc holder, and pilot valve. The lower end of the piston forms a holder in which the composition disc is retained by a disc nut. A pilot valve, actuated by the valve stem, controls the water pressure above the piston.

As the stem is loosely attached to the piston, movements of the float also act directly to operate the main valve. Sizes 1½-inch and smaller have integral seats, larger sizes have renewable screwed-in seats.

Tank float valves must be installed with flow passing through in the direction as indicated on the valve. No. 77 has a leather cup piston seal.

Materials: All of these valves, both balanced and single seated types, have bronze bodies for sizes 1½-inch and smaller and semi-steel bodies for sizes 2-inch and larger. Excepting rubber composition discs, internal parts for all valves are bronze.

Lever valves: Valves of construction as those illustrated above, but without the float, float rod, and rosette, can be furnished for operation by other suitable mechanism or by hand. Catalog numbers are:

No. 62, lever valve; for No. 27, less float parts.
No. 73, lever valve; for No. 7, less float parts.
No. 773 lever valve; for No. 77 less float parts.

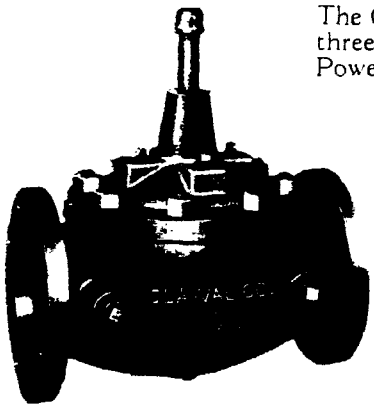
Other types of float valves: For unusual services or irregular installations, other float valves or mechanisms are available; prices and detailed information on application.

No. 177, supplied with a separate pilot valve for remote operation. Sizes 2 to 8 inches.
No. 20 float mechanism alone; consisting of float, shaft, packing box, and lever.

When ordering: Specify the catalog number, pipe size, angle or globe pattern, screwed ends, 125-pound or 250-pound flanges, inlet pressure, outlet pressure unless zero, capacity required, kind of liquid, and approximate temperature unless below 125° F.

Prices on application

Clayton Valves

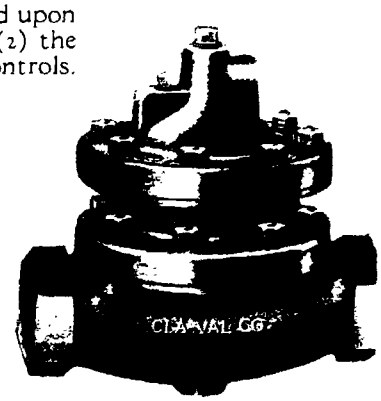


No. 100 Hy-Trol Valve

The Clayton line of valve equipment is founded upon three main elements: (1) the Hy-Trol Valve; (2) the Power-Trol Valve; and (3) Feather-Touch Controls.

The Hy-Trol is the basic valve which can be furnished with a variety of Feather-Touch Controls to simplify the control of liquids or gases for almost any application within the temperature limits of 200° F. and pressures in either the 150 or 300-pound class.

The Power-Trol, also basic, has numerous applications when used with one or more Feather-Touch Controls.



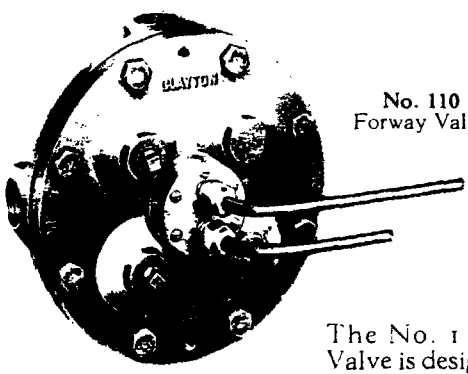
No. 100-P Power-Trol Valve

29

Hy-Trol Valve: The No. 100 Hy-Trol Valve is of a modified globe design, employing a diaphragm as the means of operation. It may be operated hydraulically or pneumatically, and may be installed in a horizontal, vertical, or inverted position. The Hy-Trol Valve is designed to handle water, oil, or gas, with either direct or remote control.

Power-Trol Valve: The No. 100-P Power-Trol Valve is designed primarily for gasoline, aromatic liquids, oils, or gases, where an independent source of pressure for both opening and closing is desirable. The pressure of the operating medium, either water or air, need be no greater than the line pressure. This valve is also used on low pressure service.

Hydraulic Forway Valve



No. 110
Forway Valve

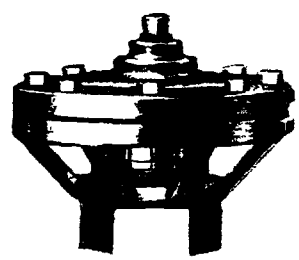
The No. 110 Forway Valve is designed to control operation of fluid motors, hydraulic cylinders, pistons, and similar power devices. It operates efficiently on either air or water at pressures up to 300 pounds per square inch, and is made in the ¾-inch pipe size only.

The Forway is actually four Hy-Trol Valves combined in one brass housing. The valve seats are brass; the diaphragm and discs are synthetic rubber.

Cla-Val pilot controls, such as the Manual, Solenoid, Float or Float Chamber, and Pressure Differential, are used to actuate the valve. The valve and pilot control provide an easy, dependable means of greatly increasing the operations that can be efficiently handled by remote hydraulic control.

The Forway Valve is installed on or near the power device, and the pilot control at a convenient remote location. The controlling fluid, transmitted by means of copper tubing, may be the same line pressure as handled by the Forway or an independent source of air or water under pressure.

Vacuum Relief Valve



No. 31
Vacuum Relief Valve

The No. 31 Vacuum Relief Valve is of the pressure type design for operation on the supply side of control valve. The stem of the valve has a tubular opening through which pressure flows to the cover chamber, forcing the diaphragm and disc assembly to the closed position.

The valve remains closed under normal pressure. It will open as soon as the pressure drops below zero and as the water flows out of the valve cover into the line, atmospheric pressure forces the valve open to admit air.

The inlet ports are designed to admit the full capacity of the valve seat area without restriction.

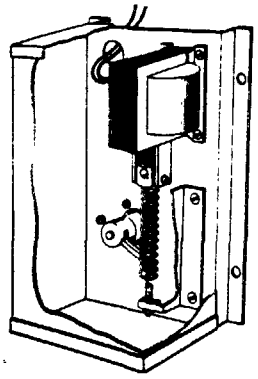
The No. 31 Valve is available in the 1-inch size, of all brass construction, and in the 2-inch size, of cast iron construction with brass working parts.

The disc and diaphragm are made of a special non-metallic material which will not stick or vulcanize to the seat.

Prices on application

Clayton Valves

Remote Controls

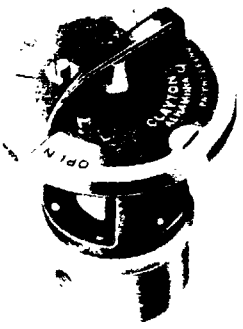


Type CS Solenoid

Type CS Solenoid Controls are used extensively for automatic operation of valves in pump lines, sprinkler systems, and automatic fire protection equipment. The electric actuator may be a float or pressure switch, time clock, or thermostat. The control is available in 110, 220, or 440 volt A.C., 50 or 60 cycles, and in a variety of D.C. voltages.

The Solenoid, ruggedly constructed for service, is housed in a steel case. Installation may be directly on the valve or at any convenient remote location.

Type CM Controls, known as Clayton Feather-Touch Controls, permit remote control of flow on Clayton Hy-Trol or Power-Trol Valves. The controls, small multi-port pilot valves, equipped with various types of actuators, are designed to transmit the flow of non-corrosive liquids or gases for hydraulic or pneumatic operation of valves.

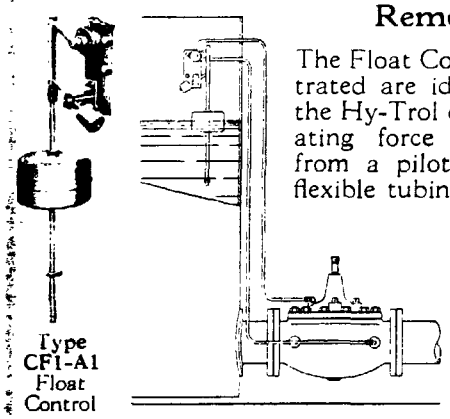


Type CM
Manual Controls

Type CM Controls are actuated manually, electrically, hydraulically, or by means of a float. These controls are available with as many as twelve outlets.

29

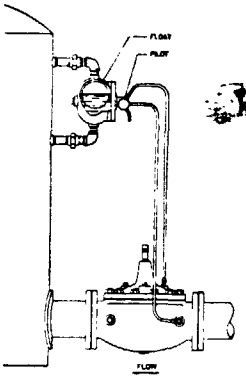
Remote Controls for Float Valves

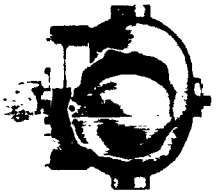


Type CF1-A1
Float
Control

The Float Control and Float Chamber illustrated are ideal for the remote control of the Hy-Trol or Power-Trol Valve. An actuating force is hydraulically transmitted from a pilot control by means of either flexible tubing or small pipe. Line pressure is generally used for operation; however, an independent source of pressure may be used.

The controls are furnished with tubing for installing valves at a 12-foot distance.



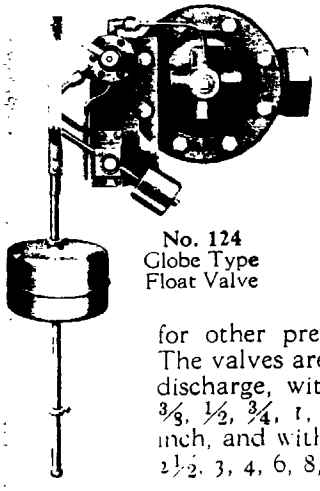


Type
CFC1-A1
Float
Chamber

Type CF1-A1 Float Control regulates the Hy-Trol Valve for open tank service. The control is mounted in the tanks; the valve is installed in the line either above or below the control. Any level differential up to 24 inches can be maintained by adjusting the upper and lower stop collars on the float rod.

Type CFC1-A1 Float Chamber is designed for use with the Hy-Trol Valve, where an external installation is desired. The vertical distance is limited by flowing pressure at the valve inlet, which is popular on feed water heaters, closed surge tanks, etc. The control is tapped for 1-inch pipe connections.

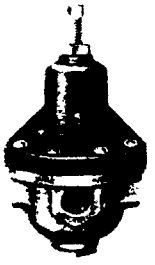
Automatic Valves



No. 124
Globe Type
Float Valve

No. 124 Float Valves, completely hydraulic in operation, automatically maintain maximum and minimum levels at any desired point. They are used for water service at moderate temperatures for pressures from 10 to 150 pounds; valves for other pressures made to order. The valves are available for horizontal discharge, with screwed ends in sizes ⅜, ½, ¾, 1, 1¼, 1½, 2, 2½, and 3-inch, and with flanged ends in sizes 2, 2½, 3, 4, 6, 8, 10, 12, 14, and 16-inch.

No. 95 Pressure Reducing Valves handle relatively small volumes of water, oil, and some gases within extremely close limits such as on drinking fountains, water coolers, humidifiers, and gas refrigerators. One inlet and two discharge outlets for straight or angle installation permit their use where gauge attachments are required.



No. 95
Pressure
Reducing Valve

The valve is spring-loaded, direct acting, with a good working area. The bronze body has a stainless steel seat.

The large diaphragm and disc are synthetic rubber. Initial pressures to 200 pounds and delivery pressures from 30 to 110 pounds are available; when not specified, the set delivery pressure is 60 pounds.

Prices on application

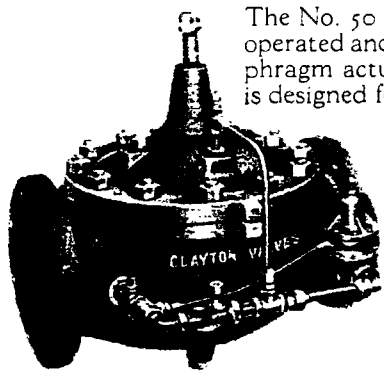
Clayton Valves

Automatic

Clayton valves are of a modified globe design, employing a diaphragm as the operating means. These valves may be either hydraulically or pneumatically operated; and installed in a horizontal, vertical or inverted position. They are designed to handle water, oil, and some gases; with either direct or remot control. Clayton valves are made in a wide range c sizes and many variations from ¼ to 3-inch, in clusive, with screwed ends: sizes 2 to 16-inch, in clusive, with flanged ends.

29

No. 50 Pressure Relief Valves

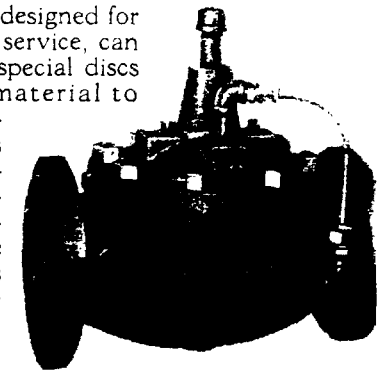


The No. 50 Valve, hydraulically operated and controlled by a diaphragm actuated pressure pilot, is designed for automatic service for relief or back-pressure duty, and will open at the pressure for which the control is set. It opens and closes without shock.

The valve may be installed so that the discharge is to atmosphere, a zone of lower pressure, a tank; or in the case of a pump installation, it may discharge into the pump suction.

This valve is set to open at 60 pounds pressure unless otherwise ordered; it can be furnished in a range of operating pressures from 5 to 300 pounds. Available sizes are: screwed ends in sizes 1, 1¼, 1½, 2, 2½, and 3-inch; flanged ends in sizes 2, 2½, 3, 4, 6, 8, 10, 12, 14, and 16-inch.

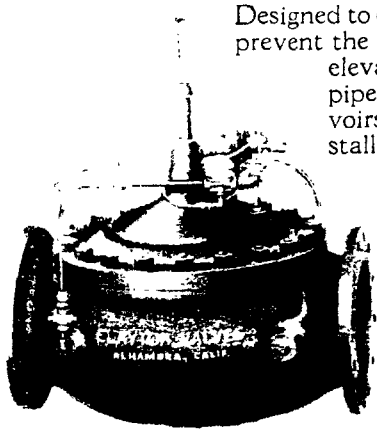
No. 81 No-Slam Check Valves



The No. 81 Valve, designed for water, oil, and air service, can be equipped with special discs and diaphragm material to handle other industrial fluids. It is highly recommended for installations with centrifugal or turbine pumps where surges and shocks must be held to a minimum. The valve opens and closes at a controlled rate of speed; for special services, this spee can be varied with a speed control or needle valv

The valve offers positive pipe line protection agains water-hammer. There are no hinged parts to stick c break, no fast moving parts to "flutter" and caus pulsations in the line, and no leakage due to outsic stuffing boxes or packing glands. This valve us the full line pressure to open and close. Installatic may be either horizontal or vertical.

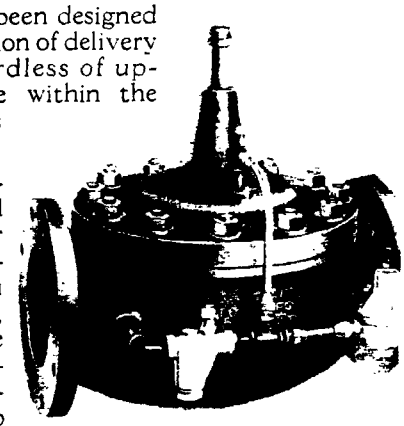
No. 206 Altitude Valves



Designed to control the level and prevent the overflow of water in elevated tanks, standpipes, or storage reservoirs, this valve is installed in the tank filling line; it automatically closes when the water reaches a predetermined level. Depending upon the type of valve, water may be withdrawn from the storage tank through a check valve, in a by-pass line around the Altitude Valve, through a separate discharge line, or, may flow back into the system through the Altitude Valve.

A hydraulic balance type of control, virtually frictionless, assures efficient control in elevated tanks or ground storage reservoirs. The valve functions dependably on low or high pressures. Sizes 2, 2½, 3, 4, 6, 8, 10, 12, 14, and 16-inch are available.

No. 90 Pressure Reducing Valves



This valve has been designed for close regulation of delivery pressure regardless of upstream pressure within the operation limits of the valve.

The valve is particularly suited for use in water distribution systems, or in a "closed" system, since it will close tight on dead-end service without any build-up in discharge.

Pilot Control springs provide a wide range o livery pressure. Unless otherwise specified, valv are factory set at 60 pounds with a delivery pressu range of 30 to 110 pounds.

Available sizes are: screwed ends in sizes 1, 1¼ 2, 2½, and 3-inch; flanged ends in sizes 2, 2½, 6, 8, 10, 12, 14, and 16-inch.

Prices on application

Safety and Relief Valves

Pop Safety Valves
- Brass, for Saturated Steam . . . page 310
- Brass, for Air and Gas . . . page 311
- Brass, for Heating Boilers, Low Pressure . . page 313
- Iron, for Heating Boilers, Low Pressure . . . page 312
- Iron, for Air and Gas . . . page 313
- Iron, for Steam, Crosby . . . page 314
- Steel, for Steam, Crosby . . . page 314

Lever and Weight Safety Valves . . . page 315

Relief Valves
- Brass, Small Sizes, for Steam, Water, and Air . . . page 316
- Brass, for Vacuum Service . . . page 317
- Brass, for Water Heaters . . . page 317
- Brass, for Steam, Water, and Oil . . . page 318
- Brass, for Air and Gas . . . page 319
- Brass, for Hydraulic Services, High Pressure . . . page 320
- Brass, for Gasoline or Noxious Gases . . . page 319
- All-Iron, for Ammonia, Air, and Gas . . . page 321
- Iron, Inside Spring, for Water and Oil . . . page 321
- Iron, Outside Spring, for Steam, Water, and Oil . . . page 322
- Iron, Crosby . . . page 324
- Steel, for Steam, Water, Oil, and Gas . . . page 323
- Steel, Crosby . . . pages 324 and 325

Cast Iron Drip Pan Elbows . . . page 315
Special Tops and Lifting Gears for Crosby Relief Valves . . page 325

For Corrosion-Resistant Alloy Relief Valves, see page 372.

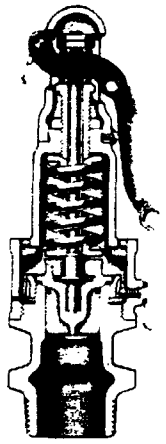
Crane Safety and Relief Valves are shown on the pages referred to above. For other Crane special duty valves and for specialties, see pages 293 to 308 and pages 327 to 364.



Crane iron body relief valves on water lines.

Brass Pop Safety Valves

For Saturated Steam



Cross Section
No. 2500



No. 2500
Top Outlet
With Wire Seal

Set at any specified pressure
from 3 to 250 pounds

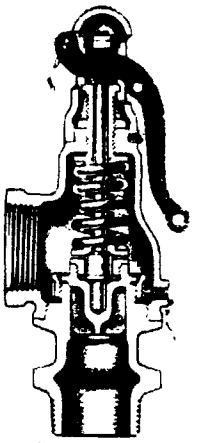
Orders must specify the set pressure as well as the catalog number.

SERVICE RECOMMENDATIONS

Crane Brass Pop Safety Valves are recommended for saturated steam for use on boilers, miniature boilers, and on unfired pressure vessels, such as receivers, pipe lines, etc.



No. 2501
Side Outlet
With Wire Seal



Cross Section
No. 2501

List Prices, Each

Size Inches	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
No. 2500, Top Outlet	15.50	15.50	17.00	20.00	23.00	29.00	40.00	57.50
No. 2501, Side Outlet	16.00	16.00	17.50	21.00	24.00	30.50	42.50	63.00

Boiler Code requirements: Valves 1/2-inch and larger comply with the 1946 A.S.M.E. Construction Codes for Power Boilers up to 250 pounds, for Miniature Boilers up to 100 pounds, and for Unfired Pressure Vessels, from 15 to 250 pounds.

Pressure setting: The screwed regulating sleeve adjustment for the main spring permits the set pressure of these valves to be increased or decreased 10 per cent; however, this maximum variation in the set pressure must be strictly observed as one spring cannot cover the complete range of pressures at which the valve may be set.

A wire seal prevents tampering with adjustments after the valves have been set at the factory.

Design: The valves are of the single disc type. All sizes except the 3/8-inch have blow-back regulating rings which permit readjustment of the blow-back when the set pressure is changed.

Materials: The valves have a brass body, base, and disc and a malleable iron lifting lever. The spring, spring washer, and stem are made of steel.

Installation: The valves should be installed in an upright position directly on the apparatus to be protected. Horizontal or angular installation may result in damage to the seating surfaces.

Piping should be carefully planned. Outlet piping should be as short as possible, with a minimum number of turns, and never smaller in size than the outlet of the valve. Inlet piping, if any is necessary, should be full size and not longer than an extra heavy fitting of equal nominal pipe size.

Lifting lever: The lifting lever is reversible and can be arranged for pull-up operation (illustrated) or reversed for push-or-pull-down operation. When installing, ample clearance should be allowed. Complete rotation of the lever is possible without disturbing the setting of the valve.

Maintenance: It is recommended that these valves be manually operated at regular intervals to assure proper action. This operation should be performed only when there is sufficient pressure available within the boiler, pressure vessel, or line to blow any accumulated foreign matter clear of the seating surfaces, particularly when starting up a new boiler.

Capacities in Pounds of Steam per Hour

90° Actual Discharge Capacity at 3% Above Set Pressure

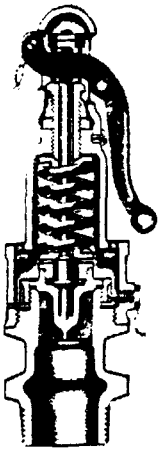
Set Pressure	Valve Size, Inches						
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
10	45	96	171	180	238	387	415
20	72	148	256	279	378	549	675
25	82	169	290	317	441	630	785
30	92	189	324	351	495	711	900
40	113	225	387	423	594	874	1105
50	135	256	414	460	646	957	1191
60	148	288	465	532	748	1100	1329
70	162	332	527	604	849	1246	1508
75	169	360	558	640	899	1246	1597
80	176	369	589	675	950	1301	1687
90	192	369	651	747	1050	1411	1866
100	210	377	683	810	1170	1466	2095
125	241	495	738	855	1440	1718	2487
150	278	559	814	1080	1440	1922	2880
175	308	603	945	1080	1561	2032	3240
200	342	621	1020	1260	1716	2301	3600
225	367	702	1095	1440	1871	2569	3960
250	392	810	1170	1620	2025	2838	4320

Capacities for other set pressures are furnished on application.

Dimensions, in Inches

Size (Size of inlet)	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
Size of outlet (No. 2501 Valve)	1/2	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
Over-all height to top of cap	6	6	6 1/2	7 7/8	7 7/8	9 1/8	10 5/8	12 3/4
Center to top of cap	3 3/4	3 3/4	3 3/4	4 5/8	4 3/8	5 1/4	6 1/8	7 3/4
Center to end of male inlet	2 1/4	2 1/4	2 3/4	3 1/4	3 1/2	3 7/8	4 1/2	5
Center to end of side outlet	1 1/8	1 1/8	1 3/8	1 5/8	1 3/4	2 1/8	2 7/16	2 7/8

Brass Safety Valves
For Air and Gas



Cross Section
No. 2550



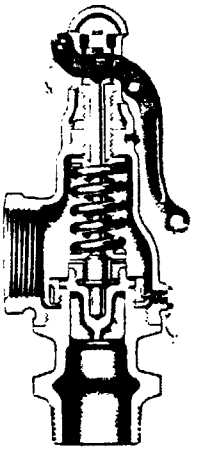
No. 2550
Top Outlet
With Wire Seal

Set at any specified pressure
from 3 to 250 pounds, 450° F. max.

SERVICE RECOMMENDATIONS
These valves are recommended for receivers, tanks, pipe lines, and similar vessels, on temperatures not exceeding 450° F. For air, either top or side outlet valves are suitable, but for gases, the side outlet type is generally used, the discharge being piped away.



No. 2551
Side Outlet
With Wire Seal



Cross Section
No. 2551

Orders must specify the set pressure as well as the catalog number.

30

List Prices, Each

Size, Inches	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
No. 2550, Top Outlet, with Wire Seal	18.50	18.50	20.00	24.00	27.00	34.00	47.50	68.00
No. 2551, Side Outlet, with Wire Seal	19.00	19.00	20.50	25.00	28.50	36.00	50.50	75.00

Pressure setting: These valves can be set at any pressure between 3 and 250 pounds. Safety valves for air and gas service always should be set 25 per cent higher than the normal operating pressure.

The main spring regulating adjustment permits increasing or decreasing the set pressure 10 per cent. This must be strictly observed as one spring cannot cover the complete range of pressures at which the valve may be set. A wire seal, inserted in the pin of the lifting lever at the factory, prevents tampering with the adjustment of the set pressure.

Design: Of the single disc type, the valves except in the 3/8-inch size have blow-back regulating rings to permit readjustment of the blow-back when the set pressure is changed. Seating surfaces are carefully prepared by grinding to assure audible tightness at all pressures up to 80 per cent of the set pressure.

Materials: The body, base, and disc are brass. The lifting lever is malleable iron. The spring, spring washer, and stem are steel.

Lifting lever: The reversible type lifting lever is illustrated above in the pull-up position; it can be reversed for push-or-pull-down operation. Complete rotation of the lever is possible without disturbing the set pressure of the valve.

Installation: Safety valves should be installed with the stem in a vertical position and preferably inverted to allow moisture to collect and seal the seating surfaces. Best results are obtained by mounting the valve directly on the apparatus to be protected without any intervening pipe or fittings between the vessel and the safety valve.

Code requirements: These valves comply with the requirements of the 1946 A.S.M.E. Code for Unfired Pressure Vessels for pressures above 15 pounds.

Capacities: Capacities are furnished on application. Inquiries should advise size, catalog number, air or gas pressure, and set pressure desired.

Maintenance: It is recommended that these valves be manually operated at regular intervals to assure proper action. This operation should be performed only when there is sufficient pressure available within the vessel or line to blow any accumulation of foreign matter clear of the seating surfaces, particularly when starting up a new installation.

Noxious gases: For noxious or inflammable gases, side outlet valves having a pressure tight outlet side are recommended. They are made to order; prices on application. Brass relief valves with side outlet are made regularly for such services; see page 310

Dimensions, in Inches

Size (Size of inlet)	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
Size of outlet (No. 2551 Valve)	1/2	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
Over-all height to top of cap	6	6	6 1/2	7 7/8	7 7/8	9 1/8	10 5/8	12 3/4
Center to top of cap	3 3/4	3 3/4	3 3/4	4 5/8	4 3/8	5 1/4	6 1/8	7 3/4
Center to end of male inlet	2 1/4	2 1/4	2 3/4	3 1/4	3 1/2	3 7/8	4 1/2	5
Center to end of side outlet	1 1/8	1 1/8	1 3/8	1 5/8	1 3/4	2 1/8	2 7/16	2 7/8

Low Pressure Iron Body Pop Safety Valves

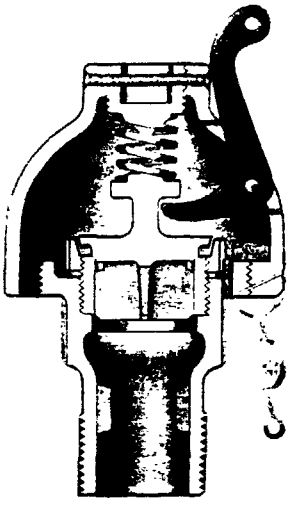
For Steam Heating Boilers

Set Pressures — Non-Adjustable

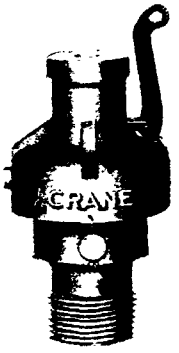
5, 10, or **15** pounds

On special order, valves can be set at any other pressure specified, between **5** and **25** pounds, at an increased price.

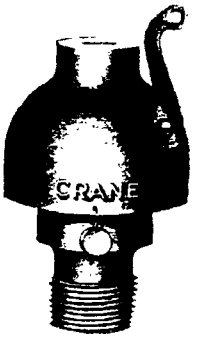
Orders must specify the set pressure and the catalog number.



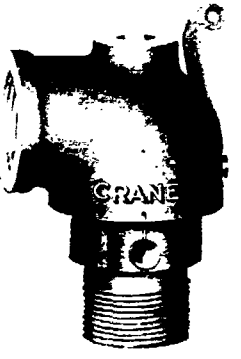
Cross Section
No. 1166



No. 1165
Up Discharge



No. 1166
Down Discharge



No. 1168
Side Outlet

All of these valves have a black enamel finish.

List Prices, Dimensions, and Capacities

Size (Size of Inlet)			Inches	¾	1	1¼	1½	2	2½	3	3½	4
No. 1165, Up Discharge			Each		8.50	9.50	12.00	16.00				
No. 1166, Down Discharge			Each	7.00	8.50	9.50	12.00	16.00				
No. 1168, Side Outlet			Each	7.50	8.50	10.00	12.00	16.00	27.00	35.50	64.00	92.50
Dimensions, in Inches	No. 1165, Over-all height				5¼	5½	6¾	7¼				
	No. 1166, Over-all height			4¾	5¼	5½	6¾	7¼				
	No. 1168	Size of side outlet		1	1¼	1¼	1½	2	2½	3	3½	4
		Over-all height		4¾	5⅛	5¼	5½	6⅞	10¾	11⅜	13⅛	14¾
		Center to end of inlet		2 15/16	3¼	3⅜	3⅝	4⅛	6	6⅞	7¾	8½
		Center to end of outlet		1⅝	1¾	2	2¼	2¾	3¼	3¾	4¼	4¾
Capacity for 5 to 15 lb. settings, lbs. steam per hour				250	410	500	620	1060	1300	2020	2820	3220

Service recommendations: These pop safety valves are particularly designed and constructed for service on low pressure steam heating boilers. They can also be used on tanks, pipe lines, receivers, etc., where safety valves are required, and where the pressure does not exceed 25 pounds.

Features of design: The valves are of the single disc type. They have a long guide integral with the bottom of the disc to assure accurate seating. The seat ring is screwed into the body and is equipped with a blow-back regulating ring which provides a means of adjusting the amount of steam the valve will relieve.

The body and base of all valves 2-inch and smaller are malleable iron and the two parts are joined in a screwed connection as illustrated above in the cross sectioned No. 1166 Valve. In sizes 2½-inch and larger the body and base are made of cast iron with a flanged and bolted connection joining the two parts. The seat and disc in all valves are made of brass.

Pressure setting: These valves are non-adjustable. After the pressure is set in the factory, the adjusting screw is locked in place with a pin, and the popping pressure cannot be altered. As a further protection against tampering by opening up the valve, a wire seal is drawn through the body and base joint.

The valves are regularly furnished for set pressures of 5, 10, or 15 pounds. When so ordered, they can be set at any other specified pressure between 5 and 25 pounds, at an increased price. Orders must specify the set pressure and the valve catalog number.

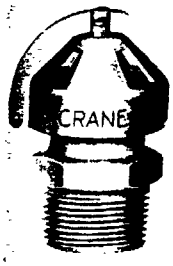
Code requirements: When these valves are set at pressures not exceeding 15 pounds, they comply with the requirements of the 1946 A.S.M.E. Code for Low Pressure Heating Boilers.

Installation: Pop safety valves should always be installed in an upright position. When side outlet valves are used in order that the discharge may be piped away, it is essential that the outlet piping be made the full size of the valve outlet tapping.

Maintenance: It is recommended that these valves be manually opened at regular intervals to assure proper action. This operation should be performed only when there is sufficient pressure available within the boiler or pressure vessel to blow any accumulated foreign matter clear of the seating surfaces, particularly when starting up a new boiler.

Low Pressure Brass Pop Safety Valves

For Steam Heating Boilers

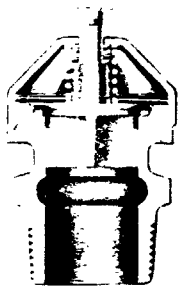


No. 2565
Open Discharge

Set Pressure — Non-Adjustable
Regularly set at **15** pounds pressure.

List Prices, Dimensions, and Capacities

Size (Size of Inlet)	Inches	¾	1	1¼	1½	2
No. 2565	Each	3.30	3.70	4.50	6.00	8.20
Overall height, open	Inches	3⅜	3⅝	4	4⅜	5¼
Capacity in pounds steam per hour		212	374	571	656	954



Cross Section

No 2565 Brass Pop Safety Valves are especially recommended for use on low pressure steam heating boilers. They are also used on tanks, receivers, pipe lines, etc. where safety valves set at 15 pounds are required.

Features: The valves, although relatively inexpensive, are particularly compact and sturdy. Made of all brass except for a steel spring, they will give excellent service if properly installed and maintained.

Pressure setting: The valves are non-adjustable. After they have been adjusted for pressure in the factory, they are permanently locked by indenting the cap into a recess in the body threads. The indentation is made with a steel stamp bearing the word "SEAL"; the valves cannot be taken apart or readjusted.

Maintenance: The valves should be manually operated at regular intervals to assure proper action. The operation should be performed only when sufficient pressure is available within the boiler to blow any accumulated foreign matter clear of the seating surfaces. This applies particularly when a new boiler is started up.

Code requirements: They comply with the requirements of the A.S.M.E. Code for Low Pressure Heating Boilers, and bear the Code cloverleaf symbol.

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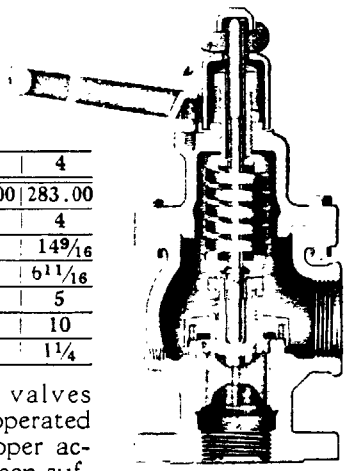
Iron Body Pop Safety Valves

For Air and Gas

Set at any specified pressure
from **5** to **150** pounds

List Prices and Dimensions

Size (Size of Inlet)	Inches	2½	3	4
No. 1102 (Inlet flange F. & D.)	Each	167.00	193.00	283.00
Size of outlet	Inches	2½	3	4
Center to top of cap	Inches	11	12	14 9/16
Center to face of inlet	Inches	5¼	5¾	6 11/16
Center to end of outlet	Inches	3⅞	4¼	5
Diameter of flange	Inches	7½	8¼	10
Thickness of flange	Inches	1	1⅛	1¼



Cross Section
No. 1102
Combination Screwed and Flanged Inlet
Screwed Side Outlet
Renewable Composition Disc

No. 1102 Pop Safety Valves are especially designed for use on air and gas receivers, pipe lines, etc. where pressures do not exceed 150 pounds.

Features of design: The valves have a renewable type Crane medium-hard composition disc to assure tight seating. A patented Crane auxiliary disc, installed directly above and acting against the main disc holder, enables the valve to accommodate large capacities with a small blow-back. Two springs control the action of this valve—a large spring for the main valve and a smaller spring for the auxiliary valve.

Pressure setting: The valves are set at any pressure specified between 5 and 150 pounds. The set pressure should be 25 per cent above the normal working pressure in the system. Orders must specify the set pressure wanted.

After the pressure is set at the factory, a wire seal is installed through the stem key to prevent removal of the cap and tampering with the adjustment.

Code requirements: These valves comply with the requirements of the A.S.M.E. Code for Unfired Pressure Vessels for pressures above 30 pounds.

Maintenance: The valves should be manually operated regularly to assure proper action, and then, only when sufficient pressure is available within the receiver or pipe line to blow any accumulated foreign matter clear of the seating surface. This applies particularly when starting up a new installation.

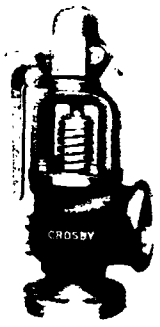
Inlet flange; drilling: The inlet flange conforms to the American Cast Iron Flange Standard, Class 250 (B16b-1944). The flange has a 1/16-inch raised face finished with concentric grooves, about 16 per inch, known as a "serrated" finish. Prices include drilling to the American Standard; no deduction is made for valves ordered "faced only".

Templates for drilling . . page 440

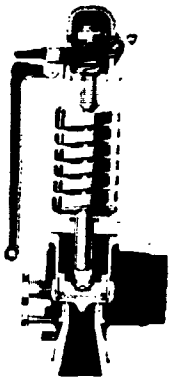
Capacities on application

Crosby Nozzle Safety Valves

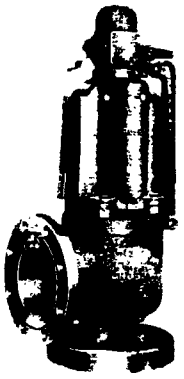
High Capacity Valves for Steam Service



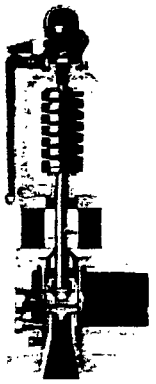
Style **HR**
Style **HO**



Industrial Service



*Marine Service
Styles **HN, HS**



Styles **HSA, HNA**

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These high capacity Safety Valves are recommended for steam only. They are ideally suited for the protection of boilers, superheaters, turbines, and pipe lines, and for general service in marine and industrial power plants and central stations.

Crosby Nozzle Safety Valves have been tested and approved by the National Board of Boiler and Pressure Vessel Inspectors.

All flanges are drilled and spot-faced according to American Standards.

The valves feature the Venturi Nozzle design, assuring smooth operation. The full throat nozzle on the steel valves provides maximum strength and freedom from distortion, with no possibility of leakage between the body and nozzle.

The disc on these valves is guided from above the seating surfaces, permitting free flow of the fluid. The nozzle and disc seating surfaces are flat and of the same width, providing absolute tightness and easy maintenance.

Further information will be furnished on request.

Style HR Valve body is made of cast iron and is available with inlet size range 2 to 4 inches, an outlet size range 2½ to 4 inches, and an inlet pressure limit of 250 pounds at 450° F. Furnished with a semi-exposed spring and regular lifting gear. A closed bonnet is furnished if specified. The semi-nozzle and disc is either made of bronze or forged stainless steel as specified.

Style HO Valve body is made of cast iron and is available with inlet size range 1½ to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 250 pounds at 450° F. Furnished with a semi-exposed spring and regular lifting gear. A closed bonnet is furnished if specified. The semi-nozzle and disc are either made of bronze or forged stainless steel as specified.

Style HNA Valve body is made of cast carbon steel or cast alloy steel depending upon temperature rating. This valve is available with inlet size range 1½ to 4 inches, an outlet size range 2 to 6 inches, and an inlet pressure limit of 600 pounds at 900°-1000° F. and 900 to 2000 pounds at 650°-1000° F. Furnished with a fully exposed spring test clamp, and regular lifting gear. The full-throat nozzle and disc insert are made of forged stainless steel. The disc holder is made of Nicoloy or Monel as specified.

Style HN Valve body is made of cast carbon steel and is available with inlet size range 1½ to 4 inches, an outlet size range 2½ to 6 inches, and an inlet pressure of 600 pounds or 900 pounds at 650°-750° F. Furnished with a fully exposed spring test clamp, and regular lifting gear. The full-throat nozzle and disc insert are made of forged stainless steel. The disc holder is made of Nicoloy or Monel as specified.

Style HSA Valve body is made of cast carbon steel or cast alloy steel depending upon temperature rating. This valve is available with inlet size range 1 to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 300, 450, or 600 pounds at 750°-900° F. Furnished with a fully exposed spring and regular lifting gear. The full-throat nozzle and disc insert are made of forged stainless steel. The disc holder is made of Nicoloy.

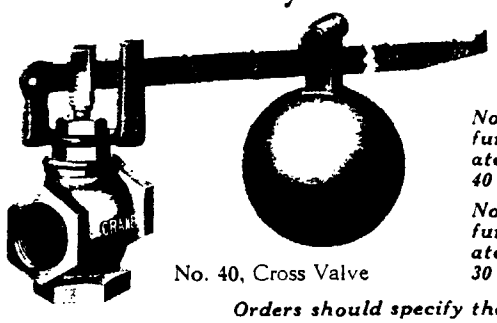
Style HS Valve body is made of cast carbon steel and is available with inlet size range 1 to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 300, 450 or 600 pounds at 650° F. Furnished with a fully exposed spring and regular lifting gear. The full-throat nozzle and disc insert are made of forged stainless steel. The disc holder is made of Nicoloy.

***Depending on orifice size, these steel valves can be furnished with spring cover and test clamp suitable for marine boiler service.**

Prices on application

Lever and Weight Safety Valves

Brass Body



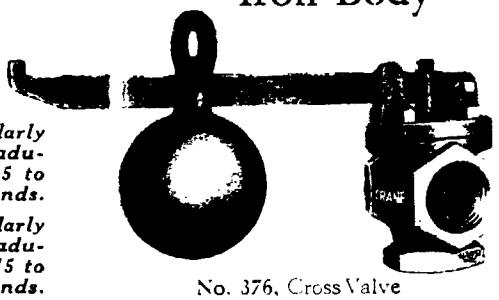
No. 40, Cross Valve

Pressure Range
15 to 100
pounds steam

No. 40 Valves are regularly furnished with levers graduated for pressures from 15 to 40 or from 41 to 100 pounds.

No. 376 Valves are regularly furnished with levers graduated for pressures from 15 to 30 or from 31 to 100 pounds.

Iron Body



No. 376, Cross Valve

Orders should specify the pressure range as well as the catalog number.

List Prices, Each, and Dimensions, in Inches

Size			Inches	¼	⅜	½	¾	1	1¼	1½	2	2½	3	4
No. 40 Valve	With Lever and Weight	For 41 to 100 pounds		6.20	7.00	9.10	10.90	13.20						
		For 15 to 40 pounds		7.70	8.40	9.00	10.80	12.60						
	Without Lever and Weight			4.50	5.20	7.00	8.40	9.80						
No. 376 Valve	With Lever and Weight	For 31 to 100 pounds							15.50	18.00	24.20	41.00	53.50	89.00
		For 15 to 30 pounds							13.20	15.70	20.50	31.80	40.30	72.00
	Without Lever and Weight								9.30	10.90	13.50	22.50	28.70	45.70
Center to end of valve				13/16	15/16	1⅛	1⅜	1⅝	2	2⅜	3¼	3½	4	5
Center to end of lever	No. 40	41 to 100 pounds		8 1/16	9 13/16	10 3/16	10 11/16	16 7/16						
		15 to 40 pounds		5¾	9 9/16	8⅝	10 15/16	11¾						
	No. 376								18	22¼	21 3/16	27⅝	35½	42⅝

For price of Levers and Weights, deduct price for "valve only" from price of "valve with lever and weight".

These valves are used for ordinary low pressure steam relief service where simple, inexpensive valves are wanted; they should not be used on air or gas.

Unlike spring-loaded pop safety and relief valves, they have large blowdown of pressure, low capacity, and no positive opening or closing point.

Pressure settings should be at least 20 per cent above the normal working pressure in the system to avoid continual leakage past the disc.

Installation: The valves have two inlet openings and one outlet. They can be installed on vertical lines with the side inlet plugged or on horizontal lines with the bottom inlet plugged. In either case, the stem must be vertical and the lever horizontal.

Materials: All parts of the No. 40 valves are brass except the cast iron yoke and weight (japanned maroon) and the steel lever.

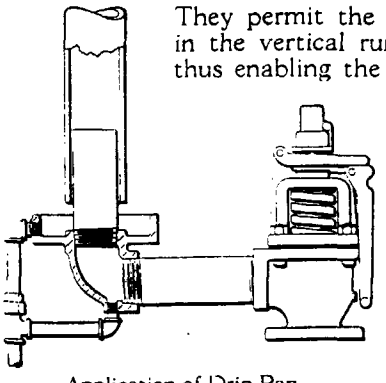
No. 376 Valves have a cast iron body and weight, a brass disc, and a steel lever. Sizes 1¼ and 1½-inch have an integral seat; larger sizes have a brass seat ring. Sizes 2-inch and smaller have a brass screwed bonnet and a brass stem; larger sizes have a bolted type cast iron bonnet and a steel stem.

Cast Iron Drip Pan Elbows

These elbows have been especially designed for use in the vent piping from the outlets of boiler safety valves discharging to atmosphere.

They permit the use of a slip joint in the vertical run of outlet piping, thus enabling the weight of the vertical piping to be supported independently. Unnecessary strains on the body of the valve are avoided and possible seat distortion is eliminated. They provide means for collecting and removing condensate and rain water from the outlet piping.

When more than one safety valve discharges into the same outlet piping, the leakage of vapor from the drip pan will indicate if any one of the valves requires attention.



Application of Drip Pan Elbow to Safety Valve Piping



No. 1100
Drip Pan Elbow

List Prices and Dimensions

Size	Inches	2	2½	3	3½	4	4½	5
No. 1100	Each	11.00	12.00	13.50	15.50	18.00	21.00	22.50
Center to inlet end	Inches	2¼	2 11/16	3⅛	3 7/16	3¾	4 1/16	4 7/16
Center to top of pan	Inches	4¾	5¼	5⅝	6 3/16	6¾	7 1/16	7 7/16
Diameter of pan	Inches	5	7	7½	8½	9	10	11
Size of drain tappings	Inches	¾	¾	¾	¾	¾	¾	¾
Length, outlet nipple	Inches	9	9	9	9	9	9	9

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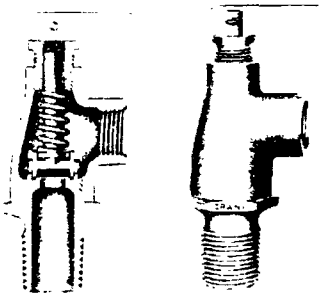
Brass Relief Valves

For Hot Water



No. 1131

Set at following pressures:

Non-Adjustable Valves

*No. 1131—**50, 75, 100,** or **125** pounds

*No. 1133½—**50, 75, 100,** or **125** pounds

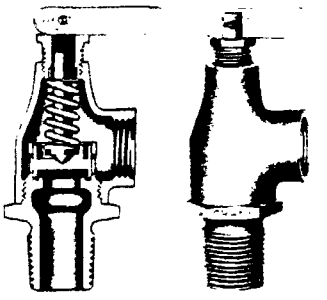
Adjustable Valves

No. A1131—**25, 50, 75,** or **125** pounds
Adjustable through ranges of 10 to 25, 26 to 50, 51 to 75, and 76 to 125 pounds

No. 1133—**25, 75,** or **125** pounds
Adjustable through ranges of 10 to 25, 30 to 75, and 80 to 125 pounds

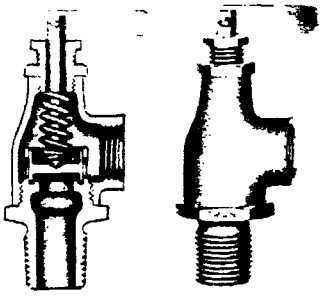
All orders must specify set pressure and catalog number.

For Cold Water



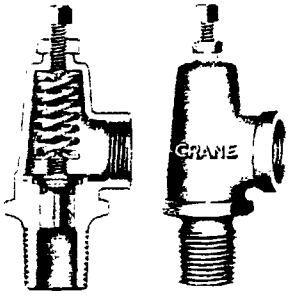
No. 1133½

For Air



No. A 1131

For Steam



No. 1133

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List Prices and Dimensions

Size (Size of inlet)			Inches	⅜	½	¾	1
List Prices	No. 1131, for Hot Water		Each		8.50	10.30	12.00
	No. A 1131, for Air		Each	10.60	10.60	13.00	
	No. 1133, for Steam		Each		8.50	10.30	
	No. 1133½, for Cold Water		Each		8.50	10.30	
Dimensions, in Inches	No. 1131	Size of outlet			⅜	½	¾
		Over-all height, closed			4 1/16	4¾	5⅛
		Center to inlet			1⅞	2 5/16	2 11/16
		Center to outlet			⅞	1 1/16	1¼
	No. A 1131	Size of outlet		⅜	½	¾	
		Over-all height, closed		4 1/16	4 9/16	4 15/16	
		Center to inlet		1¾	2	2⅜	
		Center to outlet		⅞	1 1/16	1¼	
	No. 1133	Size of outlet			½	¾	
		Over-all height			3⅞	5⅛	
		Center to inlet			1⅞	2¼	
		Center to outlet			1	1 3/16	
	No. 1133½	Size of outlet			½	¾	
		Over-all height, closed			4 7/16	4 13/16	
		Center to inlet			2	2⅜	
		Center to outlet			1 1/16	1¼	

*These valves, while non-adjustable, can be made to order set at any pressure between 10 and 125 pounds, prices on application

Recommendations: No. 1131 Valves are especially designed for use on domestic hot water heaters, but will give excellent service on any hot water line. They should not be used on steam, air, or cold water service.

No. A 1131 Valves are used on air compressors in garages, service stations, etc. where economy is wanted. They should not be used on steam or water service.

No. 1133 Valves can be recommended for steam lines when metal disc valves without lifting levers are wanted. They should not be used on air or water.

No. 1133½ Valves are particularly designed for domestic water pumping systems, and will give excellent service on cold water lines. They should not be used on hot water, steam, or air service.

Pressure setting: Nos. 1131 and 1133½ are non-adjustable and cannot be re-set in the field.

The Nos. A 1131 and 1133 are adjustable, and although regularly set at the factory, they can be re-set in the field through a definite range.

Materials and design: These valves are made of high grade materials throughout. Simple in design and inexpensive in initial cost, they will give excellent service under all ordinary conditions.

No. 1133 Valves have a brass disc; they do not have a lifting lever. The other valves are furnished with a composition disc especially selected for the specified recommended service and have a lifting lever so that the disc may be raised from the seat manually. The disc alone is not readily renewable; however, in the event replacement is necessary, disc holders complete with disc can be furnished.

Except for steel spring in Nos. A 1131 and 1133 and for composition discs, all parts are brass.

Capacities: Capacities are furnished on application. Inquiries should advise size, catalog number, type of service, and set pressure.

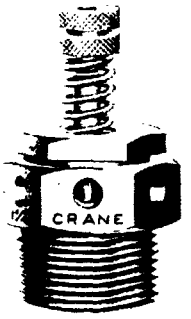
Maintenance: Manual operation of the valves at regular intervals will assure proper action. This operation should be performed only when there is sufficient pressure available to blow any accumulated foreign matter clear of the seating surfaces, particularly when starting up a new installation.

Brass Vacuum Relief Valves

Service recommendations: This valve is designed for use as a vacuum breaker on light, low pressure tanks, steam jacketed kettles, and similar apparatus, where there is a possibility of a vacuum forming which might cause injury to the apparatus because of the effect of atmospheric pressure upon it.

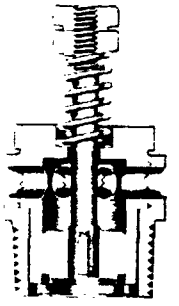
In service, the disc of the valve is normally held to its seat, both by spring tension and by the pressure in the apparatus to which the valve is attached. When the pressure in the vessel falls below atmosphere, the spring tension is overcome, and the disc is forced from its seat. Air is then admitted through the valve, thus preventing the vacuum from reaching a dangerous point.

Pressure setting: These valves are regularly furnished with springs for 10 inches of vacuum. They are set to open at 5 inches of vacuum but are adjustable for higher or lower vacuums. Valves are regularly tested for tightness at the seat with 50 pounds water pressure.



No. 1155 V
Vacuum
Relief Valve

Brass body, seat bushing, and disc.



List Prices

Size	Inches	½	¾	1	1¼	1½
No. 1155 V	Each	20.50	20.50	22.00	28.00	37.00
Height	Inches	2⅞	3	3⅜	3½	4¼

Construction: The No. 1155 V Valve is made with a two-piece body and seat bushing which removes the seat from the influence of body distortion when the valve is being installed.

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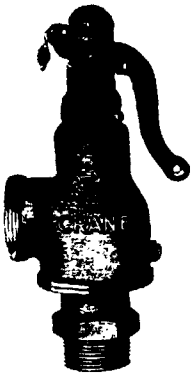
Brass Relief Valves for Water Heaters

Can be set at any specified pressure within the following range:

5 to 250 pounds pressure. Maximum temperature 400° F.

When ordering, be sure to specify the set pressure and the catalog number.



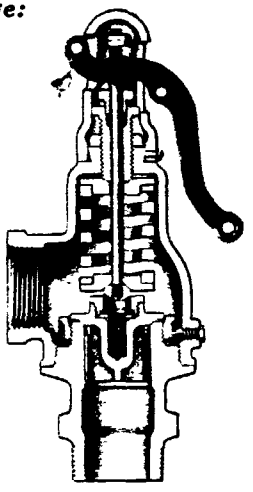
No. 2606
Male Inlet
Side Outlet

Service recommendations: This high grade and sturdy brass relief valve is especially recommended for use on water heaters, where a valve of outstanding quality is desired.

Features: The No. 2606 Valve has a pop chamber and blow-back regulating ring, which enables it to operate with the same positive action of a pop safety valve, should steam develop in the water heater. A stuffing box around the stem prevents leakage of hot water from the valve top.

List Prices and Dimensions

Size (Inlet and Outlet)		Inches	½	¾	1	1¼	1½	2
No. 2606	List Prices	Each	15.80	17.20	21.00	24.00	30.50	42.50
	Center to top	Inches	3¾	3¾	4⅝	5¼	6⅛	7¾
	Center to male inlet	Inches	2¼	2¾	3¼	3¾	4⅜	4½
	Center to outlet	Inches	1⅛	1⅜	1⅝	2 1/16	2 7/16	2¾



Cross Section

Construction: This brass relief valve has a bottom guide for the disc and is similar in design to the relief valves shown on page 318, except that it has a lifting lever, cap, and wire seal. The lever, japanned maroon, is suitable for up-pull operation, or when reversed, for down-pull.

Maintenance: The stuffing box gland should be pulled up only to "finger tightness". Excessive tightness on the packing is apt to interfere with the operation of the valve.

It is recommended that this valve be manually opened at regular intervals to assure proper action. This operation should be performed only when there is sufficient pressure available within the tank to flush any accumulated scale or foreign matter clear of the seating surfaces, particularly when starting up a new heater installation.

Pressure setting: Relief valves on liquid service should always be set 25 per cent above the normal working pressure of the system to avoid waste due to minor fluctuations of pressure.

These valves can be set for any pressure within the range of 5 to 250 pounds. Orders must specify the set pressure and the catalog number.

The original setting of the valve may be readjusted for pressures 10 per cent higher or lower, but not exceeding the maximum range stated above. For greater changes in set pressures, new springs may be required, since one spring cannot cover the entire range of pressures at which the valve can be set.

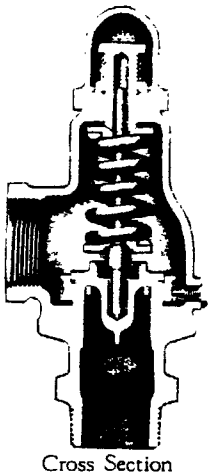
Brass Relief Valves

For Steam, Water, or Oil

Set at any specified pressure within the following ranges:

⅜ to 2½-inch — **5** to **250** pounds steam, water, or oil, **400°** F.
5 to **300** pounds water or oil, **100°** F.
3-inch — **5** to **200** pounds steam, water, or oil, **400°** F.
5 to **250** pounds water or oil, **100°** F.

Specify the set pressure and catalog number.



Cross Section



No. 2601
Male Inlet
Side Outlet
With Cap

These valves are recommended for pipe lines, presses, pumps, cylinders, etc. where a blow-back or pressure drop of 10% is permissible. Relief valves are intended to relieve excessive pressures; they should not be used in an attempt to relieve shock pressures in hydraulic lines. When a pressure drop smaller than 10% is required on steam service, use pop safety valves.

The side outlet valves are pressure tight on the outlet and can discharge against low head pressures.



No. 2602
Male Inlet
Side Outlet
With Wheel



No. 2604
Female Inlet
Side Outlet
With Cap

30

List Prices and Dimensions

Size (Size of Inlet)		Inches	⅜	½	¾	1	1¼	1½	2	2½	3
List Prices	No. 2601	Each	14.00	14.00	15.40	18.70	21.50	27.20	38.00		
	No. 2602	Each	13.80	13.80	15.00	18.00	20.50	25.50	36.00		
	No. 2604	Each		14.00	15.40	18.70	21.50	27.20	38.00	56.50	113.00
Dimensions in Inches	No. 2601	Size of outlet	½	½	¾	1	1¼	1½	2		
		Overall height	5⅜	5⅜	6	6⅞	8	9¾	11⅛		
		Center to inlet	2¼	2¼	2¾	3¼	3¾	4⅜	4½		
		Center to outlet	1⅛	1⅛	1⅜	1⅝	2 1/16	2 7/16	2¾		
	No. 2602	Size of outlet	½	½	¾	1	1¼	1½	2		
		Overall height	5⅝	5⅝	6⅛	7⅛	8⅛	9½	11¼		
		Center to inlet	2¼	2¼	2¾	3¼	3¾	4⅜	4½		
		Center to outlet	1⅛	1⅛	1⅜	1⅝	2 1/16	2 7/16	2¾		
		Diameter of wheel	2 9/16	2 9/16	2 9/16	3 1/16	3⅝	4 1/16	4¾		
	No. 2604	Size of outlet		½	¾	1	1¼	1½	2	2½	3
		Overall height		5⅛	5⅝	6⅜	7⅝	9¼	11	12½	13 11/16
		Center to inlet		2	2⅜	2¾	3⅜	3⅞	4⅜	4⅞	5 3/16
		Center to outlet		1⅛	1⅜	1⅝	2 1/16	2 7/16	2¾	3	3½

Features of design: To assure true seating, the single disc has a long bottom guide which operates in the finished bore of the base. The seat is integral with the base of the valve.

These valves except the ⅜, 2½, and 3-inch sizes are equipped with adjustable blow-back regulating rings around the seat, which provide a means of adjusting the blow-down of pressure when changing or regulating the set pressure. The adjustment of this ring may be made from the outside of the valve without interfering with the pressure setting. A locking plug screwed into and projecting through the wall of the body prevents the regulating ring from loosening up once it has been set for blow-down.

A stuffing box filled with asbestos packing and surrounding the main spring adjusting screw under the locknut forms an effective seal for the body.

Installation: Relief valves should always be installed with the stem in a vertical position, in order to insure proper seating of the disc.

Materials: The base, body, and disc of all of these valves are made of a high grade brass. The spring is steel; the stem is steel, with the stem point case-hardened, or is made of bronze.

Fire protection service: Relief valves used in connection with fire protection installations ordinarily must comply with various Underwriters' specifications. Before ordering valves for this service, a careful study should be made of all such specifications applying to the locality in which the valves will be used, to make sure that suitable valves are secured.

Pressure setting: These valves can be set at any pressure within the ranges specified above. On steam service, relief valves should be set at least 10% higher than the normal working pressure in the system; on water or oil service, 25% higher.

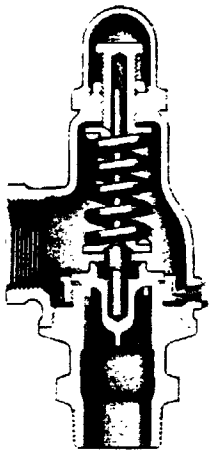
Pressure adjustment: The set pressure of these valves can be adjusted after installation to any pressure within a range of 10% above or below the original factory setting, but not exceeding the maximum pressure for which the valve is recommended.

Capacities on application

Brass Relief Valves

For Air or Gas

250-Pound



Cross Section
No. 2651

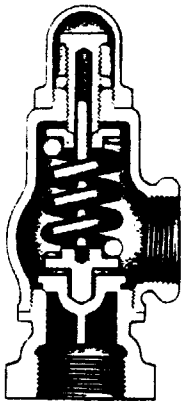


No. 2651
Male Inlet
Side Outlet

500-Pound



No. 2674
Female Inlet
Side Outlet



Cross Section
No. 2674

Set at any specified pressure within the following ranges:

250-Pound Valves—10 to 250 pounds
300-Pound Valves—10 to 300 pounds
500-Pound Valves—301 to 500 pounds

Maximum temperature — 400° F.

Orders must specify the set pressure and the catalog number.

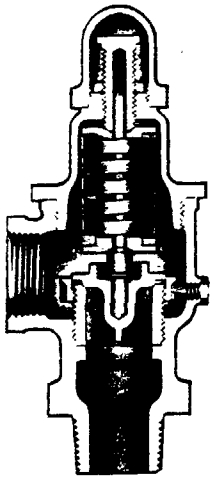
SERVICE RECOMMENDATIONS

The valves shown on this page are recommended for air or gas compressors, cylinders, pipe lines, etc., where a blow-back or pressure drop of 10% is permissible. When a pressure drop smaller than 10% is required, pop safety valves should be used.

The valves are pressure tight on the outlet and may discharge against low back pressures. The No. 2668 Valve is especially suitable for gasoline and noxious gases. It can be dismantled without disturbing the piping connections.

30

300-Pound



Cross Section
No. 2668



No. 2668
Male Inlet
Side Outlet

For Gasoline or Noxious Gases

List Prices and Dimensions

Size (Size of Inlet)			Inches	3/8	1/2	3/4	1	1 1/4	1 1/2	2
List Prices	No. 2651		Each	17.50	17.50	19.00	23.00	26.50	33.50	46.50
	No. 2668		Each	18.70	18.70	20.50	25.00	28.50	36.00	50.50
	No. 2674		Each		20.50	22.30	27.20	31.20	39.50	55.00
Dimensions in Inches	No. 2651	Size of outlet		1/2	1/2	3/4	1	1 1/4	1 1/2	2
		Center to top		3 1/8	3 1/8	3 1/4	3 5/8	4 1/4	5 3/8	6 5/8
		Ctr. to male inlet		2 1/4	2 1/4	2 3/4	3 1/4	3 3/4	4 3/8	4 1/2
		Center to outlet		1 1/8	1 1/8	1 3/8	1 5/8	2 1/16	2 7/16	2 3/4
	No. 2668	Size of outlet		1/2	1/2	3/4	1	1 1/4	1 1/2	2
		Center to top		3 5/16	3 5/16	3 3/8	4	4 7/8	6 1/4	7 3/8
		Ctr. to male inlet		2 5/16	2 7/16	2 7/8	3 3/16	3 11/16	4	4 11/16
		Center to outlet		1 1/16	1 1/16	1 5/16	1 5/8	2 1/16	2 3/8	2 3/4
	No. 2674	Size of outlet			1/2	3/4	1	1 1/4	1 1/2	2
		Center to top			3 1/4	3 1/4	3 1/2	4 1/4	5 3/8	6 1/4
		Ctr. to female inlet			2 1/8	2 1/8	2 1/2	2 15/16	3 1/8	3 5/8
		Center to outlet			1 3/8	1 3/8	1 5/8	1 3/4	2	2 1/2

Features of design: The valves are of the single disc type with bottom guide to assure proper seating. Except the 3/8-inch size and all the No. 2674, they have blow-back regulating rings which enable the user to adjust the blow-down when changing or regulating the set pressure. A stuffing box around the spring adjusting screw is filled with asbestos packing to form an effective seal for the body.

The No. 2668 have a screwed-in seat bushing; the seat is integral with the base on the other types.

Materials: The base, body, and disc are brass. All valves have a steel spring and stem, the stem point being casehardened.

Pressure setting: Relief valves used on air or gas should be set at least 25% higher than the normal working pressure in the system. Orders must specify the set pressure.

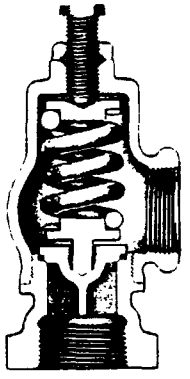
Pressure adjustment: The set pressure of these valves can be adjusted after installation to any pressure within a range of 10% above or below the original factory setting, but not exceeding the maximum pressure for which the valve is recommended.

Seat tightness: The seating surfaces are carefully ground to insure audible tightness at all pressures up to 80 per cent of the set pressure.

Installation: Relief valves should always be installed with the stem in a vertical position. For air and gas service, these valves should preferably be installed inverted to allow moisture to collect and seal the seating surfaces.

Capacities on application

Brass Hydraulic Relief Valves



Cross Section
No. 1128



No. 1128

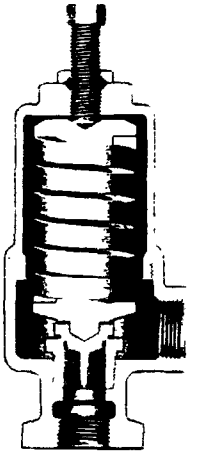
Set at any specified pressure within the following ranges:

No. 1128
All sizes, 300 to 600 pounds

No. 1130
½-inch valves, 800 to 8000 pounds
¾-inch valves, 800 to 6000 pounds
1-inch valves, 800 to 4500 pounds
1¼-inch valves, 800 to 4000 pounds
1½-inch valves, 800 to 2600 pounds
2-inch valves, 800 to 2600 pounds



No. 1130



Cross Section
No. 1130

Orders for valves must specify the set pressure and catalog number.

List Prices

Size	Inches	½	¾	1	1¼	1½	2
No. 1128	Each	33.50	36.00	43.50	50.00	62.50	87.50
No. 1130	Each	74.50	74.50	81.50	126.00	134.00	193.00

30

Service recommendations: These valves are particularly designed to safeguard high pressure oil lines, hydraulic apparatus operating at high pressures such as hydraulic presses and elevators, or high pressure pumping systems. The valves are to be used at atmospheric temperatures and for services discharging to atmosphere.

Hydraulic Relief Valves should never be used as unloading valves or in an attempt to relieve shock in hydraulic systems.

Features: This line of valves is characterized by rugged construction, simplicity of design, and the use of high grade materials.

The No. 1128 Valves have a base and disc cast in Crane Special Brass, a strong, hard, leaded tin bronze; the body seat ring is integral with the base. The bonnet is made of brass.

On No. 1130 Valves, the base and bonnet are brass. The disc is Exelloy on ½ and ¾-inch sizes and Crane 18-8 Mo Alloy Steel on larger sizes. The renewable, screwed-in body seat ring is made of Crane No. 49 Nickel Alloy.

Both valves feature an exceptionally long spring made of the best quality steel. The valves have an adjusting screw with a hexagon end for wrench engagement. A lock nut is provided so that the adjusting screw may be locked at the desired set pressur

All of these valves are pressure tight on discharg A stuffing box around the adjusting screw, and und the lock nut, is filled with high grade packing to se the top end of the valve.

Pressure setting: All hydraulic relief valves ca be readjusted for pressures 10 per cent above below the original set pressure, but should never b set at pressures in excess of the maximum rating f which the valve is designed. If a greater change the set pressure is to be made, a new spring may b required, since one spring will not cover the enti range of pressures at which the valve can be set.

Relief valves should be set at least 25 per cent high than the normal working pressure in the system order to avoid wasting water or oil in discharges d to minor fluctuations of pressures.

The function of these valves is to safeguard th apparatus and the piping against excessive pressure and they should not be used in an attempt to mai tain pressure at a maximum point. Operating pre sures maintained continuously close to the s pressure of the valve will tend to cause leakage ar maintenance difficulties.

Orders for relief valves must specify the set pressu desired and the catalog number.

Dimensions, in Inches

Size (Size of Inlet)		½	¾	1	1¼	1½	2
No. 1128	Size of outlet	½	¾	1	1¼	1½	2
	Center to top	2⅞	2⅞	3⅝	3⅞	4½	5⅝
	Center to inlet	2⅛	2⅛	2½	2 15/16	3⅛	3⅝
	Center to outlet	1⅜	1⅜	1⅝	1¾	2	2½
No. 1130	Size of outlet	1	1	1	1½	1½	2
	Center to top	7¼	7¼	7¼	9½	9½	11¾
	Center to inlet	3	3	3	3⅝	3⅝	4⅛
	Center to outlet	2 11/16	2 11/16	2 11/16	3 3/16	3 3/16	3 13/16

Capacities on application

All-Iron Relief Valves

For Ammonia, Air, or Gas



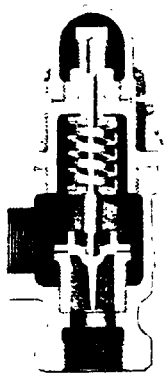
No. 1118
Screwed Inlet and Outlet

Can be set at any specified pressure within the following range:
10 to 300 pounds Maximum temperature 400° F.

This relief valve has been particularly designed for ammonia service, but may also be used wherever all-iron construction is preferred because of conditions corrosive to brass. For air or gas service, the seat should be oil sealed. Service temperatures should not exceed 400° F.

Valves ½ to 1¼-inch have a screwed bonnet; sizes 1½ and 2-inch have a bolted bonnet. The bonnet and cap joint are sealed with a lead gasket.

Features: The No. 1118 Valve is of sturdy construction and simple design. The body and bonnet are Crane Ferrosteel, the body seat ring and disc are steel, and the stem is steel and has a casehardened point. Seating surfaces are easily reground; pipe threads tapped into the top of the disc permit insertion of a pipe nipple for rotating the disc.



Cross Section

Pressure setting: Relief valves should always be set at least 25 per cent above the normal working pressure in the system in order to prevent wastage of fluid when minor fluctuations of pressure occur. The pressure setting can be readjusted 10 per cent above or below the original set pressure, but not in excess of the maximum given above.

List Prices and Dimensions

Size (Size of Inlet)		Inches	½	¾	1	1¼	1½	2
No. 1118	List Prices	Each	41.50	44.00	52.50	62.50	92.50	113.00
	Size of outlet	Inches	¾	1	1¼	1½	2	2½
	Center to top	Inches	3⅜	4¼	5⅜	6¾	6⅞	7½
	Center to end of inlet	Inches	2¼	2⅝	3⅛	3¾	3 5/16	4⅜
	Center to end of outlet	Inches	1⅜	1⅝	2	2½	3	3 15/16

Capacities on application
Orders must specify the set pressure and catalog number.

30

Inside Spring
Iron Body Relief Valves

For Water or Oil



No. 1123

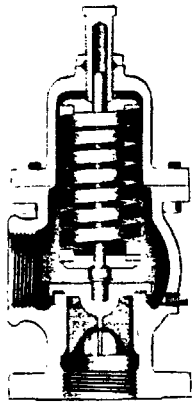
Orders must specify set pressure and Catalog No.

Can be set at any specified pressure within the following range:
10 to 300 pounds Maximum temperature 200° F.
Outlet pressures are not to exceed 20 pounds gauge.

This relief valve is designed for service on water or oil, where the temperature does not exceed 200° F. It is commonly used on pump discharge lines, on standpipes, pipe lines, cylinders, oil lines, etc. The valve should not be used as an unloading valve or to relieve shock from hydraulic lines.

Pressure setting: Relief valves on liquid service should be set 25 per cent above the normal working pressure of the system to assure tightness at the seat. They may be readjusted for pressures 10 per cent above or below the original set pressure, but not exceeding the maximum given above.

Materials: The No. 1123 Valve has an iron body and bonnet, a steel spring, and a brass stem. The seat and disc are regularly made of brass.



Cross Section

Construction: The valve is of the inside spring type with a flanged bonnet securely bolted to the body, making a pressure tight joint. A machined recess filled with packing is provided around the adjusting screw to seal this point and render the valve pressure tight on discharge.

List Prices and Dimensions

Size (Size of Inlet and Outlet)		Inches	2½	3	4
No. 1123 F. & D.	List Prices	Each	92.50	110.00	165.00
	Center to top	Inches	11	11½	12½
	Center to face of inlet	Inches	5¼	5¾	6 11/16
	Center to end of outlet	Inches	3⅞	4¼	5

The inlet connection is suitable for a flanged or a screwed joint. The outlet connection is screwed.

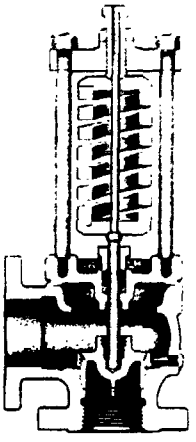
Flange dimensions and facing: The dimensions and drilling of the inlet flange conforms to the American Cast Iron Flange Standard, Class 250 (B16b-1944). It has a 1/16-inch raised face finished with concentric grooves, approximately 16 grooves per inch, known as a "serrated" finish.

Drilling: List prices include facing and drilling (F. & D.) of the inlet flange to the American Cast Iron Flange Standard, Class 250. No deduction is made when valves are ordered faced only.

Capacities on application

Templates for drilling . . . . page 440

Outside Spring
Iron Body Relief Valves



Cross Section

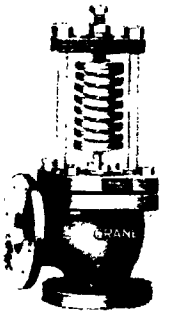
WORKING PRESSURE — 250 pounds
MAXIMUM SET PRESSURE — 300 pounds

For steam, gas, hot water, or oil
Maximum temperature 450° F.

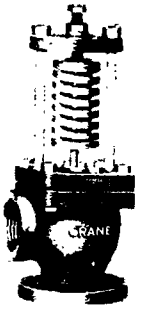
Outlet pressures not to exceed 20 pounds gauge.

Order must specify the set pressure and catalog number.

If order does not specify fluid on which valve is to be used, valves for steam will be furnished.



No. 1113
Flanged Inlet
Flanged Outlet



No. 1114
Flanged Inlet
Screwed Outlet

Recommendations: Nos. 1113 and 1114 Valves are recommended for steam, gas, hot water, or oil services at working pressures up to 250 pounds and temperatures up to 450° F. They may be set for a maximum pressure of 300 pounds, and they are suitable for outlet pressures not exceeding 20 pounds gauge.

List Prices and Dimensions

Size (Size of Inlet)			2	2½	3	4
List Prices, F. & D.	No. 1113	Each				400.00
	No. 1114	Each	170.00	227.00	270.00	
Dimensions, Inches	Size of outlet		2½	3	4	5
	Center to top		12½	15½	19	24½
	Center to face of inlet		6½	7	7½	9½
	Center to end of outlet		3 15/16	4½	4⅞	
	Center to face of outlet					7

Construction: These valves are of the outside spring and yoke construction, in which the spring is not directly exposed to the temperature of the fluid within the body. They have a bolted bonnet equipped with a stuffing box. The seat bushing is renewable.

The valves are pressure tight on the outlet side and are suitable for use when discharging into a line operating under low head pressures, or for handling noxious or inflammable fluids.

In addition, these valves have a pop chamber and an adjustable blow-back regulating ring which, on steam and gas service, gives them an action more positive than ordinary relief valves, as well as a means of regulating the blowdown of pressure.

The inlet of these valves is regularly made with a combination flanged and screwed connection.

Seat and disc: The seat and disc are made of brass.

Pressure setting: To insure tight seating of relief valves, they should be set at slightly higher pressures than the normal working pressure of the installation. Valves for steam or gas should be set at least 10 per cent higher, and valves for water or oil, 25 per cent above the normal working pressure.

These valves may be readjusted for pressures 10 per cent above or below the original set pressure, but not exceeding the maximum given above.

Flange dimensions and facing: The dimensions of the inlet flange conforms to the American Cast Iron Flange Standard, Class 250 (B16b-1944). It has a 1/16-inch raised face, finished with concentric grooves, approximately 16 grooves per inch, known as a "serrated" finish.

The outlet flange of the No. 1113 Valve conforms to the American Cast Iron Flange Standard, Class 125 (B16.1-1948). This flange is plain faced and has a smooth finish.

Drilling: List prices include facing and drilling (F. & D.) to the particular Standard applying, as indicated in the preceding paragraphs. No deduction is made when valves are ordered faced only.

Dirt in Piping

Pipe scale and dirt in piping systems are the greatest enemies of valves, regulators, meters, and other mechanical devices. They cause endless trouble and frequently serious damage. Such foreign matter lodges on valve seats and starts leakage: it gets into automatic devices with close-fitting, moving parts and prevents proper operation; and it collects at points of low velocity, obstructing the passage of flow.



Regardless of how clean the piping materials are when being installed, a generous use of strainers or sediment separators is a small but sound investment, considering the protection they provide. The Crane line is shown on pages 342 and 343.

Be sure to blow out the accumulated sediment at regular intervals.

Capacities on application

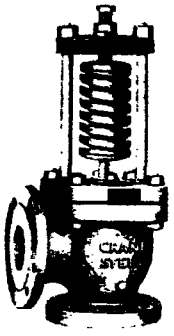
Templates for drilling pages 439 and 440

Outside Spring
Alloy Cast Steel Relief Valves

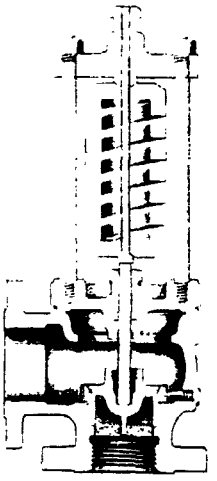
WORKING PRESSURE — 300 pounds
MAXIMUM SET PRESSURE — 360 pounds

For steam, hot water, oil, or gas; maximum temperature 900° F.
Outlet pressure not to exceed 20 pounds gauge

When ordering be sure to specify set pressure and catalog number.
If order does not specify fluid on which valve is to be used, valves for steam will be furnished.


No. 1113 LX

Pressure setting: This valve, when used for steam or gas, should be set at least 10 per cent higher than the normal working pressure, and when used for water or oil, at least 25 per cent higher. It may be readjusted for pressures 10 per cent above or below the original set pressure, but not exceeding the maximum given above. For a greater adjustment, new springs may be required, since one spring will not cover the entire range of pressures at which this valve can be set.


Cross Section

30

List Prices and Dimensions

Size (Size of Inlet)		Inches	2	2½	3	4
No. 1113 LX, Flanged, F.D.& S.F.		Each	307.00	375.00	455.00	717.00
Dimensions, in Inches	Size of outlet		2½	3	4	5
	Diameter of seat opening		2	2½	3	4
	Center to top		12½	15½	19	24½
	*Center to face of inlet		6½	7	7½	9½
	*Center to face of outlet		4¾	5½	6	7

*Includes 1/16-inch raised face.

Service recommendations: The Crane No. 1113LX Alloy Steel Relief Valve is recommended for high temperature service on steam, hot water, oil, and gases (maximum temperature not to exceed 900° F). It is suitable for outlet pressures up to 20 pounds gauge.

Construction: This valve is of the outside spring and yoke construction, in which the spring is not directly exposed to the temperature of the fluid within the body. It has a bolted bonnet equipped with a stuffing box. The seat bushing is renewable.

The valve is pressure tight on the outlet side and is suitable for use when discharging into a line operating under low head pressures, or for handling noxious or inflammable gases and fluids.

In addition, the No. 1113 LX Valve has an adjustable blow-back regulating ring which, on steam and gas service, provides a means for adjusting the blowdown of pressure when changing or regulating the set pressure.

Materials: The body is made of Crane No. 4 Carbon-Molybdenum Steel; the bonnet, of Carbon Cast Steel; and the disc and stem, of Exelloy. The seat bushing is Crane 18-8 Mo Alloy; and the spring, a high grade alloy steel. The bonnet bolt-studs are Triplex Steel.

Flange dimensions and facing: The end flanges conform to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939.

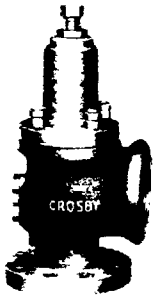
The inlet flange conforms to the 300-Pound Standard; the outlet flange, to the 150-Pound Standard.

End flanges are furnished faced, drilled, and spot faced (F.D.& S.F.) and have an American Standard 1/16-inch raised face, finished with concentric grooves, approximately 32 grooves per inch, known as a "serrated" finish.

A smooth finish can be furnished on raised or male faces. Ring joint, male, female, or other types of facing can also be furnished. See the Crane Discount Sheet for prices

Capacities on application *Templates for drilling . . page 441*

Crosby Nozzle Relief Valves



Style **JO**

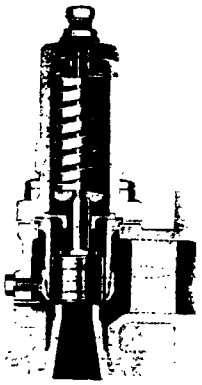


Style **JJBC**

These *high capacity relief valves are widely used for other than steam boiler service in refinery, chemical, industrial, and process plants where positive, dependable action is required. They are recommended for air, gas, steam, vapor, and liquids.

All valves have a venturi nozzle with top guided disc and flat seats, assuring free fluid flow, high capacity, smooth performance, and easy maintenance.

Style JJBC-1 and JJBC-3 are furnished with a closed bonnet, cooling fins, and bolted cap. Other styles are furnished with a closed bonnet and screwed cap unless otherwise specified.



Style **JJC**
Cross Section

Style JO-a Valve has a cast iron body, bronze semi-nozzle, bronze disc and trim. This valve is available with an inlet size range 1½ to 4 inches, an outlet size range 2 to 6 inches, and an inlet pressure limit of 250 to 400 pounds at 100°-450° F.

30

Style JO-b Valve has a cast iron body, stainless steel semi-nozzle, disc, and trim. This valve is available with an inlet size range 1½ to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 250 to 400 pounds at 100°-450° F.

Style JO-c Valve has a cast carbon steel body, stainless steel full-throat nozzle, disc, and trim. This valve is available with an inlet size range 1½ to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 250 to 600 pounds at 100°-450° F.

Style JO-c (For Hydrofluoric Acid) Valve has a cast carbon steel body, cast Monel nozzle and disc, and Monel trim. This valve is available with an inlet size range 1½ to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 250 to 600 pounds at 100°-450° F.

Style JO-c (For Hydrochloric Acid) Valve has a cast carbon steel body, cast Hastelloy B nozzle and disc, and Hastelloy trim. This valve is available with an inlet size range 1½ to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 250 to 600 pounds at 100°-450° F.

Style JO-d Valve has a cast carbon steel body, stainless steel full-throat nozzle, disc, and trim. This valve is available with an inlet size range 1½ to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 250 to 750 pounds at 100°-450° F.

Style JO-cc Valve has a cast carbon steel body, stainless steel full-throat nozzle, disc, and trim. This valve is available with an inlet size range 1 to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 400 to 1200 pounds at 100°-450° F.

Style JO-dd Valve has a cast carbon steel body, stainless steel full-throat nozzle, disc, and trim. This valve is available with an inlet size range 1 to 6 inches, an outlet size range 2 to 8 inches, and an inlet pressure limit of 300 to 1050 pounds at 450°-800° F.

Style JO-ccc Valve has a cast carbon steel body, stainless steel full-throat nozzle, disc, and trim. Available with an inlet size range 1½ to 4 inches, ar outlet size range 2 to 6 inches, and an inlet pressure limit of 1000 to 3600 pounds at 100°-450° F.

Style JO-ddd Valve has a cast carbon steel body stainless steel full-throat nozzle, disc, and trim Available with an inlet size range 1½ to 4 inches, ar outlet size range 2 to 6 inches, and an inlet pressure limit of 730 to 3300 pounds at 450°-800° F.

Style JJC-1 Valve has a cast alloy steel body, stainless steel full-throat nozzle, disc, and trim. Available with an inlet size range 1½ to 6 inches, an outlet size range 2½ to 8 inches, and an inlet pressure limit o 250 to 1875 pounds at 800°-900° F.

Style JJC-3 Valve has a cast alloy steel body, stainless steel full-throat nozzle, disc, and trim. This valve is available with an inlet size range 1½ to inches, an outlet size range 2½ to 8 inches, and an inlet pressure limit 500 to 5500 pounds at 450°-900°F

Style JJBC-1 Valve has a cast alloy steel body, stainless steel full-throat nozzle, disc, and trim. This valve is available with an inlet size range 1½ to 6 inches an outlet size range 2½ to 8 inches, and an inlet pressure limit of 230 to 1625 pounds at 900°-1000° F

Style JJBC-3 Valve has a cast alloy steel body, stainless steel full-throat nozzle, disc, and trim. This valve is available with an inlet size range 1½ to 6 inches an outlet range 2½ to 8 inches, and an inlet pressure limit 470 to 2700 pounds at 900°-1000° F.

For conditions requiring higher inlet pressure and higher back pressure-temperature ratings than listed above, Style JJAC-6 and JJAC-7 Valves are available. Complete data will be furnished on request.

***Note:** Medium capacity modifications of Style JC valves are available in Styles JW-a and JW-b (iron) and JW-c and JW-d (steel). Complete data will be furnished on request.

Prices on application

Safety valves for steam boilers . . page 314

Crosby Steel Relief Valves

With Forged Steel Base and Disc

:yle JR is a low capacity valve recommended for ɔn-coking refinery service, preferably on liquids, ıd for pumps or pump lines carrying sour crude oil oil vapors. It is not recommended for steam, air, oil vapor service where exact operation is required, for use on steam boilers.

his valve is available with inlet sizes ½ and ¾-inch, ı outlet size of 1 inch, and a pressure limit of 500 ı 5000 pounds at 400°-750° F.

he cylinder and cap are made of cast carbon steel; ıse and disc are stainless steel. Furnished with flat ats and top guided connections.

tyle JMB, a medium capacity valve for steam, air, ıs, oil, and oil vapor lines, is recommended for rvice on oil cracking equipment (non-coking), ıustic pump discharge lines, ammonia lines, and ır general services corrosive to bronze. It should ɔt be used on steam boilers, nor on air service beɔnd 1000 psi. For higher air pressures Styles JO-C and JO-CCC are recommended.



Cross Section Style JR



Style JR



Style JMB

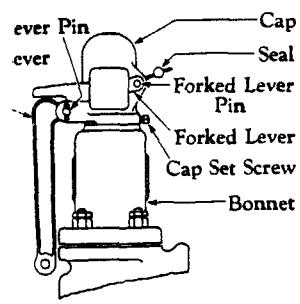
Prices on application

This valve is available with inlet sizes ¾ and 1-inch, an outlet size of 1½ inches, and a pressure limit of 500 to 5000 pounds at 400°-750° F.

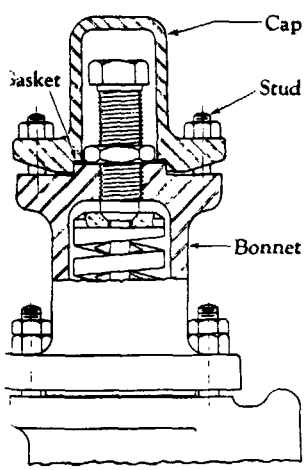
The cylinder and cap are made of cast carbon steel; base and disc are stainless steel. Furnished with flat seats and top guided connections.

30

Special Tops and Lifting Gears



Regular Lifting Gear Closed Top



Bolted Cap

For Crosby Nozzle Relief Valves

Crosby Nozzle Relief Valves are regularly furnished with closed bonnets and without lifting gears. When so specified, they can be equipped with any of the special tops or lifting gears described on this page.

Regular lifting gears: The regular type of lifting gear with either a closed bonnet (see illustration at left) or an exposed spring is recommended for services where the valve is not required to be tight on the discharge side.

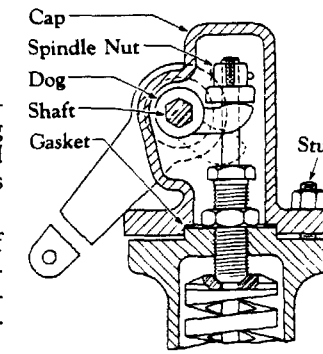
Packed lifting gears: The packed type of lifting gear with closed bonnet is recommended where tightness on the discharge side is necessary or where conditions necessitate frequent testing of the valves.

The packed lifting gear eliminates having stuffing boxes around the main spindle.

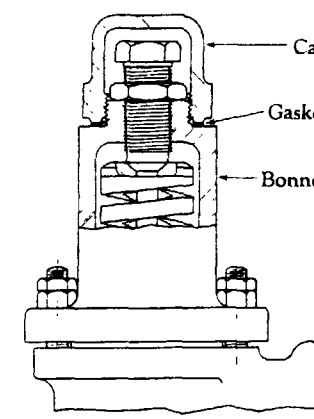
Caps: Caps are recommended for valves used on services that do not require a lifting gear but do require that the valves be tight on the discharge side due to possible back pressure.

Test gags: Valves having a regular or packed lifting gear or cap can be fitted, when so desired, to accommodate test gags (not illustrated) which will hold the valves shut against over-pressure when the equipment on which they are installed is being given a hydrostatic test. Test gags should never be more than "finger tight".

Prices on application



Packed Lifting Gear Closed Top

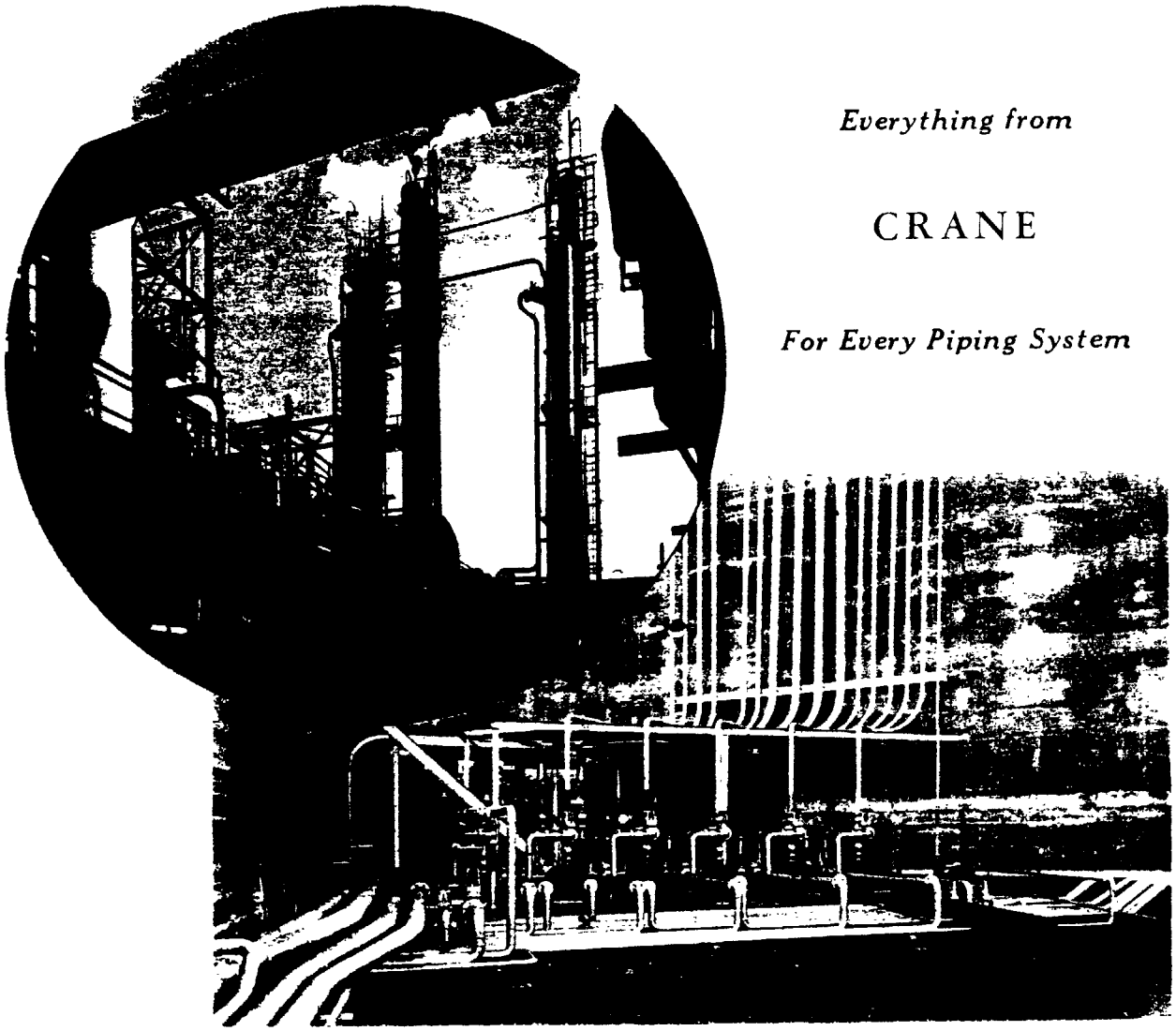


Screwed Cap

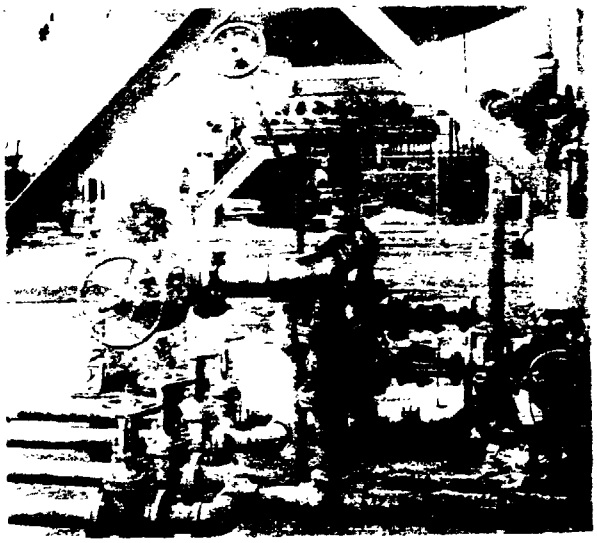
Everything from

CRANE

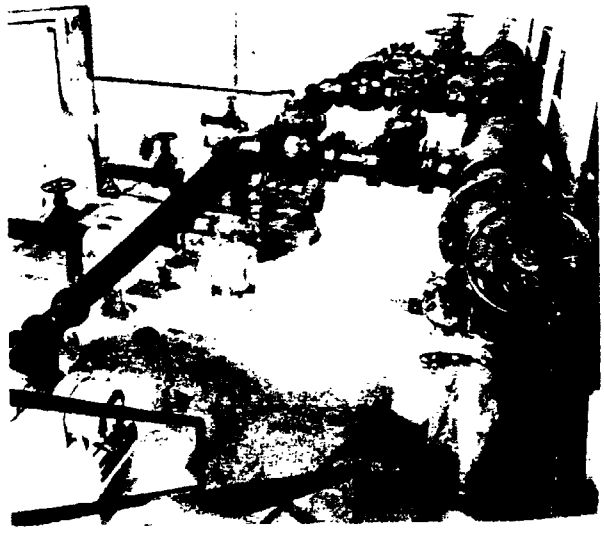
For Every Piping System



Oil piping manifold at terminal.



The base of a petroleum fractionating tower equipped with Crane valves and fittings



A sewage treatment plant Crane-equipped, for dependable performance—for long service

Pressure Regulators, Steam Traps, Separators, and Expansion Joints

Regulators and Pressure Reducing Valves
- Crane Pressure Regulators ..... pages 328 to 331
- Klipfel Pressure Reducing Valves ..... pages 332 and 333
- Mueller Water Pressure Regulators ..... page 334
- Fulton Sylphon Temperature Regulators ..... page 334

Inverted Open Float Steam Traps ..... pages 335 to 339
Automatic Air Vent or Water Drain Valves ..... pages 338 and 339
Thermostatic Traps ..... page 338

Separators and Strainers
- Steam and Oil Separators ..... pages 340 and 341
- Sediment Separators ..... pages 342 and 343
- Dexter Automatic Separators ..... page 344
- Logan Aridifiers ..... page 344
- Swartwout Exhaust Heads ..... page 345

Expansion Joints
- Brass ..... page 346
- Iron Body ..... page 346
- Copper and Rubber ..... page 347
- Adsco, Iron and Steel ..... page 348

Drip Pockets ..... page 341
Expansion in Pipe Lines ..... page 345

31

To make this catalog more convenient to use, the complete Crane line of special duty valves and of specialties has been divided into several groups. Special duty valves are shown on pages 293 to 325, and specialties not referred to above are shown on pages 349 to 364.

Standard Types of Pipe Bends . pages 484 and 485

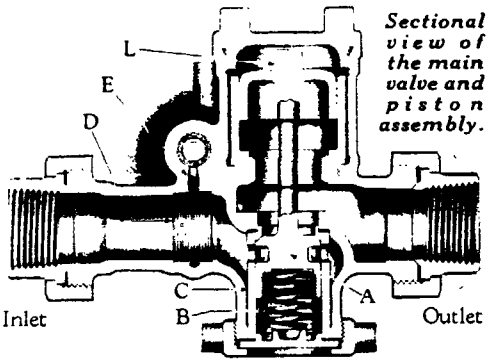
Brass Pressure Regulators

Two essential but separate mechanisms—the main valve assembly and auxiliary valve assembly—are features of Crane Pressure Regulators. Interconnected for transmission of pressure but independent mechanically, they operate in the same body.

Except for necessary pipe connections, the regulator would function as well with the units separated.

The main valve assembly includes a disc and seat. movement of the disc is controlled by a piston a ated by pressure from the auxiliary valve.

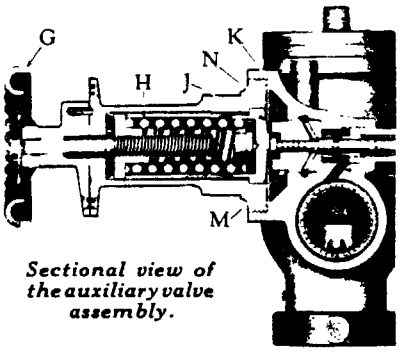
The auxiliary valve assembly includes a device to m ually set the desired outlet pressure, an auxil valve to control the operation of the main valve, a mechanism to operate the auxiliary valve itsel



Sectional view of the main valve and piston assembly.

Operation of Crane Pressure Regulators

With the regulator properly installed in the line and ready to go into service, the successive steps which take place in its operation are as follows:



Sectional view of the auxiliary valve assembly.

1. High pressure steam (or air) from the inlet piping flows into the inlet side of the regulator as far as the main disc A, which is held lightly to its seat by the main disc spring B.

2. This high pressure then passes into the main disc spring chamber through the ports in the liner C and acts to hold the main disc tightly to its seat.

3. A portion of the high pressure steam (or air) in the regulator inlet passes through the screen D into the high pressure port E and fills the chamber around the auxiliary valve F, which is held lightly to its seat by the auxiliary valve spring.

4. When the handwheel G is turned in a clockwise direction, the regulating spring H is compressed, deflecting the diaphragm J. This deflection of the diaphragm moves the auxiliary valve F off its seat and allows pressure to flow through the intermediate pressure port K into the chamber above the piston L.

5. The piston then moves downward, overcoming resistance of the main disc A, forcing it off its seat.

6. Steam (or air) then flows past the main disc A and fills the outlet piping system. Pressure from outlet of the regulator is transmitted back thrc the low pressure port M to the diaphragm chan N. As the pressure builds up in this chambe finally overcomes the tension on the diaphragr caused by the regulating spring H, and forces diaphragm back toward its original position.

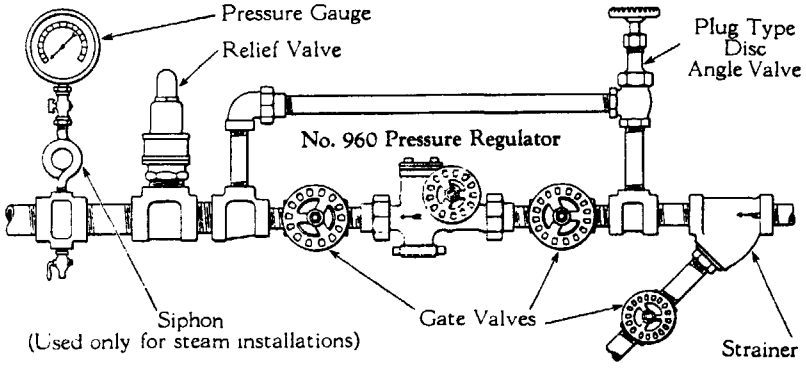
7. Just as soon as the diaphragm returns to its c inal position, the auxiliary valve closes, thus cut off the pressure to the top of the piston L.

8. The high pressure in the spring chamber of main disc A then forces the main disc back tc seat, cutting off the steam (or air) supply to outlet side of the regulator.

9. As the outlet pressure falls, the pressure in diaphragm chamber also falls, with the result the regulating spring tension again deflects the phragm and moves the auxiliary valve off its sea

10. The entire cycle of operations is then repea The cycle is automatic and practically instantane there is no lag between operations.

Recommended Piping Arrangement for Pressure Regulator



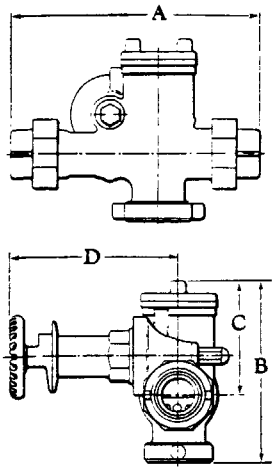
Automatically Maintained Press

When the handwheel is set to ob any desired outlet pressure, pressure is maintained within c limits if the quantity of steam o being used remains fairly const

Continually Proportioned Flou

When steam or air is being use the outlet system, the regula actually operates in a "floating" p tion; that is, both the main disc the auxiliary valve move back forth without pausing at any position, and thus continually portion the flow of steam or ai satisfy the outlet requirements

Brass Pressure Regulators

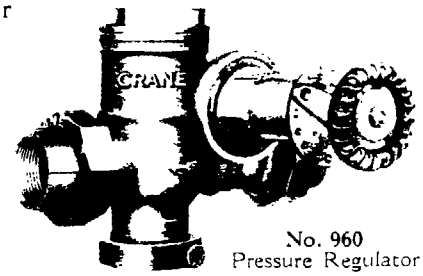


MAXIMUM INLET PRESSURES
250 pounds steam, 450° F. 250 pounds air

For description, operation, and recommended installation, see the preceding page.

List Prices and Dimensions

Size Inches	Price Each	Dimensions, in Inches A	B	C	D
½	89.00	7	4⅝	3	6
¾	99.00	8¼	5¾	3⅝	6¼
1	111.00	9	6⅜	4	7¼
1¼	138.00	9⅝	7	4½	7½
1½	171.00	10¾	8	5	7½
2	215.00	12	9⅛	5⅝	7½



No. 960
Pressure Regulator

For steam and air capacities, see the following two pages.

Service recommendations: Crane Pressure Regulators have been specifically designed to provide accurate, automatic pressure regulation on steam and air. They are particularly suitable for use in modern process work, on vulcanizers, cookers, dryers, paper machines, heating systems, air tools, air blasts, and many other services. They may be used to reduce pressure to engines and pumps if ample receiver capacity to eliminate pulsations is provided between the engine or pump and the regulator.

Fundamental characteristics: These regulators should not be confused with ordinary reducing valves. They will not allow the outlet pressure to build up to the inlet pressure when no steam or air is being used in the outlet piping. Reasonable fluctuations of the inlet pressure do not affect the outlet pressure.

The regulators are reliable and feature a wide range of available reduced pressures, simplicity of operation, accessibility for inspection, and convenience in making repairs. They have malleable iron union rings and tail-pieces on the inlet and outlet ends.

Locking: Each regulator is equipped with a locking device to permit protection of the pressure setting against tampering. Locks are furnished only when specified and at an advance in price.

Outlet pressure ranges: Regulators are fitted with regulating springs and diaphragms to suit any one of the following ranges of outlet pressures:

1 to 10 pounds	**20 to 100 pounds**
5 to 30 pounds	**90 to 200 pounds**

How to order regulators: Orders should specify the size of the regulator (or capacity desired; see pages 330 and 331) and the outlet pressure. Unless otherwise specified, regulators suitable for steam will be furnished; if wanted for air, specify "for air".

These regulators should not be used where the outlet pressure is more than 80% of the inlet pressure.

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Operating Characteristics of Crane Pressure Regulators

A Pressure Regulator should be chosen on the basis of its capacity to provide the rate of flow required in the outlet piping. The nearer correct it is to the proper size, the more trouble-free it will be and the longer it will last. A regulator that is too large is not only subject to extreme throttling and undue wear but may also supply steam or air in surges, causing pulsations. A regulator that is too small, particularly on low pressures, will dance and chatter.

Best results are obtained when the regulator is selected to supply flow rates that are approximately 50 per cent of the maximum obtainable through the regulator. This condition keeps the disc unseated—keeps it properly throttling the flow by holding the disc in a "floating" position—while at the same time permitting variations in flow demand in either direction. In addition, the damaging effects of wire-drawing and the danger of having small particles of foreign matter adhere to the seating surfaces and cause an increase in the outlet pressure, are substantially reduced.

Theoretically, if the flow demand remained fixed at all times, it would be possible to select a regulator (an orifice would give the same results) that would deliver the required amount of steam or air at exactly the desired outlet pressure. Actually, however, such ideal conditions seldom exist, because the flow demand in outlet piping varies with many factors, such as shut-off intervals, number of pieces of equipment in operation, warming-up periods, etc. Under practical operating conditions, therefore, when a regulator is set for one condition of flow demand and this condition changes, the regulator will strive automatically to compensate for the change, but in so doing will produce some variation in the outlet pressure. An increase in demand will cause a decrease in the outlet pressure, up to the point where the regulator is delivering its fullest possible capacity, in other words, is providing no regulation at all, if the demand is great enough. A decrease in demand will cause an increase in the outlet pressure, up to the point of the actual outlet or dead-end pressure setting on the regulator, if the demand ceases entirely.

Important: Select the regulator on the basis of its capacity. See pages 330 and 331 for capacity tables. Orders should always specify the desired outlet pressure. The regulator is then equipped with the proper springs and diaphragm as indicated under "outlet pressure ranges" above; the regulating wheel permits adjustment throughout the range.

Capacities of No. 960 Pressure Regulators

Explanation of Tables

The capacity tables ("steam" below and "air" on the opposite page) show (1) inlet pressures at convenient increments from 30 to 250 pounds, (2) capacities or rates of flow at various pounds change in the outlet pressure, and (3) last column in each half of table, maximum rate of flow.

The columns showing pounds change in outlet pressure to obtain rate of flow apply to ***any*** outlet pressure. For example, assume steam at 100 psi is to be reduced through a ½-inch regulator to a maximum or dead-end outlet pressure of 20 psi: at 19 psi outlet pressure (1-pound decrease) the regulator would deliver 41 pounds of steam per hour, at 18 psi outlet pressure (2-pound decrease) the regulator would deliver 70 pounds of steam per hour, at 12 psi outlet pressure (8-pound decrease), 225 pounds, etc. In this example, if the selected maximum or dead-end outlet pressure were 60 psi, the capacity would be the same at 59, 58, and 52 psi outlet pressure (1, 2, and 8-pound change or decrease), respectively, etc.

The heavy black line through the tables separates the rates of flow at each inlet pressure at approximately 50 per cent of the maximum capacity of the regulator. The normal flow demand of the outlet system should correspond with the capacity of the regulator as shown near this black line. This will assure the use of a regulator that operates properly, has long life, and provides practical variation in lower or higher capacity when the flow demand varies from normal.

The "maximum — no regulation" columns show the maximum rate of flow, which occurs when the flow demand is so great that the outlet pressure has dropped to the point where the regulator is delivering full capacity (no regulation). This latter figure is provided so that the safety valve which should be installed in the outlet piping can be properly sized; for proper protection and maximum safety, the safety valve should be capable of discharging at least the maximum flow through the regulator.

(*Continued on the following page*)

Steam Capacities

Inlet Pressure	Rate of Flow of Saturated Steam In Pounds per Hour											
	Pounds Change in Outlet Pressure to Obtain Rate of Flow											Maximum
Psi	1	2	3	4	5	8	10	12	15	20	25	No Regulation
½-inch Regulators												
30	27	50	70	90	110	150						187
40	29	55	80	100	125	175						228
50	31	58	85	110	135	200	225					270
60	33	60	88	113	138	205	230	270				311
70	35	62	91	116	141	210	240	280				353
80	37	64	94	119	144	215	250	290	320			394
90	39	68	97	122	147	220	260	300	340			436
100	41	70	100	125	150	225	270	310	360	410		478
125	43	76	108	135	165	245	295	340	390	450		580
150	45	82	117	150	185	270	325	375	425	490	520	685
175	47	88	126	160	200	295	355	405	460	535	565	790
200	49	95	135	175	215	320	385	435	495	580	610	895
250	55	110	165	215	270	410	485	540	605	685	710	1060
¾-inch Regulators												
30	48	89	124	160	195	265						330
40	51	97	142	175	220	310						405
50	55	103	150	195	240	355	400					480
60	58	106	155	200	245	365	405	480				550
70	62	110	160	205	250	370	425	495				625
80	65	113	165	210	255	380	440	515	565			695
90	69	120	170	215	260	390	460	530	600			770
100	73	124	175	220	265	400	480	550	635	725		845
125	76	135	190	240	290	435	520	600	690	795		1025
150	80	145	205	265	325	480	575	665	750	865	920	1210
175	83	155	225	285	355	520	630	715	815	945	1000	1400
200	87	170	240	310	380	565	680	770	875	1025	1080	1585
250	97	195	290	380	480	725	860	955	1070	1210	1255	1875
1-inch Regulators												
30	84	155	215	280	340	465						580
40	90	170	250	310	390	540						705
50	96	180	265	340	420	620	700					835
60	102	185	275	350	430	635	715	835				965
70	108	190	280	360	435	650	745	870				1095
80	115	200	290	370	445	665	775	900	990			1220
90	121	210	300	380	455	680	805	930	1055			1350
100	127	215	310	390	465	700	835	960	1115	1270		1480
125	133	235	335	420	510	760	915	1055	1210	1395		1800
150	140	255	365	465	575	835	1010	1165	1320	1520	1610	2125
175	146	275	390	495	620	915	1100	1255	1425	1660	1750	2450
200	152	295	420	540	665	990	1195	1350	1535	1800	1890	2775
250	170	340	510	665	835	1270	1505	1675	1875	2125	2200	3285

Inlet Pressure	Rate of Flow of Saturated Steam In Pounds per Hour											
	Pounds Change in Outlet Pressure to Obtain Rate of Flow											Maximum
Psi	1	2	3	4	5	8	10	12	15	20	25	No Regulation
1¼-inch Regulators												
30	145	270	380	490	595	815						1015
40	155	300	435	545	680	950						1240
50	170	315	460	595	735	1085	1220					1465
60	180	325	480	615	750	1115	1250	1465				1690
70	190	335	495	630	765	1140	1305	1520				1915
80	200	350	510	645	780	1165	1360	1575	1740			2140
90	210	370	525	660	800	1195	1410	1630	1845			2365
100	225	380	545	680	815	1220	1465	1685	1955	2225		2595
125	235	415	585	735	895	1330	1600	1845	2120	2445		3150
150	245	445	635	815	1005	1465	1765	2035	2310	2660	2825	3720
175	255	480	685	870	1085	1600	1930	2200	2500	2905	3070	4290
200	265	515	735	950	1165	1740	2090	2360	2690	3150	3310	4860
250	300	595	895	1165	1465	2225	2635	2930	3285	3720	3855	5755
1½-inch Regulators												
30	190	350	490	630	770	1050						1310
40	205	385	560	700	875	1225						1595
50	215	405	595	770	945	1400	1575					1890
60	230	420	615	790	965	1435	1610	1890				2175
70	245	435	635	810	985	1470	1680	1960				2470
80	260	450	660	835	1010	1505	1750	2030	2240			2760
90	275	475	680	855	1030	1540	1820	2100	2380			3050
100	285	490	700	875	1050	1575	1890	2170	2520	2870		3345
125	300	530	755	945	1155	1715	2065	2380	2730	3150		4060
150	315	575	820	1050	1295	1890	2275	2625	2975	3430	3640	4795
175	330	615	880	1120	1400	2065	2485	2835	3220	3745	3955	5530
200	345	665	945	1225	1505	2240	2695	3045	3465	4060	4270	6265
250	385	770	1155	1505	1890	2870	3395	3780	4235	4795	4970	7420
2-inch Regulators												
30	215	400	560	720	880	1200						1495
40	230	440	640	800	1000	1400						1825
50	250	465	680	880	1080	1600	1800					2160
60	265	480	705	905	1105	1640	1840	2160				2490
70	280	495	730	930	1130	1680	1920	2240				2825
80	295	510	750	950	1150	1720	2000	2320	2560			3150
90	310	545	775	975	1175	1760	2080	2400	2720			3490
100	330	560	800	1000	1200	1800	2160	2480	2880	3280		3825
125	345	610	865	1080	1320	1960	2360	2720	3120	3600		4640
150	360	655	935	1200	1480	2160	2600	3000	3400	3920	4160	5480
175	375	705	1010	1280	1600	2360	2840	3240	3680	4280	4520	6320
200	390	760	1080	1400	1720	2560	3080	3480	3960	4640	4880	7160
250	440	880	1320	1720	2160	3280	3880	4320	4840	5480	5680	8400

(Continued from the preceding page)

Example: Unlike most capacity tables, these are designed to show accurate and complete capacity ratings under any combination of varying operating conditions. For example, assume a regulator is desired that will reduce 100 psi inlet steam pressure to approximately 40 psi on the outlet and deliver steam at a normal rate of 225 pounds per hour. Adjusted for 40 psi maximum or dead-end outlet pressure, the ½-inch regulator will deliver this rate of flow when the outlet pressure has dropped 8 pounds, or is 32 psi; this regulator would have additional capacity (up to 410 pounds per hour with an outlet pressure of 20 psi), for warming up periods, and at the same time would have an ample range of lower capacity at 35, 36, 37, 38, and 39 psi outlet pressure, when the required rate of flow was less than normal. If originally adjusted to 48 psi maximum or dead-end outlet pressure, this regulator would deliver the desired rate of flow at 40 psi, but the pressure in the outlet would build up to a maximum of 48 psi when the flow demand ceased entirely.

The ¾-inch regulator would also deliver this rate of flow, at about 30 psi if adjusted to 40 psi dead-end outlet pressure, or at about 40 psi if adjusted to 44 psi dead-end outlet pressure. The 1-inch regulator would also deliver this rate of flow with only about 2 pounds change between the dead-end and the normal-flow outlet pressures, but it would be too large for most satisfactory operation, etc.

Choose the regulator on the basis of its capacity to provide the desired rate of flow without requiring manual attention of the regulating wheel and within acceptable limits of variation between the dead-end outlet pressure and the actual outlet pressure under the desired flow conditions. Use of the regulating wheel can, of course, narrow these limits if manual adjustment is made following changes in flow demand.

These regulators are not recommended for use where the desired outlet pressure is more than 80 per cent of the inlet pressure.

See pages 328 and 329 for description of regulators and explanation of operating characteristics.

Air Capacities

Inlet Pressure	Rate of Flow of Free Air In Cubic Feet per Minute, at 70° F. — Pounds Change in Outlet Pressure to Obtain Rate of Flow											
Psi	1	2	3	4	5	8	10	12	15	20	25	Maximum No Regulation
½-inch Regulators												
30	10	18	25	32	39	53						66
40	10	19	28	35	44	62						81
50	11	20	30	39	48	71						96
60	12	21	31	40	49	72	81	92				110
70	12	22	32	41	50	74	85	99				125
80	13	23	33	42	51	76	89	103	114			140
90	14	24	34	43	52	78	92	107	121			155
100	15	26	35	44	53	80	96	111	128	146		170
125	16	27	38	48	58	87	105	121	138	160		206
150	16	29	41	53	65	96	115	133	151	174	184	244
175	17	34	45	57	71	105	126	144	163	190	200	280
200	18	37	48	62	76	114	137	154	176	206	216	318
250	20	39	59	76	96	146	172	192	215	243	252	376
¾-inch Regulators												
30	18	32	44	57	69	94						117
40	18	34	50	62	78	110						143
50	19	35	53	69	85	126						170
60	21	37	55	71	87	127	143	163				195
70	21	39	57	73	88	131	150	175				221
80	23	41	58	74	90	135	158	182	202			248
90	25	42	60	76	92	138	163	189	214			274
100	27	46	62	78	94	142	170	196	227	258		300
125	28	48	67	85	103	154	186	214	244	283		365
150	28	51	73	94	115	170	204	235	267	308	326	432
175	30	60	80	101	126	186	225	255	289	336	354	495
200	32	65	85	110	135	202	242	273	312	365	382	565
250	35	69	104	135	170	258	304	340	380	430	446	665
1-inch Regulators												
30	31	56	77	99	121	164						205
40	31	59	87	109	136	192						251
50	34	62	93	121	149	220						298
60	37	65	96	124	152	223	251	285				341
70	37	68	99	127	155	229	264	307				388
80	40	71	102	130	158	236	276	319	353			434
90	43	74	105	133	161	242	285	332	375			480
100	47	81	109	136	164	248	298	344	397	453		525
125	50	84	118	149	180	270	326	375	428	496		640
150	50	90	127	164	202	298	356	412	468	540	570	755
175	53	105	140	177	220	326	390	446	505	590	620	870
200	56	115	149	192	236	353	425	477	545	640	670	985
250	62	121	183	236	298	453	533	595	665	755	780	1165

Inlet Pressure	Rate of Flow of Free Air In Cubic Feet per Minute, at 70° F. — Pounds Change in Outlet Pressure to Obtain Rate of Flow											
Psi	1	2	3	4	5	8	10	12	15	20	25	Maximum No Regulation
1¼-inch Regulators												
30	54	98	136	174	212	288						358
40	54	103	152	190	239	337						440
50	60	109	163	212	261	386						520
60	65	114	168	217	266	391	440	500				595
70	65	119	174	223	272	402	462	540				680
80	71	125	179	228	277	413	483	560	620			760
90	76	130	185	233	282	424	500	580	655			840
100	81	141	190	239	288	434	520	605	695	795		925
125	87	147	206	261	315	472	570	655	750	870		1120
150	87	157	223	288	353	520	625	720	820	945	1000	1325
175	92	185	244	310	386	570	685	780	885	1030	1085	1520
200	98	201	261	337	413	620	745	835	955	1120	1175	1725
250	109	212	320	413	520	795	935	1045	1165	1320	1370	2040
1½-inch Regulators												
30	70	126	175	224	273	371						462
40	70	133	196	245	308	434						565
50	77	140	210	273	336	497						670
60	84	147	217	280	343	505	565	645				770
70	84	154	224	287	350	520	595	695				875
80	91	161	231	294	357	530	625	720	800			980
90	98	168	238	301	364	545	645	750	845			1085
100	105	182	245	308	373	560	670	775	895	1020		1190
125	112	189	266	336	406	610	735	845	965	1120		1440
150	112	203	287	371	455	670	805	930	1055	1220	1290	1710
175	119	238	315	399	497	735	880	1010	1140	1330	1400	1960
200	126	259	336	435	530	800	960	1080	1230	1440	1510	2225
250	140	273	413	530	670	1020	1205	1345	1505	1700	1765	2630
2-inch Regulators												
30	80	144	200	256	312	424						530
40	80	152	224	280	352	496						650
50	88	160	240	312	384	570						770
60	96	168	248	320	392	575	650	735				880
70	96	176	256	328	400	590	680	790				1000
80	104	184	264	336	408	610	710	825	910			1120
90	112	192	272	344	416	625	735	855	965			1240
100	120	208	280	352	424	640	770	890	1025	1170		1360
125	128	216	304	384	464	695	840	970	1105	1280		1650
150	128	232	328	424	520	770	920	1065	1210	1390	1470	1950
175	136	272	360	456	570	840	1010	1150	1305	1520	1600	2240
200	144	296	384	496	610	910	1095	1230	1410	1650	1730	2545
250	160	312	472	610	770	1170	1375	1535	1720	1945	2015	3010

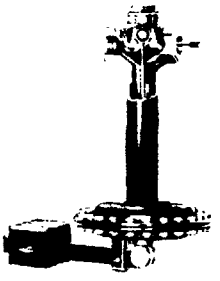
Klipfel Ball-Type Pressure Reducing Valves

MAXIMUM INLET PRESSURES
Screwed Ends — **250** pounds steam
Standard Flanged Ends — **125** pounds steam
Extra Heavy Flanged Ends — **250** pounds steam

For Steam, Water, Air, or Gas

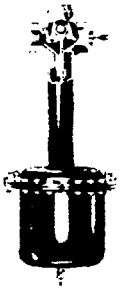


No. 400
Spring Loaded
For 10 to 50 pounds reduced pressure

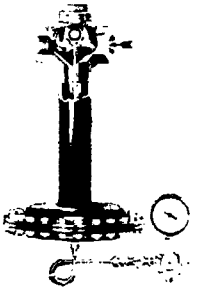


No. 410, Single Lever
For vacuum to 20 pounds reduced pressure

No. 411, Twin Levers
For 20 to 40 pounds reduced pressure



No. 431
Air Loaded
Dome Type
For vacuum to 150 pounds reduced pressure



No. 432
Air Loaded
Pilot Controlled
For 0 to 150 pounds reduced pressure

These valves include several improvements which contribute to closer regulation of reduced pressure, greater capacity, tight closing, and durability. The ball is very hard stainless steel and is free to seat perfectly. Grinding-in is never required. The streamlined form of the opening between the ball and seat and the large body passages permit a great volume of flow. The stainless steel seat is beveled at a sharp angle to fit the ball tightly along a narrow line of contact. The guides are integral with the seat.

The internal Pitot tube control in Nos. 410, 411, 431, and 432 Valves avoids the use of an external feeler pipe. The Pitot tube, rather than an external feeler pipe, is more satisfactory for most applications.

Range of sizes: The valves are available in sizes ⅜, ½, ¾, 1, 1¼, and 1½-inch with screwed ends only, and in sizes 2 and 2½-inch with screwed, standard flanged, or extra heavy flanged ends. End flanges on flanged valves are faced and drilled.

Materials: These valves have a bronze body in sizes 1½-inch and smaller; larger sizes have semi-steel bodies. All sizes have a stainless steel ball and seat. No. 400 has a semi-steel bracket and diaphragm chamber. The other valves have a wrought steel water leg, diaphragm chamber, or air dome.

No. 400: In this valve, seven interchangeable springs are available, each adapted to handle a limited portion of the 10 to 75-pound reduced pressure range. The bracket is attached directly to the body in all sizes for increased strength and rigidity.

Operation: The spring holds the diaphragm up so that the valve remains open until the reduced pressure, transmitted through the feeler pipe, is great enough to move the diaphragm and force the ball to the seat.

No. 410: This valve is recommended for steam heating service, process work, and other applications where reduced pressures from 0 to 20 pounds are required. When so ordered, the lever can be arranged for vacuum service. The reduced pressure is adjusted by changing the weights on the lever.

Operation: The diaphragm is balanced between the loading force exerted by the weight, and the reduced pressure transmitted through the diagonal Pitot tube from the body outlet into the water leg. Any increase or decrease in reduced pressure moves the diaphragm to close or open the valve until normal pressure is restored and diaphragm is again in balance.

No. 411: This valve is the same as No. 410 except that it is equipped with two independent levers for symmetrical distribution of loading on reduced pressures from 20 to 40 pounds.

No. 431: This is a perfected design of Dome Type, Air Loaded, Reducing Valve. It can accommodate reduced pressures from vacuum to 150 pounds by merely changing the air pressure pumped into the dome to equal the desired reduced pressure. The accuracy and sensitivity of regulation is uniform over the entire range of adjustment.

Operation: The tank or dome is filled with air to the required pressure by an ordinary tire pump. The elastic pressure of air (or other gas) confined in the tank or dome, is utilized to load the diaphragm and balance it against the reduced pressure.

No. 432: This valve is recommended for use where the reduced pressure must be changed frequently. When connected to a source of compressed air at sufficiently high pressure, the pilot valve is adjusted to maintain a loading pressure on the diaphragm equal to the desired reduced pressure. This valve is convenient for remote control.

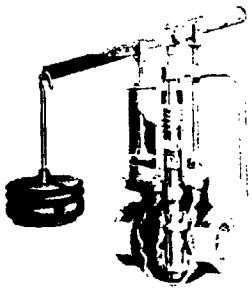
The complete valve includes pressure gauge, 6 feet of copper tubing, fittings, Schrader air valve, and pilot valve where such parts are required.

Operation: A small, adjustable pilot valve maintains a constant air pressure under the diaphragm equal to the desired reduced pressure. The Pitot tube produces a sucking effect which lowers the pressure in the water leg as the flow increases, thereby causing the valve to open more and deliver a slightly rising pressure as the demand increases.

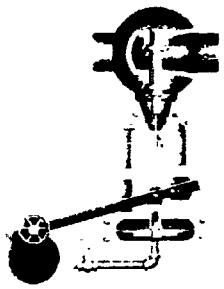
Prices on application

Klipfel Pressure Reducing Valves

MAXIMUM INLET PRESSURES
Standard — Screwed Ends — **150** pounds steam
Standard — Flanged Ends — **125** pounds steam
Extra Heavy — Screwed or Flanged Ends — **250** pounds steam



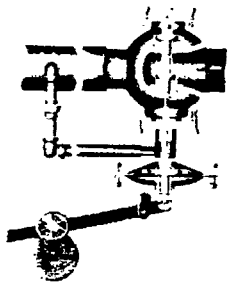
No. 1, For Steam Only
Piston Type
10 to 150 pounds
reduced pressure



No. 38, For Steam,
Water, Air, or Gas
Vacuum to medium
reduced pressures



No 300, For Steam,
Water, Air, or Gas
10 to 75 pounds
reduced pressure



No. 310, For Steam,
Water, Air, or Gas
Vacuum and low
reduced pressures

Range of sizes: Sizes ⅜, ½, ¾, 1, 1¼, and 1½-inch are furnished with screwed ends only; sizes 2, 2½, 3, 4, 5, and 6-inch are furnished with screwed ends, standard flanged ends (F. & D.), or extra heavy flanged ends (F. & D.); sizes 8, 10, and 12-inch (available in Nos. 38 and 310 valves only) are furnished with standard flanged ends (F. & D.) or extra heavy flanges (F. & D.)

Materials: These valves have a bronze body in sizes 1½-inch and smaller; sizes 2-inch and larger have semi-steel body. All sizes are bronze trimmed.

No. 1: No. 1, for steam only, has a long water sealed piston which is balanced between the reduced pressure in the valve outlet and the weighted lever. The oil filled dashpot insures steady operation. The desired reduced pressure should be specified so that the right piston size and correct number of weights can be furnished. The inner valve has a close sliding fit in the seats, but is not perfectly tight closing.

Operation: Steam enters at the right end of the body and flows through the ports of the balanced inner valve into the outlet chamber where its pressure balances the piston against the weight and lever. Any rise or fall in reduced pressure moves the piston which gradually closes or opens the valve until normal pressure is restored.

No. 38: This valve is suitable for ordinary fluids not injurious to a rubber diaphragm, for reduced pressures up to 35 pounds. The diaphragm chamber is separated from the valve body for cooler operation of the diaphragm on steam lines. This valve may be used as a steam pump governor by connecting the feeler pipe from the pump discharge to the diaphragm chamber. The double seated inner valve is almost tight closing. This valve will also operate in the inverted position.

Operation: Used as a reducing valve, a feeler pipe with a restricting valve connects the tapped opening in the diaphragm chamber to the outlet pipe. The weight on the left end of the lever holds the valve open until the reduced pressure is sufficient to raise the diaphragm and close the valve. Regardless of changes in initial pressure a constant reduced pressure is maintained as it must always balance the diaphragm against the constant force exerted by the weight and lever.

No. 300: This valve is used for handling ordinary fluids up to 250 pounds inlet pressure and for any reduced pressure between 10 and 75 pounds. Springs are made extra long and compressed nearly solid when installed. Much more accurate regulation at a specified pressure is obtained in this way than is possible with a short spring or one only partly compressed. Interchangeable springs of different gage wire are available, each for the best regulation within a moderate range of adjustment. Adjustment of the reduced pressure is accomplished by turning the nuts on the side rods. The valve will operate just as well in an inverted position.

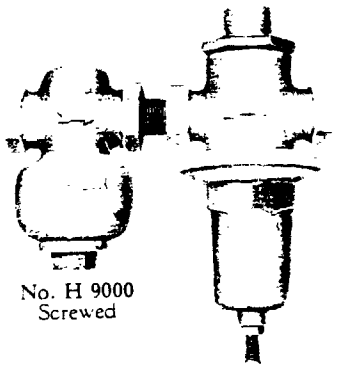
Operation: The spring holds the diaphragm up and the valve fully open until the reduced pressure, transmitted from the outlet pipe through the feeler pipe, is sufficient to force the diaphragm down and partially close the valve. Any change in reduced pressure moves the diaphragm and inner valve in a direction to restore the normal set pressure.

No. 310: This valve is suitable for handling any ordinary fluid which is not injurious to a rubber diaphragm. It is widely used for low pressure steam or vacuum heating. The large area of the diaphragm and the absence of packing box friction promotes sensitive and accurate regulation regardless of changes in inlet pressure and required capacity. When used for cold fluids, this valve may be inverted.

Operation: The reduced pressure, transmitted from the valve outlet through the diagonal drilled hole and down to the diaphragm chamber, balances the diaphragm against the force exerted by the weight and lever. Any rise in this pressure moves the inner valve toward the closed position. A drop in outlet pressure allows the valve to open farther. The reduced pressure is raised by adding more weights on the lever.

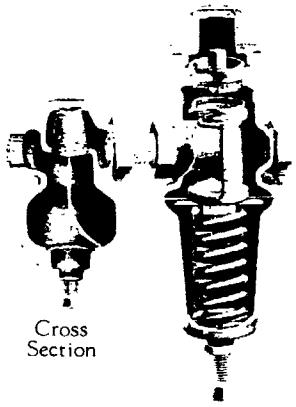
Prices on application

Mueller Water Pressure Regulators


No. H 9000
Screwed

Service recommendations: The No. H9000 Regulators are suitable for use on hot and cold water, air, and liquid soap lines, and are particularly adapted for industrial service.

Pressure range: The valves are regularly made for initial pressures from 40 to 250 pounds and delivery pressures from 25 to 75 pounds. They can be furnished to order for any initial pressure up to 250 pounds or for delivery pressures from 5 to 125 pounds (special springs required). The valves are set for 45 pounds delivery pressure unless otherwise ordered. Orders should specify catalog number, size, inlet and outlet pressures, and service.


Cross Section

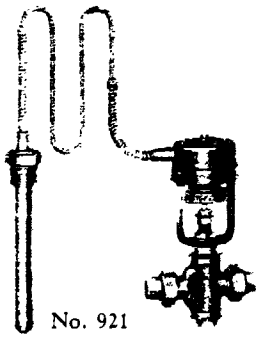
Construction: These regulators are furnished with strainers, completely assembled. The regulating valve, made entirely of brass and bronze (2½-inch size has an iron body), has full seat opening and can supply a full volume of water at the reduced pressure. The special composition diaphragm will withstand a pressure of 800 pounds. A special composition disc is not affected by hot water. The removable seat ring, disc, and diaphragm make repair possible without removing the valve from the line.

Dimensions, in Inches

Size	¼	⅜	½	¾	1	1¼	1½	2	2½
End to end, assembly	5 1/16	6⅜	7 7/16	8 15/16	9 13/16	12 11/16	14½	17⅜	20
Center to top	1 7/16	2¼	2¼	3½	3⅛	3½	4	4 13/16	5⅜
Center to bottom	4 15/16	5½	7	8	8	10¼	10 13/16	14 3/16	16¼

31

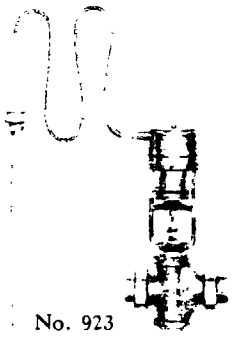
Fulton Sylphon Temperature Regulators


No. 921

Fulton regulators are used for heating, ventilating, air conditioning, and industrial process temperature control.

These regulators are furnished with a No. 12 B Bulb made of copper with fittings of brass. Brass armor covers the flexible copper tubing between the bulb and regulator. The copper tubing is regularly furnished 8 feet long.

Temperature range: The Fulton Temperature Regulators are regularly furnished in selected, variable temperature ranges of 40° to 480° F. and are adjustable between limits of any temperature range selected.


No. 923

Valve Sizes and Pressures

Valve size	Inches	¼	⅜	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10
*Pressure Limits, Pounds	No. 921	165	100	175	175	110										
	No. 923			250	250	175	175	130	85	65	55	40				
	No. 931			250	250	175	250	225	85	65	85	60	50	40	15	10

*Pressure drop across valve.

No. 921 Temperature Regulator: The No. 921 Regulator is available in valve sizes ¼ to 1-inch. Valve sizes ¼ and ⅜-inch are equipped with a direct acting valve with stainless steel trim. Valve sizes ½ to 1-inch are direct-acting having steel union ends and bronze trim. A reverse-acting valve can be furnished at extra cost. The No. 921 is available with thermometer mounted on top if specified.

No. 923 Temperature Regulator: The No. 923 Regulator has a direct-acting valve with bronze trim. A reverse-acting valve is available at extra cost. Valve sizes ½ to 1½-inches have steel union ends; larger sizes have flanged ends (125-pound A.S.A. rating). The No. 923 has an indicating sc[illegible] and is available with thermometer mounted on [illegible] if specified.

No. 931 Temperature Regulator: The No. 9[illegible] Regulator is used in industrial processes where [illegible] definite temperature is required. This regulator is furnished with a direct-acting valve in sizes ½ to 5-inch with bronze trim.

A reverse-acting valve will be furnished at additional cost. Valve sizes ½ to 1½-inch have steel union ends, and valve sizes 2-inch and larger have flanged ends (125-Pound A.S.A. rating)

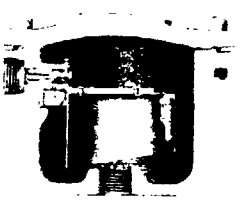
Prices on application

Inverted Open Float Steam Traps

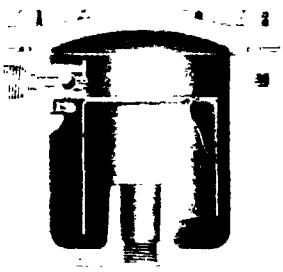
(Patent Pending)

General Description

Fuel is wasted and efficiency greatly reduced unless condensate is drained from steam lines as rapidly as it accumulates. At the same time, the practice of recovering condensate for heating, for hot water needs or for return to boilers saves many fuel dollars.



No. 9810



No. 9812



No. 9820

Typical cross sections of Crane Inverted Float Steam Traps

Both of these operations are performed efficiently and economically with Crane Inverted Open Float Steam Traps. They provide a simple, trouble-free method for removing condensate from steam piping, separators, and all types of steam heated equipment.

Construction: These traps are small and compact, but have high discharging capacities, and are free from complex operating mechanisms. They are extremely simple, having only one major moving part, the float, which actuates the disc through a simple lever. The disc is ball-type and is guided to its seat; it holds pressure easily. The body has an internal inlet nozzle which retains the water seal and precludes the possibility of live steam passing through the trap. A small hole in the top of the float allows air and other non-condensable gases to accumulate at the top of the trap.

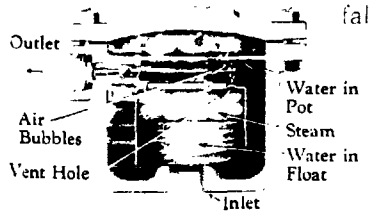
The cover or cap is bolted to the body, the joint being fitted with a Cranite gasket. ½-inch Traps have a 1/16-inch raised face on the body and cap; larger sizes have a male and female joint. Bolts are arranged so that the cap can be assembled in one position only, at which the word "Outlet" on the cap is directly over that opening on the side of the body.

Materials: On the Nos. 9810, 9811, 9812, 9813, and 9814 Traps the body and cap are made of cast iron; On the Nos. 9820 and 9821, these parts are Ferrosteel. All Traps have a renewable Exelloy seat bushing and fulcrum rod, and a 16 per cent to 18 per cent chromium steel ball disc; these parts have excellent resistance to wear, erosion, and corrosion. The float, lever, and lever supports are made from brass, copper, or other non-corrosive materials. The Traps are unusually strong and durable.

Capacity: The capacity of any trap depends upon the effective seat pressure and the orifice size. The only force available to open the disc against the effective seat pressure in the trap is the weight of the float multiplied by the lever arm attached to the disc, and this is a fixed quantity for any one trap. As the effective seat pressure is increased the orifice area must be decreased. If the area is too large, the trap will fail to function. If the area is too small, the trap will function properly, but its capacity will be reduced.

Each trap is furnished with one of several sizes of seat orifices. Since both the capacity of the trap and the maximum pressure at which it can be used depend upon the size of the seat orifice, care should be exercised when ordering to see that both pressure and capacity are considered. See pages 336 and 337.

Operation

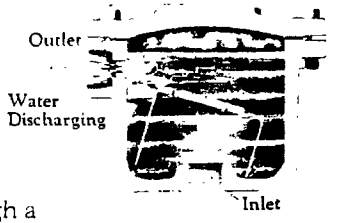


Trap Closed

Incoming steam under the float buoys the float up, keeping the outlet closed.

These traps are actuated solely by the rise and fall of the float resting on the accumulated condensate. The float is buoyant when filled with incoming steam, and the discharge valve is closed. When incoming condensate floods the float, it sinks, thereby opening the valve and permitting the condensate to be discharged by the effective pressure.

Air or other non-condensable gas vents through a small hole in the top of the float and collects in the upper part of the trap. At each operation, this air or gas is discharged. The entire cycle of operation is practically instantaneous. If the condensate accumulates at a rate equal to the trap capacity, continuous discharge may occur; for these conditions a larger capacity trap should be used.



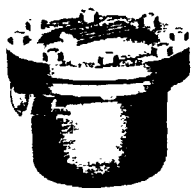
Trap Open

Incoming condensate fills the float, sinks it and opens the outlet.

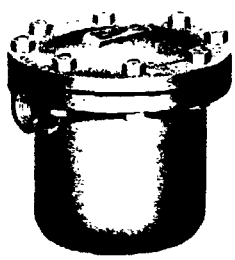
List prices, pressures, and dimensions page 336 *Capacities* page 337
Suggestions for installing traps page 339 *Sediment Separators* pages 342 and 343

Inverted Open Float Steam Traps

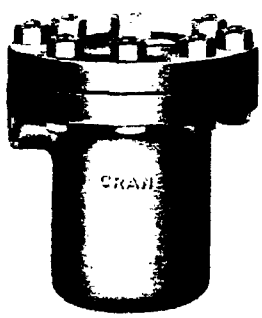
(Patent Pending)



No. 9810



No. 9811, No. 9812, No. 9813, and No. 9814



No. 9820 and No. 9821

RANGE OF WORKING PRESSURES
1 to 300 pounds saturated steam

How to order: Each trap is furnished with one of several sizes of seat orifices. Since both the capacity of the trap and the maximum pressure at which it can be used depend upon the size of the seat orifice, care must be exercised when selecting a trap to be sure that it will satisfy the needs of the installation. Capacities are shown on the opposite page; orifice sizes, maximum pressures, and seat numbers are shown in the table at the right.

When ordering, be sure to specify the catalog number and the maximum pressure. If the maximum pressure is not included, the order should state either the orifice size or the seat number.

List Prices and Dimensions

Catalog No. of Trap	List Price Each	Dimensions, in Inches		
		Pipe Size	Height	Diameter
No. 9810	13.50	1/2	4 1/2	5 3/8
No. 9811	21.00	1/2	7 3/8	7 1/2
No. 9812	21.00	3/4	7 3/8	7 1/2
No. 9813	33.50	3/4	11	8 1/2
No. 9814	50.00	1	12 3/16	8 3/4
No. 9820	37.50	3/4	9 5/8	8 3/8
No. 9821	65.00	1	11 15/16	9 7/8

Orifice Sizes, Maximum Pressures, and Seat Numbers

Catalog No. of Trap	Size of Orifice, Inches	Maximum Pressure (Marked on Trap), Psi	Seat Number
No. 9810	.059	150	16A
	1/16	125	15A
	5/64	75	14A
	3/32	50	13A
	1/8	30	12A
	5/32	15	11A
	3/16	5	10A
No. 9811 and No. 9812	3/32	200	26A
	1/8	150	25A
	5/32	100	24A
	3/16	50	23A
	1/4	30	22A
	5/16	15	21A
	11/32	5	20A
No. 9813	5/32	200	38A
	3/16	150	37A
	7/32	100	36A
	5/16	50	34A
	3/8	30	33A
	1/2	15	32A
	5/8	5	31A
No. 9814	7/32	200	36A
	1/4	150	35A
	5/16	100	34A
	3/8	50	33A
	1/2	30	32A
	5/8	15	31A
	11/16	5	30A
No. 9820	3/32	300	13A
	1/8	250	12A
No. 9821	5/32	300	24A
	3/16	250	23A

Capacity: Pipe size is not a measure of the capacity of a trap to discharge condensate or water. Capacity is determined by the design and construction of the trap, the size of the orifice, and the effective seat pressure. Crane Inverted Open Float Steam Traps have large capacity, as shown on the opposite page; they should be selected on the basis of their ability to discharge the maximum rate of condensation expected in the system.

Safety factor: Since condensate loads are difficult to determine and since intermittent discharge is preferred to continuous discharge, it is necessary to select a trap which allows some factor of safety between its actual continuous discharge capacity and the condensation rate of the system. A 2 to 1 safety factor is the smallest recommended, and selecting traps with three or four times more capacity than is expected is often considered good practice. Where heavy condensate loads must be discharged in a short time, as during warming-up periods, the selection of the trap should be based on the period in minutes in which it will be necessary to evacuate the condensate.

Maximum pressure: The maximum pressure at which each orifice for each trap will operate is shown in the large table on this page and also across the top of the table on the opposite page; this pressure is stamped on the cover of the trap. The traps will operate at the lower pressures for which capacities are given, but not at pressures higher than the maximum.

Effective seat pressure: The effective seat pressure, also known as "differential pressure", is the net difference between the inlet and outlet pressures on the trap. To determine the effective seat pressure, subtract the outlet pressure from the inlet pressure; when discharging into a vacuum, the effective seat pressure is the inlet pressure plus 1 pound for each 2 inches of vacuum. Where the inlet and outlet pressures vary, use the minimum effective seat pressure to determine the size of orifice for the capacity required, and use the maximum effective seat pressure to determine the maximum pressure of the trap.

General description and operation . page 335
Capacities . . . . . page 337
Suggestions for installation . page 339

Inverted Open Float Steam Traps
Continuous Discharge Capacities in Pounds of Water per Hour

Effective Seat Pressure Lbs. per Sq. in.		No. 9810							No. 9811 and No. 9812							No. 9813							No. 9814							No. 9820	No. 9821		
		Orifice Size, Inches																															
		.059	1/16	5/64	3/32	1/8	5/32	3/16	3/32	1/8	5/32	3/16	1/4	5/16	11/32	5/32	3/16	7/32	5/16	3/8	1/2	5/8	7/32	1/4	5/16	3/8	1/2	5/8	11/16	3/32	1/8	5/32	3/16
		Maximum Pressure—Pressure Marking on Trap																															
		150	125	75	50	30	15	5	200	150	100	50	30	15	5	200	150	100	50	30	15	5	200	150	100	50	30	15	5	300	250	300	250
1								385							1300							4295							5200				
2	3 & 4					240	370	535					955	1490	1805						3815	5970					3815	5970	7225				
5				145	205	370	575	830			575	830	1475	2300	2785				2300	3315	5890	9205			2300	3315	5890	9205	11135				
	6 to 9			145	205	370	575				575	830	1475	2300					2300	3315	5890				2300	3315	5890	9205					
10	11 to 14	110	125	195	280	500	785			500	785	1130	2015	3145				1540	3145	4530	8050		1540	2015	3145	4530	8050	12580					
15		135	155	240	345	615	955		345	615	955	1380	2455	3835			1380	1880	3835	5520	9815		1880	2455	3835	5520	9815	15340					
	16 to 19	135	155	240	345	615			345	615	955	1380	2455				1380	1880	3835	5520			1880	2455	3835	5520	9815						
20	21 to 24	155	175	275	390	700			390	700	1090	1575	2800			1090	1575	2140	4370	6295			2140	2800	4370	6295	11190						
25	26 to 29	175	195	305	440	785			440	785	1225	1765	3140			1225	1765	2405	4895	7060			2405	3140	4895	7060	12540				785		1765
30		185	210	330	475	850			475	850	1320	1905	3385			1320	1905	2595	5290	7620			2595	3385	5290	7620	13350				850		1905
	31 to 39	185	210	330	475				475	850	1320	1905				1320	1905	2595	5290				2595	3385	5290	7620					850		1905
40	41 to 49	215	245	380	545				545	970	1550	2180				1550	2180	2970	6060				2970	3880	6060	8725				545	970	1550	2180
50		240	270	420	605				605	1075	1690	2430				1690	2430	3310	6735				3310	4320	6735	9710				605	1075	1690	2430
	51 to 59	240	270	420					605	1075	1690					1690	2430	3310					3310	4320	6735					605	1075	1690	2430
60	61 to 74	260	295	460					660	1175	1840					1840	2650	3610					3610	4715	7365					660	1175	1840	2650
75		285	325	510					710	1295	2030					2030	2915	3975					3975	5190	8095					710	1295	2030	2915
	76 to 89	285	325						710	1295	2030					2030	2915	3975					3975	5190	8095					710	1295	2030	2915
90	91 to 99	310	355						795	1410	2205					2205	3175	4320					4320	5645	8820					795	1410	2205	3175
100		325	370						825	1470	2300					2300	3305	4505					4505	5880	9170					825	1470	2300	3305
	101 to 124	325	370						825	1470						2300	3305						4505	5880						825	1470	2300	3305
125		365	415						930	1655						2590	3725						5075	6625						930	1655	2590	3725
	126 to 149	365							930	1655						2590	3725						5075	6625						930	1655	2590	3725
150		390							1000	1770						2775	3990						5435	7100						1000	1770	2775	3990
	151 to 174								1000							2775							5435							1000	1770	2775	3990
175	176 to 199								1105							3065							6005							1105	1955	3065	4405
200									1170							3250							6365							1170	2075	3250	4670
	201 to 224																													1170	2075	3250	4670
225	226 to 249																													1270	2270	3545	5000
250																														1310	2325	3640	5110
	251 to 274																													1310		3640	
275	276 to 299																													1345		3740	
300																														1375		3825	

Safety factor: The table above shows actual continuous discharge capacities. A safety factor of at least 2 to 1 should be used when selecting a trap, to assure intermittent discharge and reserve capacity in case of errors in estimating condensate loads; see explanation on opposite page.

Effective seat pressures: The increments commonly used for listing effective seat pressures are shown in bold face in the column at the left. To avoid unnecessary interpolation and the danger of overlooking the maximum pressure of the trap, intermediate pressure ranges have been added in light face. See opposite page for explanation of effective seat pressures.

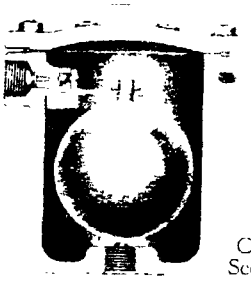
Figures enclosed by heavy lines: For easy identification, the most advantageous capacities for each orifice in each trap have been enclosed by heavy black lines. For example, assume a trap is needed on a 15-pound line to discharge (including safety factor) 250 pounds of water per hour against 5 pounds outlet pressure (10 pounds effective seat pressure).

The No. 9810 Trap would fill this need, with orifices and capacities as follows: 3/32-inch, 280 lbs.; 1/8-inch, 500 lbs.; or 5/32-inch, 785 lbs. The latter (figure enclosed within heavy black lines) would be the best choice from the standpoint of intermittent discharge, liberal safety factor, etc.

Air Vent or Water Drain Valves

Ball Float Type

(Patent Pending)



Cross Section

RANGE OF WORKING PRESSURES
1 to 150 pounds as Air Vent Valve
1 to 125 pounds as Water Drain Valve

This is a simple, efficient, and economical device for automatically removing air from water or oil piping or pressure vessels, or for automatically removing water or oil from compressed air systems. The valves are not suitable for use on steam services.



No. 976 or No. 977

Air Vent Valve: When used to remove air from water or oil-laden systems, the valve should be installed at the highest point in the system where air will collect. Normally filled with water or oil, as the air accumulates it displaces the liquid in the body, causing the float to drop and opening the valve. As the air is discharged and the water or oil re-enters the body, the float rises and closes the valve to prevent the escape of the liquid.

List Prices and Dimensions

Valve	No. 976	No. 977
List Prices Each	17.00	34.50
Pipe size Inches	½	¾
Height Inches	6⅜	7⅜
Diameter Inches	5⅝	7½

Water Drain Valve: When used to remove water or oil from air-laden systems, they must be installed in an inverted position (upside down), at the lowest point to which the liquid will naturally gravitate. The cycle of operation is the reverse of that described in the paragraph above.

Materials: These valves are sturdy and ruggedly constructed. The body and cap are cast iron, the joint being fitted with a Cranite gasket and bolted. The seat is Exelloy; the disc, ball type and guided to the seat, is made of 16 to 18 per cent chromium steel. The ball float is copper.

How to order: Each valve is furnished with one of two sizes of seat orifices, which determines both the capacity and the maximum pressure of the valve; see the capacity table at the upper right. When ordering, specify the catalog number and the maximum pressure, the orifice size, or the seat number.

Capacity: These valves should be selected on the basis of their capacity, allowing an ample factor of safety (at least 2 to 1) between the maximum capacity required for the system and the continuous discharge capacity of the valve in order to assure intermittent discharge.

Continuous Discharge Capacities at 70° F.

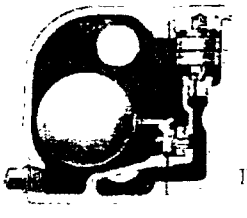
Effective Seat Pressures Lbs. per Sq. In.		Cubic Feet of Free Air per Minute				Lbs. Water per Hr. (Inverted Position)			
		No. 976		No. 977		No. 976		No. 977	
		Orifice Size, Inches							
		5/64	1/8	3/32	5/32	5/64	1/8	3/32	5/32
		Maximum Pressure—Marked on Cap							
		150	30	150	30	125	30	125	30
		Seat Number							
		14A	12A	26A	24A	14A	12A	26A	24A
1		1.1	2.9	1.7	4.6	65	170	95	270
2	3 & 4	1.2	3.1	1.8	4.9	95	240	135	370
5	6 to 9	1.4	3.7	2.0	5.7	145	370	205	575
10	11 to 14	1.8	4.6	2.6	7.2	195	500	280	785
15	16 to 19	2.2	5.6	3.1	8.7	240	615	345	955
20	21 to 24	2.5	6.5	3.7	10.0	275	700	390	1090
25	26 to 29	2.9	7.5	4.2	11.6	305	785	440	1225
30		3.3	8.4	4.7	13.0	330	850	475	1320
	31 to 39	3.3		4.7		330		475	
40	41 to 49	4.0		5.8		380		545	
50	51 to 74	4.7		6.8		420		605	
75	76 to 99	6.6		9.4		510		710	
100	101 to 124	8.4		12.0		575		825	
125		10.2		14.7		650		930	
	126 to 149	10.2		14.7					
150		12.0		17.3					

Note: The increments commonly used for listing effective seat pressures are shown in bold face in the column at the left. To avoid unnecessary interpolation and the danger of overlooking the maximum working pressure of the valve, intermediate pressure ranges have been added in light face.

Maximum pressure: The maximum pressure at which each orifice will operate is shown in the capacity table, and is stamped on the cap of the valve. The valve will operate at lower pressures, but not at pressures higher than the maximum

Effective seat pressure: The effective seat pressure is the net difference between the inlet and outlet pressure on the valve.

Float and Thermostatic Traps



50 Series Float and Thermostatic Trap

These Hoffman Traps find wide application in steam heating installations. The 50 Series Float Trap (not illustrated) is used for removing condensate only; the 5[illegible] Series Float and Thermostatic Trap (illustrated at the left) has both a float mechanism for removing condensate and a thermostatic element, permitting air to by-pass to the trap outlet to avoid air binding. The traps are made in sizes ¾ to 2-inch, with capacities up to 12 [illegible] pounds of condensate per hour; prices and additional information will be furnished on request

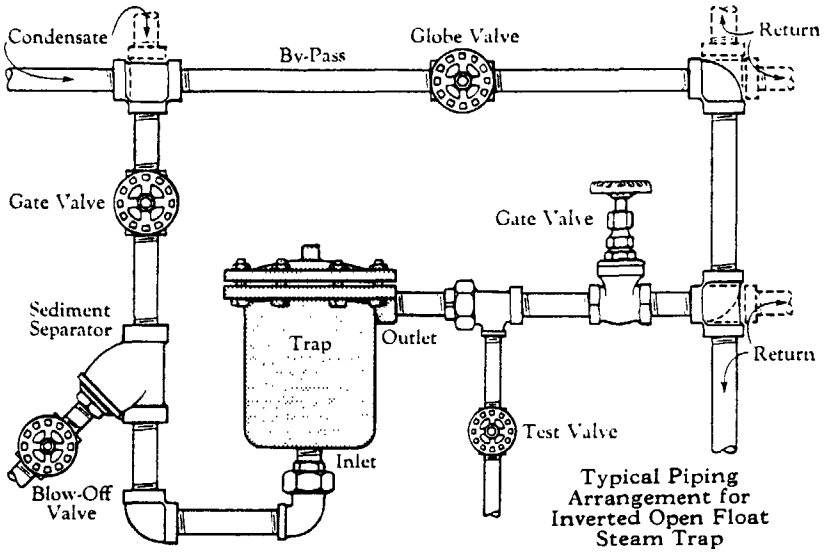
Installation
Steam Traps and Air Vent or Water Drain Valves

Use Crane Plug Type Disc Globe or Angle Valves for all throttling service.

Crane Inverted Open Float Steam Traps, Air Vent Valves, and Water Drain Valves can only be used for discharging to regions where the pressure is less than that in the trap or valve. They can be used to discharge into a back pressure or vacuum, but the pressure rating of the trap or valve must be greater than (a) the difference between the back pressure and the inlet pressure or (b) the sum of the vacuum and the inlet pressure. For complete description, capacities, etc., see pages 335 to 338.

These products are thoroughly and carefully tested before shipment. Properly selected and installed, they will give many years of satisfactory and efficient service. The illustrations on this page show a preferred, typical piping arrangement for each of these products, so designed that the trap or valve is accessible for the periodic inspection and cleaning that usually accompanies the use of any automatic device.

Blow new lines clear of all foreign matter before installing traps, air vent valves, or water drain valves.

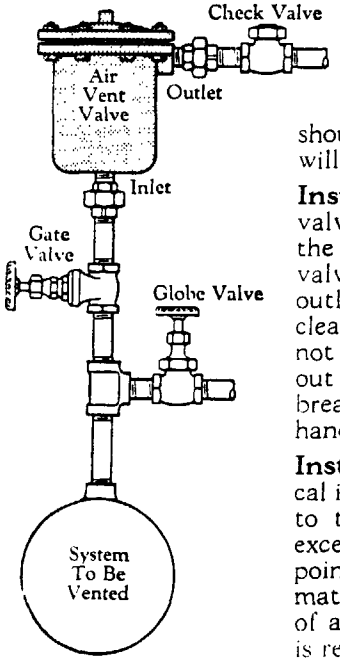


Typical Piping Arrangement for Inverted Open Float Steam Trap

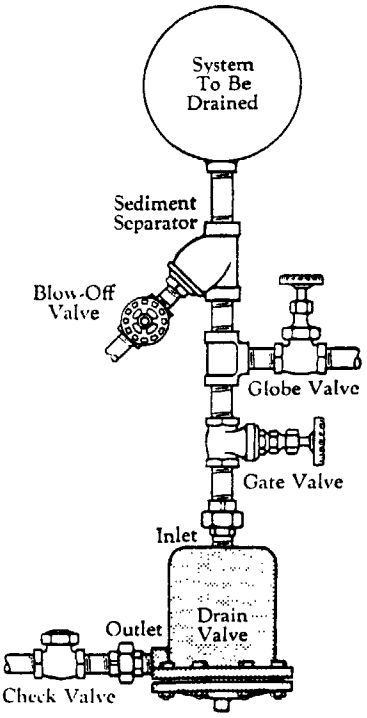
Installation of Steam Traps: Wherever possible, install the trap below the lowest point in the system, with the line leading to the trap pitched downward to assure good drainage. Use a sediment separator just ahead of the trap to prevent scale, sediment, and other foreign matter from entering the trap and interfering with proper operation; a valve on the separator will make it possible to periodically blow-out accumulated foreign matter. The gate valves in the inlet and outlet lines, when shut, permit isolating the trap for inspection and cleaning. If only the gate valve in the outlet line is closed, the test valve can be opened to observe the operation of the trap; if the trap is functioning properly, there will be no flow of water between periods of discharge, nor any flow of steam. A by-pass line with a globe valve makes it possible to rid the system of condensate by hand throttling while the trap is out of service. A check valve (not illustrated) should be used in the outlet or return line where two or more traps are discharging into a common line; should one trap be shut down, the check valve will prevent back flow from the remaining units.

Installation of Air Vent Valves: Install the valve at the highest point in the system, pitching the inlet line upward to the vent valve. A gate valve in the inlet line and the check valve in the outlet make it possible to isolate the valve for cleaning and inspection. The check valve will not allow air to pass back into the system; without it, the air vent valve will also act as a vacuum breaker. The globe valve permits venting by hand throttling when the gate valve is shut.

Installation of Water Drain Valves: The typical installation for the water drain valve is similar to that of the air vent valve described above except inverted, with the valve at the lowest point in the system. In addition, since foreign matter will tend to collect at low points, the use of a sediment separator with blow-off valve also is recommended.



Typical Piping Arrangement for Air Vent Valve



Typical Piping Arrangement for Water Drain Valve

Do not install an air vent or water drain valve where it can freeze.

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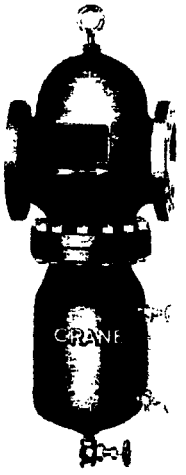
Steam and Oil Separators



Horizontal
No. 07, 125-Pound
No. 011, 250-Pound

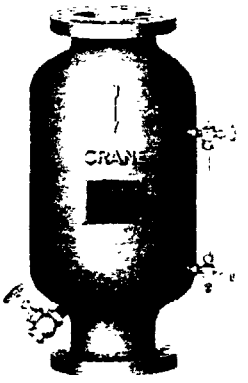
WORKING PRESSURES
125-Pound — **125** pounds saturated steam
250-Pound — **250** pounds saturated steam

Service Recommendations: Horizontal Separators are recommended for use in live steam lines to remove condensation from the steam before it is used in steam-heated apparatus, such as cooking kettles, evaporators, heating systems, etc. They can also be used as oil separators.

Vertical Separators are used to remove condensation from vertical lines with downward flow, such as steam lines to turbines, pumps, etc.

List prices of 125-Pound Horizontal Separators include a nipple, a No. 438 Brass Gate Valve for drain, and a No. 610 Water Gauge.

List prices of 250-Pound Horizontal and Vertical Separators include a nipple, a No. 362 E Brass Globe Valve for drain, and a No. 616 Water Gauge.



Vertical
With Top Inlet
No. 013, 250-Pound

List Prices, Each (Flanged, Faced, and Drilled)

Size	Inches	1½	2	2½	3	3½	4	5	6	8	10	12
Horizontal	No. 07, 125-Pound	85.00	99.50	121.00	149.00	178.00	206.00	270.00	348.00	476.00	603.00	710.00
	No. 011, 250-Pound	94.00	110.00	133.00	163.00	195.00	227.00	298.00	383.00	522.00		
Vertical	No. 013, 250-Pound	94.00	110.00	133.00	163.00	195.00	227.00	298.00	383.00	522.00		

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Construction and materials: These separators afford an efficient, economical means of removing free oil and condensate. Their large areas, the ample size and proper shape of their baffle surfaces, and the location of their openings, assure the highest degree of efficiency with the lowest possible pressure drop.

The 125-Pound Separators are made of cast iron. The 250-Pound Separators are made of Ferrosteel, the No. 011 having a cast iron drip pocket.

Flange dimensions: End flanges of 125-Pound and 250-Pound Separators conform to the American Cast Iron Flange Standards, Class 125 (B16.1-1948) and Class 250 (B16b-1944), respectively.

Drilling: List prices of all separators include facing and drilling to the particular standard applying, as listed above. No deduction is made for separators ordered faced only.

Importance of proper size: To secure maximum efficiency, separators should be selected on the basis of the amount of steam to be handled, not on existing pipe sizes. Too small a separator means too high a velocity, resulting in poor separation. To secure a proper size separator, use the following formula:

$$C = \frac{A \times B \times 2.4}{V}$$

in which C = Area of inlet in square inches
A = Pounds of steam per hour
B = Volume in cubic feet per pound of steam at given pressure
V = Velocity in feet per minute (7000 max.)

Welded Steel Steam Receiver Separators

Crane can supply Steel Steam Receiver Separators of the welded type. Of high quality, and carefully and accurately fabricated, they conform to the A.S.M.E. Boiler Construction Code for Unfired Pressure Vessels.

Inquiries and orders for receiver separators must be accompanied by complete specifications, including drawings showing the size and location of all openings. Prices on application.

Dimensions, in Inches

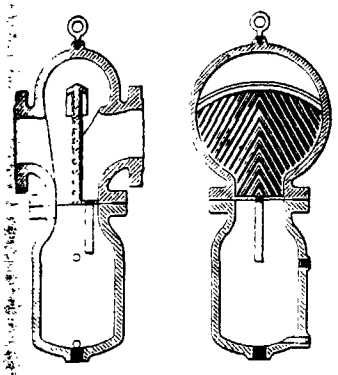
Size of Separator		1½	2	2½	3	3½	4	5	6	8	10	12
Horizontal	Face to face	10	10	11	12	14	14	16	17	20	23	26
	Center to top	4	4¾	5½	9½	11	11¼	12¾	15	18	22	26½
	Center to bottom	17	17	18½	20⅛	22½	23¼	26⅛	28¾	34½	40⅜	45
	Greatest width	6⅝	7¾	8¾	9½	11⅛	12	14¼	16½	21	25	29
Vertical	Face to face	27	27	27	29	31	31	33	38	41		
	Greatest diameter	11	10¾	10⅞	12⅜	14	14	15⅞	17⅜	20		
Size of drain		½	½	¾	1	1	1	1¼	1¼	1¼	1½	1½
Size of valve for drain		½	½	½	½	½	½	½	½	1	1	1½
Center to center of water gauge		6	6	6	6	6	10	10	10	*14	14	14

General description *page 341*

*10" on the No. 013

Templates for drilling . . . pages 439 and 440

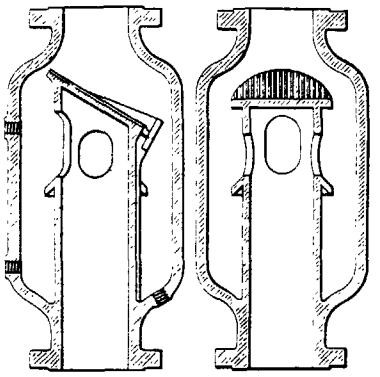
Steam and Oil Separators (Cont.)



Side Section End Section
Horizontal Separators

PRINCIPLE OF DESIGN

The design of Crane Steam and Oil Separators is based upon a scientific principle involving the tendency of a non-elastic body to move in a straight line. Water and oil entrained in flowing steam are non-elastic; therefore, if the direction of the steam flow is abruptly changed, these fluids will tend to be precipitated out of the current. If the velocity of the flowing steam is greatly decreased at the same time, the precipitation of the fluids will be increased, and there will be no tendency to pick them up again as the dry steam passes the baffle plates.



Side Section End Section
Vertical Separators

A necessity in steam-consuming plants: In handling steam, it is essential the steam be delivered at its point of usage as moisture-free as possible.

In live steam lines, condensation is always a source of loss, whether the steam is to be used to drive an engine, turbine, or pump, or whether the steam is to be used as a heating medium.

In exhaust steam lines, oil from the engines or pumps renders the steam unfit for further use as a heating medium or for direct return to the boilers. Oil in pipes, radiators. etc., checks free radiation of heat. Oil in boilers combines with water impurities, and if present in any appreciable quantity, forms a thick insulating coating over the heating surface.

Crane Steam and Oil Separators remove such condensation and oil efficiently and economically.

Horizontal separators: The bodies of horizontal separators provide a greatly enlarged cross section resulting in a lower velocity of the entering steam. Midway of this enlarged section, a corrugated baffle plate, interposed in the flow, frees the steam of most of its entrained moisture. The steam rises over the top of the baffle, and deflected by the curved walls of the head, strikes the corrugations of the reverse side of the baffle before passing on.

The corrugations of the baffle plate run at an angle to the current of steam, affording ready drainage as well as effectively preventing the steam from picking up and carrying globules of water or oil over the top of the baffle. The normal flow of steam is away from the accumulation of condensate in the separator, which also aids in separation.

Vertical separators: Vertical separators employ the same principles of design as the horizontal type, but due to the change in form, there are certain necessary changes in structural details, which do not alter their effectiveness.

Automatic drainage: To secure maximum efficiency, all separators must be properly drained. This drainage should be automatic and only the best of steam traps should be used; see pages 335 to 337.

Cast Iron Drip Pockets



No. 420, 125-Pound
No. 422 E, 250-Pound

WORKING PRESSURES

125-Pound—**125** pounds steam
250-Pound—**250** pounds steam

Drip Pockets are tapped for water gauge. Drip Pockets for 250 pounds steam, 450° F., are made to order of Ferrosteel at a 25 per cent advance in price.

Service recommendations: Drip pockets are used primarily as condensation collectors, but also aid in keeping the pipe line clean by receiving foreign matter. They should be located where condensation is most likely to collect.

Size: Full size drip pockets, corresponding to the size of the line on which they are applied, should always be used except on lines larger than 12-inch. The 12-inch size, used with a reducing fitting, is large enough for steam lines from 12 to 24-inch.

Flange dimensions: Flanges on 125-Pound and 250-Pound Drip Pockets conform to the American Cast Iron Flange Standards, Class 125 (B16.1-1948) and Class 250 (B16b-1944), respectively. Prices include facing and drilling (F. & D.) to the Standard applying; no deduction for drip pockets ordered faced only.

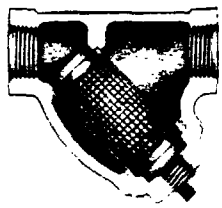
List Prices, Each, and Dimensions, in Inches

Size Inches		2½	3	3½	4	5	6	8	10	12
Flanged, F. & D.	No. 420, 125-Pound	33.00	36.50	40.00	43.00	50.00	61.50	91.50	133.00	200.00
	No. 422 E, 250-Pound	40.50	44.50	48.50	52.70	60.70	75.00	111.00		
Overall height		13⅛	14⅛	16	16¼	18⅛	20¼	24½	28½	32
Size of drain		¾	1	1	1	1¼	1¼	1¼	1½	1½
Size of tapping for water gauge		½	½	½	½	½	½	½	½	½
Center to center of tappings		6	6	6	10	10	10	14	14	14

Templates for drilling, pages 439 and 440.

Y-Pattern Sediment Separators

Iron Body and Cast Steel



Typical
Cross Section
Iron Body, Screwed

WORKING PRESSURES			
	Sediment Separator	Saturated Steam	Cold water, oil, or gas
Iron Body	125-Pound	125 pounds	200 pounds
	250-Pound	250 pounds	500 pounds
Cast Steel	Rated for 600 pounds steam, 950° F. Other ratings same as 600-Pound Screwed Gate Valves, page 226.		



Iron Body, Screwed
*No. 988½, 125-Pound
*No. 990½, 250-Pound



Iron Body, Flanged
No. 989½, 125-Pound
No. 991½, 250-Pound

*Nos. 988½ and 990½ Separators 1½-inch and smaller have a screwed cap, as illustrated; larger sizes have a flanged cap

List Prices and Dimensions

Screwed—Iron Body and Cast Steel

Size			Inches	¼	⅜	½	¾	1	1¼	1½	2	2½	3
No. 988½, 125-Pound (Iron)			Each	4.00	4.00	4.60	5.30	6.40	8.00	10.20	19.50	24.00	31.50
No. 990½, 250-Pound (Iron)			Each			5.20	6.00	7.20	9.00	11.30	21.50		
No. 994 D, 600-Pound (Steel)			Each			†	26.00	33.00	44.00				
Dimensions in Inches	End to end			3¼	3¼	3¾	4¼	5	6	7	8½	10	11½
	Center to extreme bottom	Iron		2¼	2¼	2¾	3	3¾	4½	5¼	8	9¼	10½
		Steel					4	4½	5½				
	Size of blow-off			⅜	⅜	⅜	½	¾	¾	1	1	1¼	1¼



600-Pound
Cast Steel
No. 994 D
Screwed

Flanged, F. & D.—Iron Body

Size			Inches	2	2½	3	4	5	6	8	10	12
No. 989½, 125-Pound			Each	28.00	34.00	44.00	88.50	122.00	178.00	Prices on application		
No. 991½, 250-Pound			Each	32.50	39.00	51.00	102.00	153.00	223.00			
Dimensions in Inches	Face to face	No. 989½		10¾	11⅞	13¼	16¼	18	20½	25	31	34
		No. 991½		11¼	12½	14	17	19	21½	26	33	36
	Center to extreme bottom	No. 989½		8	9¼	10½	13	15	16½	20	24½	28
		No. 991½		8	9¼	10½	13	15½	17	20½	25	28
	Size of blow-off			1	1¼	1¼	1¼	1½	1½	2	2	2

†½-inch No. 994 D Cast Steel Sediment Separators can be made from the ¾-inch size, using steel face bushings; price furnished on application

Service recommendations: Crane Y-Pattern Sediment Separators are used to protect equipment against damage from dirt, grit, scale, and all foreign matter in steam, water, air, oil, and gas lines.

The No. 994 D Separators are used where severe services require the durability and strength of steel.

Features: These separators are simple in design and rugged in construction. Their large screening area makes them exceptionally efficient. Internal parts are readily accessible. The separators not only prevent passage of foreign matter, but also furnish a pocket for its accumulation, from which the matter can be easily removed through the blow-off connection. The connection is fitted with a plug.

Materials: The iron body separators have a screwed brass cap on sizes 1½-inch and smaller and a bolted iron cap on larger sizes.

The cast steel separators have a body and bolted cap made of Crane No. 4 Carbon-Molybdenum Alloy Cast Steel. The joint between the body and cap is of the male and female type, being equipped with a metallic gasket held in place by Triplex Steel studs.

Screens: The strainer element is a Monel mesh screen rolled into the shape of a cylinder. The ends are reinforced. One end fits into a recess in the diagonal wall of the body and the other is retained by the cap. The screen is secure; it will not loosen in service.

The mesh type of screen is furnished for greater efficiency and increased screening area. The screening area in Crane Separators is much greater than the area of the pipe (more than 500 per cent on the 20 mesh screen), assuring free fluid flow with minimum pressure loss.

20 mesh Monel screens (400 holes per square inch) suitable for service on steam, water, and medium or heavy oils, are regularly furnished with the separators. When specified, 40 mesh Monel screens (1600 holes per square inch) can be furnished at no additional charge, for service on air, gas, gasoline and light oils.

Finer mesh screens, perforated screens, or screens made of steel or 18-8 Chrome-Nickel Alloy can be furnished when so ordered; prices on application.

Flange dimensions and drilling: Inlet and outlet flanges on the No. 989½ Sediment Separators conform to the American Cast Iron Flange Standard, Class 125 (B16.1-1948); on the No. 991½, the flanges conform to the American Cast Iron Flange Standard, Class 250 (B16b-1944).

Prices of flanged sediment separators include facing and drilling (F. & D.) to the Standard applying. No deduction is made if they are ordered faced only.

Templates for drilling *pages 439 and 440*

Iron Body Sediment Separators

125-Pound

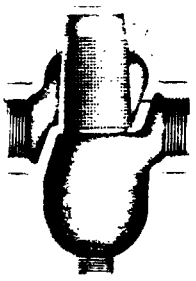


No. 986
Screwed

WORKING PRESSURES
125 pounds saturated steam
200 pounds cold water, oil or gas

List Prices and Dimensions

Size	Inches	½	¾	1	1¼	1½	2	2½	3
No. 986	Each	3.20	4.00	5.20	6.40	8.80	13.60	19.00	25.00
End to end	Inches	3⅛	3¾	4¼	5	5½	6¾	8	9½
Center to top	Inches	1¾	2¼	2⅞	3 5/16	3 13/16	5	7	8
Center to bottom	Inches	2⅜	2¾	3⅜	4	4 9/16	5½	7	8½
Size of drain	Inches	½	½	¾	¾	1	1	1¼	1¼


Cross Section

ervice recommendation: Dirt and pipe scale in iping conveying steam, water, air, oil, and other fluids e serious trouble makers, frequently cutting the seats d discs of valves and interfering with the operation automatic devices and machines.

rane Sediment Separators will effectively remove foreign matter passing through the lines in which ey are installed. They not only prevent the passage such matter but furnish a pocket for its accumuion, from which the matter can be easily blown.

onstruction: No. 986 Separators have a cast iron dy and a brass screwed cap in sizes 1½-inch and naller; 2-inch and larger have a bolted iron cap.

he strainer element is a brass screen rolled into the m of a frustrum of a cone, one end of which seats the cap and the other on a machined surface in the bridge wall of the body. The area through the screen is much greater than the area of the pipe size. Unrestricted flow to the line fluid is assured even when some of the holes are clogged with foreign matter.

Screens: Unless otherwise ordered, these separators are furnished with screens having perforations .057-inch in diameter (135 holes per square inch) and are then suitable for steam, water, and medium or heavy oils. For air, gas, gasoline, volatile oils, and fuel oils, screens having perforations .033-inch in diameter (331 holes per square inch) will be furnished.

When finer perforations are desired, .02-inch diameter perforated screens (952 holes per square inch) can be furnished from stock. Screens having any other diameter perforations can be furnished on special order.

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250-Pound


No. 988
Screwed

WORKING PRESSURES
250 pounds saturated steam
400 pounds cold water, oil, or gas

List Prices and Dimensions

Size	Inches	½	¾	1	1¼	1½	2	2½	3
No. 988	Each	5.00	6.20	8.00	10.00	13.50	21.00	26.00	34.50
End to end	Inches	3	3½	3½	3¾	4	4½	5⅜	6
Center to top	Inches	2⅛	2⅝	3	3½	3⅞	4¾	5¾	6½
Center to bottom	Inches	3⅛	4	4	4⅝	5¼	6½	8	9¼
Size of drain	Inches	½	¾	¾	1	1	1	1¼	1¼


Cross Section

eatures: Crane 250-Pound Sediment Separators, ke the 125-Pound described above, embody the four ssential principles of a good separator: arrestment f foreign matter, a pocket for its accumulation, rge screen area, and a vertical screen, allowing a rge percentage of the heavy particles to drop aturally to the pocket.

laterials: The strainer element is a flat brass screen pported between the body and cap by a malleable on grate.

he body and bolted cap are made of cast iron.

Screens: Unless otherwise ordered, these separators are furnished with screens having perforations .057-inch in diameter (135 holes per square inch) and are then suitable for steam, water, and medium or heavy oils. For air, gas, gasoline, volatile oils, and fuel oils, screens having perforations .033-inch in diameter (331 holes per square inch) will be furnished.

When finer perforations are desired, .02-inch diameter perforated screens (952 holes per square inch) can be furnished from stock. Screens having any other diameter perforations can be furnished on special order.

Dexter Automatic Separators



Type A Separator

Service recommendation: Dexter Separators, used to remove water, oil, and dirt from compressed air lines, are recommended for pressures up to 125 pounds.

Tools and equipment operate better and last longer when protected by these separators, since the elimination of water from the compressed air permits adequate lubrication, and prevents clogging by foreign matter or subjection to the abrasive action of pipe scale particles.

Spoilage of work is eliminated. Spray painting, air-jet cleaning, blowing dust from band saws, are typical operations that require the clean, dry air furnished by the Dexter Automatic Separators.

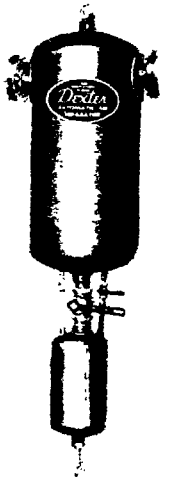
Type A Separators are used mainly for point-of-use installations—on service outlets in factory systems, and on portable compressors. These separators should be installed as close as possible to service outlets so there can be no further condensation in the lines. A shut-off cock at the inlet is recommended, to permit removal of the screen for cleaning.

The separators can be furnished complete with pressure regulating valve and pressure gauge for paint spray applications.

Type C Separators are made in the larger sizes required for installation in main lines of distribution systems. A shut-off cock permits removal of the screen for cleaning without interrupting the operation of the pipe line.

Construction: Types A and C are basically similar. They have the same welded tubular construction that provides strength and compactness without excessive weight.

Operation: Operation is based upon the simple principle that when compressed air is allowed to expand, the water and oil vapors contained in the air are precipitated.



Type C Separator

The practical application of this principle involves: (1) bringing about the necessar expansion without interrupting the free flow of a through the separator; (2) segregating the precip tated water and oil so that they cannot be picked u by the flowing air stream; and (3) venting the sepa rated water and oil into the atmosphere.

Operation is entirely automatic and continuous ex cept for the occasional cleaning of the screen t remove dirt and scum collected in the eliminato

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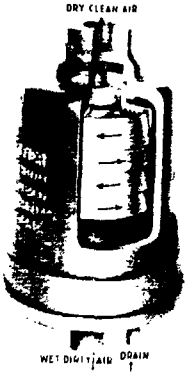
Dimensions, in Inches

Size		1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10
Type A	Width	1 3/4	2 3/4	2 3/4	2 3/4	5 1/2	5 1/2	8	8	9 1/2								
	Height	8	15	15	15	19 1/2	19 1/2	25	25	25								
Type C	Width				2 3/4	5 1/2	5 1/2	8	8	9 1/2	19 1/2	22	23 1/2	26 1/2	31 1/2	37 3/8	52 1/2	61 1/8
	Height				20	30 1/2	30 1/2	35 1/2	35 1/2	36	62 1/8	72	84 9/16	87 3/4	98 1/16	111 3/8	127 3/16	141 13/1

Logan Aridifiers



Aridifier with a section of the casing cut out to show top spider, rotors, and drainage well.

This simple unit positively purges air and gas lines of moisture, oil, dirt, rust, and fine scale. By removing moisture from compressed air, it eliminates freezing, fouling, corrosion, and rapid tool wear.

Dimensions, in Inches

Type	Size of Pipe	Over-all Diameter	Overall Height
Threaded	3/8	4 5/16	4 3/4
Threaded	1/2	4 3/4	7
Threaded	3/4 to 1	7	8 1/2
Threaded	1 1/4 to 1 1/2	7 3/4	9 1/4
Threaded	2	8 7/8	10 1/8
Flanged	3	12 3/4	9
Flanged	4	14 1/2	10 3/16
Flanged	6	18 5/8	12

In sand and shot blast equipment, the Aridifier pr vents caked sand. Where air is used for spraying air brushing, it eliminates defective finishes. Clo ging of orifices and premature wear resulting fro foreign particles are prevented. It is recommend for pressures up to 150 pounds.

The Logan Aridifier consists primarily of a rugge nickel-iron casing having an air inlet at the low end and an outlet at the upper end. It enclos series of rotors mounted, free to revolve, on stainl steel grease-packed bearings, and having incline vanes through which air may pass.

Each alternate rotor has its vanes inclined in th opposite direction to prevent the air stream fro whirling. As air passes through the rotor, water, o or foreign matter is thrown outward by centrifug force and runs down the inner wall of the casing t the drain.

State c.f.m. and air line pressure when ordering.

Prices on application

Swartwout Cast Iron Exhaust Heads

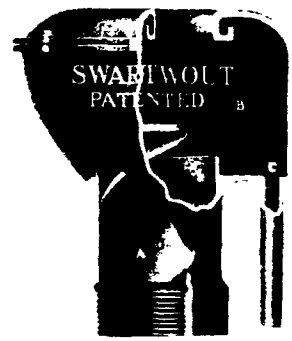
Swartwout Exhaust Heads effectively remove water and oil from exhaust steam discharging to atmosphere. If exhausted direct from the pipe, water and oil would tend to deteriorate roofs and side walls of buildings.

These exhaust heads neither interrupt nor slow down the flow of steam; nor is there any appreciable back pressure. Oil and water are removed simultaneously and only dry steam passes out into the atmosphere.

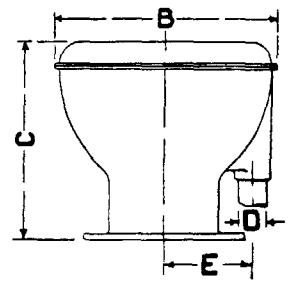
Construction: Centrifugal force, utilized in the design of the Swartwout Exhaust Head, is responsible for the removal of oil and water without any change in the direct flow of steam. Although made of cast iron, the exhaust heads are light. They are durable, ornamental, and rustproof. Once in position, there is no further expense for replacement, except where plant expansion necessitates the use of a larger head.

Flange dimensions and drilling: The end flange on flanged Exhaust Heads conforms to the American Cast Iron Flange Standard, Class 125 (B16.1-1948).

Prices include facing and drilling to this Standard. No reduction in price is made if Exhaust Heads are ordered faced only.



Swartwout Exhaust Head



These exhaust heads are made with a screwed connection in sizes 5-inch and smaller, and with a flanged connection in larger sizes.

Prices on application

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Dimensions, in Inches

Screwed					Flanged, F. & D.				
Size Inches	B	C	D	E	Size Inches	B	C	D	E
1	7 3/4	8 1/8	1/2	2 7/8	6	16	14 7/8	1	6 3/8
1 1/4	7 3/4	8 1/8	1/2	2 7/8	8	18 3/4	17 7/8	1 1/4	7 1/2
1 1/2	7 3/4	8 1/8	1/2	2 7/8	10	23	21 3/4	2	9 3/8
2	9	10	3/4	3 5/16	12	28 1/2	25	2 1/2	11 3/4
2 1/2	9	10	3/4	3 5/16	14	30 1/2	27	2 1/2	12 7/8
3	9 3/4	10 3/4	3/4	4 1/16	16	34 1/4	30 1/2	3	14
3 1/2	9 3/4	10 3/4	3/4	4 1/16	18	38	33 7/8	3	15 11/16
4	11 1/2	11 11/16	1	4 15/16	20	41 1/4	38 3/8	3 1/2	16 3/4
4 1/2	11 1/2	11 11/16	1	4 15/16	24	56 1/2	46	4	19 1/2
5	13 7/8	13 1/4	1	5 1/2	30	62	57	4	24 1/2

Expansion in Pipe Lines

The expansion for any length of pipe may be found by the following method: from the table below, obtain the difference in increased length at the minimum and maximum temperatures, divide this result by 100 to obtain the increase in length per foot, and multiply by the length of the line in feet.

Linear Expansion

Temp. Degrees F.	Inches per 100 Feet				Temp. Degrees F.	Inches per 100 Feet				Temp. Degrees F.	Inches per 100 Feet	
	Steel	Wrought Iron	Brass	Copper		Steel	Wrought Iron	Brass	Copper		Steel	Wrought Iron
0	0	0	0	0	340	2.76	2.87	4.30	3.95	680	5.965	6.20
20	.15	.155	.25	.25	360	2.935	3.05	4.58	4.15	700	6.17	6.42
40	.30	.31	.45	.45	380	3.11	3.235	4.85	4.40	720	6.375	6.625
60	.455	.475	.67	.65	400	3.29	3.43	5.14	4.64	740	6.58	6.835
80	.61	.63	.92	.87	420	3.465	3.62	5.45	4.89	760	6.79	7.05
100	.77	.80	1.17	1.10	440	3.65	3.805	5.73	5.15	780	6.99	7.275
120	.915	.96	1.41	1.35	460	3.835	4.00	5.96	5.37	800	7.21	7.49
140	1.075	1.13	1.69	1.57	480	4.02	4.19	6.25	5.64	820	7.415	7.73
160	1.235	1.29	1.91	1.77	500	4.21	4.39	6.55	5.88	840	7.63	7.93
180	1.40	1.46	2.15	2.00	520	4.39	4.58			860	7.84	8.145
200	1.57	1.64	2.43	2.25	540	4.59	4.78			880	8.055	8.37
220	1.73	1.81	2.71	2.52	560	4.78	4.975			900	8.28	8.60
240	1.89	1.98	2.97	2.74	580	4.975	5.175			920	8.495	8.82
260	2.065	2.16	3.22	2.95	600	5.17	5.38			940	8.72	9.05
280	2.23	2.335	3.47	3.17	620	5.365	5.58			960	8.945	9.28
300	2.41	2.52	3.76	3.42	640	5.565	5.785			980	9.17	9.52
320	2.59	2.70	4.07	3.70	660	5.765	5.99			1000	9.40	9.75

125-Pound Expansion Joints

Brass



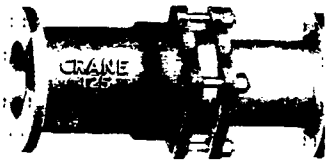
Semi-Guided, Screwed
No. 404
Standard Traverse
No. 406
Special Traverse

WORKING PRESSURES
125 pounds saturated steam
200 pounds cold water, oil, or gas

Iron Body



Semi-Guided, Screwed
No. 398
Standard Traverse
No. 400
Special Traverse



Semi-Guided, Flanged
No. 401
Standard Traverse
No. 403
Special Traverse

List Prices and Dimensions

Size	Brass Expansion Joints, Screwed: No. 404 Standard Traverse List Price	Trav-erse	End to end, open	No. 406 Special 6-inch Traverse List Price	Size	Iron Body Expansion Joints, Screwed: No. 398 Standard Traverse List Price	Trav-erse	End to end, open	No. 400 Special 6-inch Traverse List Price	Flanged, F. & D.: No. 401 Standard Traverse List Price	Trav-erse	Face to face, open	No. 40 Specia 6-inch Travers List Price
Inches	Each	Inches	Inches	Each	Inches	Each	Inches	Inches	Each	Each	Inches	Inches	Each
½	3.75	2	6⅜		1½	20.00	2½	13¾	26.50	27.00	2½	13⅜	33.50
¾	5.50	2¼	7¼	11.00	2	21.50	2½	13¾	29.00	29.50	2½	12⅛	37.00
1	6.50	2¼	7⅜	12.50	2½	25.00	2½	14½	34.00	35.00	2½	12¼	44.00
1¼	8.50	2¼	7⅜	15.50	3	32.50	2¾	15¼	46.50	44.50	2¾	13	58.50
1½	10.50	2¼	7⅝	18.50	3½	45.50	3	17¼		62.00	3	15	
2	18.50	2½	8⅜	28.50	4	53.00	3¼	18⅛	75.00	71.50	3¼	15¾	93.50
2½	30.00	2½	9⅛		5					93.00	4	17½	117.00
3	55.00	2¾	10⅜		6					108.00	4	19⅛	138.00
					8					135.00	4	19¾	
					10					185.00	4	21¾	
					12					270.00	4	23⅝	

Brass Expansion Joints: Crane brass semi-guided expansion joints are chiefly used in interior piping work, on steam and hot water heating lines, domestic hot water lines, and for air, oil, and gas service. The joints are sturdily constructed and well-proportioned. A large packing nut provides ample space for packing.

Iron Body Expansion Joints: The iron body semi-guided expansion joints are of good proportions throughout and are made of high quality materials. The stuffing box is of ample size; the bolted packing gland, carefully machined to guide the sleeves, assures uniform pressure on the packing.

Flanged end joints 6-inch and smaller and all screwed end joints have brass sleeves. Flanged end joints 8-inch and larger have steel sleeves, chromium-plated; brass sleeves can be furnished when desired; prices on application.

Iron joints are furnished with drain bosses. They will be tapped, when so ordered, at an extra price.

Packing: Expansion Joints are regularly furnished without packing in the stuffing boxes, unless specifically ordered packed, in which case an extra charge is made. Orders for packed joints must specify the kind of packing wanted, or give complete information on the fluid to be handled.

Crane Pipe Bends pages 484 to 486

Installation: To secure the maximum efficiency from expansion joints and to assure satisfactory operation, the pipe line must be properly anchored and guided to force the joints to compensate for expansion and contraction.

Over-all length of special traverse joints: To find the over-all length of special traverse joints, take the over-all length of the standard traverse joint of the same size and add twice the difference between the special traverse and the standard traverse.

End flanges: End flanges of flanged iron joints conform to the American Cast Iron Flange Standard Class 125 (B16.1-1948). List prices include facing and drilling to this Standard. When ordered faced only they will be furnished at the same price as for faced and drilled. See page 439 for drilling templates.

Special Iron Body Joints: When required, iron body joints can be furnished with an anchor base which will be drilled with four bolt holes. A service outlet which will be screwed can also be furnished. Prices on application.

All-Iron Expansion Joints will be furnished with steel sleeves, chromium-plated, unless otherwise specified. Prices on application.

Guided Expansion Joints page 348

Badger Expansion Joints

Non-Equalizing



Non-Equalizing
Flanged or
Welding Ends

The Non-Equalizing "Packless" Expansion Joint is used to relieve stress and absorb vibration between connecting equipment, and to compensate for changes in lengths of pipe lines due to temperature fluctuations.

This expansion joint is formed from single pieces of tubing. Heat-treated after forming, it retains its strength and flexing qualities, assuring long life.

The joint is made of copper for normal pressures and temperatures, or of stainless steel where corrosion is a problem. Special metals can be furnished to order.

This joint is limited to use on pipe lines with traverses not exceeding ½ inch, and for pressures from high vacuum to 25 pounds. It can be furnished round (any diameter), oval, rectangular, or in any special shape required, with either flanged or welding ends, and in any required length.

Self-Equalizing

With Directed Flexing Action



Self-Equalizing -- Welding Ends

This joint features "directed flexing," which distributes the flexing stress. The corrugations, working with the Directed-Flexing Rings, avoid excessive stress. The equalizing rings progressively control and limit the flexing movement as well as support the corrugated members for high pressures.

The joints are furnished in sizes up to 30-inch diameter. Single joints are available in traverses up to 6 inches; double joints, in traverses up to 12 inches.

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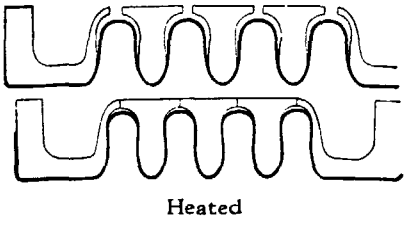
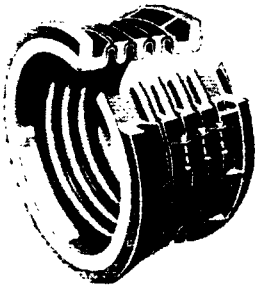
Principle of Directed Flexing Action



The Directed Flexing principle is based on the progressively-controlled movement of the all-curve corrugations by the correspondingly shaped equalizing rings. This principle of operation is shown in the illustration at the left.

The top portion of the illustration shows the position of the corrugations and equalizing rings while the pipe line is cold. The lower portion of the illustration shows their positions after the pipe line is heated.



Rubber Spool-Type Expansion Joints

For Vacuum Service

Style 4039

Dimensions and Ratings

Size Inches	Dimensions in Inches				*Ratings for Style 4140	
	A	B	C	D	Compression Inches	Working Pressure 180° F. Max.
6	6	1	½	6	.43	125 pounds
8	8	1⅛	¾	6	.43	115 pounds
10	10	1⅛	¾	6½	.43	115 pounds
12	12	1⅛	¾	6½	.68	115 pounds
14	14	1¼	¾	7½	.68	75 pounds
16	16	1¼	¾	7½	.68	60 pounds
18	18	1¼	¾	8	.68	60 pounds
20	20	1⅜	⅞	8	.68	60 pounds
24	24	1⅜	⅞	8¼	.81	50 pounds
30	30	1⅜	1	8¼	.93	50 pounds
36	36	1⅜	1	8½	.93	40 pounds

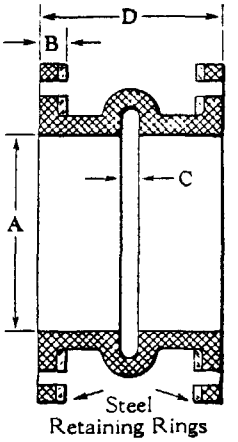
Style 4039 is recommended for 30 inches of mercury.

For Pressure Service

Style 4140

Rubber Spool-Type Expansion Joints are used on piping installations to avoid excessive stress, absorb vibration, and to eliminate undesirable sounds. The joints are reinforced with solid metal rings embedded in the carcass and with heavy duck. They also have full faced, fabric reinforced rubber flanges.

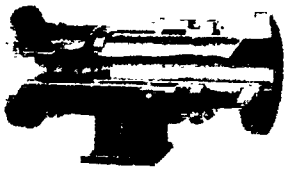
Smaller sizes, larger sizes, and other types of Rubber Expansion Joints can be furnished when required.



Prices on application

Adsco Iron and Steel Body Expansion Joints

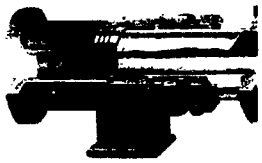
Internally Guided Type



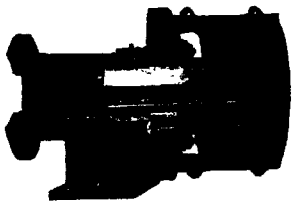
The small overall diameter permits installation in limited space. The slip is guided internally and cannot pull out of the body. The polished surface of the slip is not in contact with other metal parts.

Piston Ring (Internally Guided Type)

This expansion joint has no external guide, permitting installation where space is limited; otherwise it is similar to the type shown below. ***It can be packed under full operating pressure.*** Piping should be well guided.



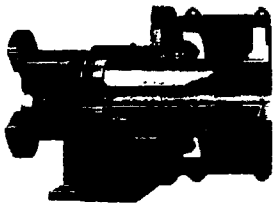
Internally — Externally Guided Type



The slip is fully guided at extreme ends throughout its entire length of travel. This feature is frequently called for in Army and Navy specifications. A two-piece removable external guide permits smaller manholes.

Piston Ring (Externally Guided Type)

This type is similar to the joint shown directly above. ***It can be packed under full operating pressure without interrupting service.*** Piston rings hold the line pressure during packing operation.



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Catalog Numbers of Types Available

Type	Semi-Steel 1¼ to 20-inch Pipe Size		Fabricated Steel 1½ to 20-inch Pipe Size		Semi-Steel 1½ to 20-inch Pipe Size		Fabricated Steel 1½ to 20-inch Pipe Size	
	125-Pound Standard	250-Pound Standard	150-Pound Standard	300-Pound Standard	125-Pound Standard	250-Pound Standard	150-Pound Standard	300-Pound Standard
	Internally Guided Type				Piston Ring, Internally Guided Type			
Single, No Base	S-1-IS	S-5-IS	S-151-IS	S-301-IS	S-1-P	S-5-P	S-151-P	S-301-P
Single, With Base	S-2-IS	S-6-IS	S-152-IS	S-302-IS	S-2-P	S-6-P	S-152-P	S-302-P
Double, With Base	D-2-IS	D-6-IS	D-152-IS	D-302-IS	D-2-P	D-6-P	D-152-P	D-302-P
	Internally-Externally Guided Type				Piston Ring, Externally Guided Type			
Single, No Base	S-1-GIS	S-5-GIS	S-151-GIS	S-301-GIS	S-1-PG	S-5-PG	S-151-PG	S-301-PG
Single, With Base	S-2-GIS	S-6-GIS	S-152-GIS	S-302-GIS	S-2-PG	S-6-PG	S-152-PG	S-302-PG
Double, With Base	D-6-GIS	D-6-GIS	D-152-GIS	D-302-GIS	D-2-PG	D-6-PG	D-152-PG	D-302-PG

Bodies, single or double, are fabricated steel or cast semi-steel, and are provided with a drip connection when specified. The bodies of these expansion joints can also be furnished with or without a base or service outlet connection for a branch line.

Slips, in cast semi-steel joints, are bronze in sizes 3½ inch and smaller, and chromium-plated steel in sizes 4-inch and larger. Both types of slips are equipped with Van Stone flanges. In fabricated steel joints, all slips are chromium-plated steel with steel flanges welded to the slips.

Stuffing boxes hold ample packing, assuring tight joints with minimum repacking

Packing is not regularly furnished with the expansion joints unless specified. When joints are ordered packed, the pressure, temperature, and fluid handled should be specified.

Packing glands are accurately machined. They ha a long lip to permit compression of the packing one-half the original depth.

Glands studs and nuts are of non-corrosive metal prevent freezing. The studs are embedded in the bo and furnish rigidity to the packing gland.

Service outlets for branch lines are in the form of service fitting in the Piston-Ring Type Joint. On other styles, the outlets are integral with the bo

Bases are integral with the body, and have four bo holes. Their heavy webs withstand severe strain.

The standard traverse is 4 inches per slip. Also fu nished with 8 and 12-inch traverses per slip.

Drip connections are provided when specified.

Lubrication fittings are provided when specifi Otherwise holes are tapped and plugged.

Prices on application

Gauges, Hydrant, Flexible Joints, Unit Heaters, and Miscellaneous Specialties

Water Gauges and Gauge Accessories
- Brass Water Gauges ..... page 350
- Gauge Glasses ..... page 351
- Gauge Glass Cutters ..... page 351
- Extra Guards for Water Gauges ..... page 351
- Siphons for Steam Gauges ..... page 351

Brass Try Cocks ..... page 351

Water Hydrant (Frost-Proof) and Hydrant Wrench ..... page 353
Buckeye Brass Whistles ..... page 352
Sherman Fusible Plugs ..... page 352

Joints
- Brass Swing Joints ..... page 351
- Barco Flexible Ball, Swivel, and Revolving Joints ..... page 354
- Chiksan Ball-Bearing Swivel Joints ..... page 355

Crosby Gauges and Recorders ..... pages 356 and 357
Marshalltown Gauges ..... page 357

Heating and Ventilating Equipment
- Sturtevant Unit Heaters ..... page 358
- Trane Unit Heaters ..... page 359
- Ilg Heating and Ventilating Equipment ..... page 360
- Reznor Gas-Fired Unit Heaters ..... page 361
- Hoffman-Economy Heating Pumps ..... page 361

McDonnell Boiler Controls ..... page 362
Steam Jet Pumps or Ejectors ..... page 362
Penberthy Injectors and Ejectors ..... page 363
Lubricators, Oilers, and Grease Cups ..... page 364

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The items referred to above are only a portion of the complete Crane line of specialties and of special duty valves. For other products of this nature, see pages 293 to 348.

For Brass Whistle Valves, see page 54.

For Corrosion-Resistant Alloy Liquid Level Gauges, see page 372.

For All-Iron Liquid Level Gauges, see page 396.

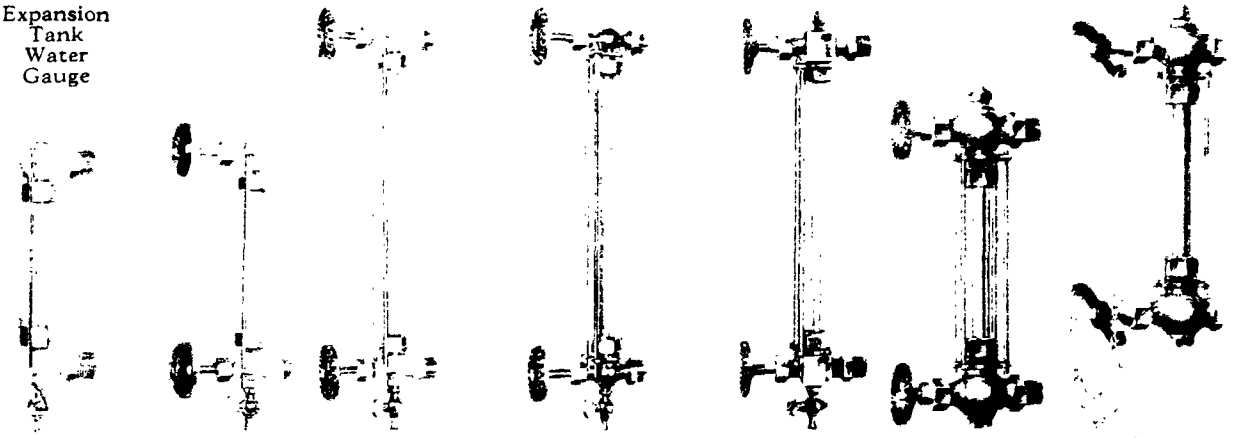


Valves, fittings, flanges, fabricated piping, specialties — all piping requirements can be had from one source when "Crane" is specified.

Brass Water Gauges

100-Pound 175-Pound 250-Pound

Expansion Tank Water Gauge



No. 623 Rough | No. 625 Rough | No. 624 Rough | No. 610 Polished | No. 616 Polished | No. 613 Polished | No. 615 Polished

For 100 pounds working pressure

For 175 pounds working pressure

For 250 pounds working pressure

Made with Crane Special Brass Bodies.

Center to Center of Valves

Unless otherwise ordered, the No. 610, No. 613, No. 615, No. 616, No. 624, and No. 625 Gauges are furnished with the centers shown below:

½-inch No. 610 . . . with 14-inch centers
¾-inch No. 610 . . . with 18-inch centers
¾-inch No. 613 . . . with 18-inch centers
¾-inch No. 615 . . . with 18-inch centers
½-inch No. 616 . . . with 14-inch centers
½-inch No. 624 . . . with 14-inch centers
½-inch No. 625 . . . with 8-inch centers

When other centers are required, orders must so specify.

The No. 623 Gauge regularly is furnished with 13½-inch centers, as listed in the table at the right. Any other center is considered special; prices on application.

Centers over 36 inches: When Water Gauges with centers greater than 36 inches are required, two Gauges of shorter lengths, staggered on the boiler, are recommended.

No. 613 Gauge: The lower valve of the No. 613 Water Gauge is drilled and tapped for a ⅜-inch drain.

By closing both valves and removing the cap at the top of the upper valve, the glass in this Gauge can be renewed while the boiler is under pressure.

List Prices and Dimensions

½-inch No. 610	Price, with 14″ or shorter centers	Each	13.50
	Extra for each inch over 14″, up to 36″		.08
	Size of glass for 14″ centers	Inches	⅝×12¾
	Length of guard rod for 14″ centers	Inches	14
¾-inch No. 610	Price, with 18″ or shorter centers	Each	20.00
	Extra for each inch over 18″, up to 36″		.08
	Size of glass for 18″ centers	Inches	¾×16
	Length of guard rods for 18″ centers	Inches	17
¾-inch No. 613	Price, with 18″ or shorter centers	Each	27.00
	Extra for each inch over 18″, up to 36″		.11
	Size of glass for 18″ centers	Inches	⅝×16
	Length of guard rods for 18″ centers	Inches	17
¾-inch No. 615	Price, with 18″ or shorter centers	Each	45.00
	Extra for each inch over 18″, up to 36″		.17
	Size of glass for 18″ centers	Inches	⅝×16
	Length of guard rods for 18″ centers	Inches	17
½-inch No. 616	Price, with 14″ or shorter centers	Each	16.00
	Extra for each inch over 14″, up to 36″		.08
	Size of glass for 14″ centers	Inches	½×12½
	Length of guard rods for 14″ centers	Inches	14
½-inch No. 623	Price, with 13½″ centers	Each	*
	Size of glass	Inches	⅝×12
½-inch No. 624	Price, with 14″ or shorter centers	Each	7.40
	Extra for each inch over 14″, up to 36″		.08
	Size of glass for 14″ centers	Inches	⅝×12¾
	Length of guard rods for 14″ centers	Inches	15
½-inch No. 625	Price, with 8″ or shorter centers	Each	7.30
	Extra for each inch over 8″, up to 36″		.06
	Size of glass for 8″ centers	Inches	⅝×6¾
	Length of guard rods for 8″ centers	Inches	9

*Price on application.

No. 615 Gauge: The No. 615 Gauge is especially suited for service on boilers having the Water Gauge above the reach of the operator. It is chain operated and regularly is furnished with chains that drop 12½ feet below the lower valve.

When the valves are open, the levers stand in a horizontal position. When the valves are closed, the levers stand at an angle of 45 degrees, with the right hand side down.

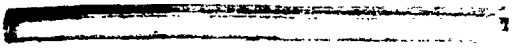
The lower valve of the No. 615 Water Gauge is drilled and tapped for a ⅜-inch drain.

By closing both valves and removing the cap at the top of the upper valve, the glass in this Gauge can be renewed while the boiler is under pressure.

Corrosion-Resistant Liquid Level Gauges . page 372 *Ammonia Liquid Gauges pa*

Water Gauge Accessories

PYREX
High Pressure Gauge Glasses

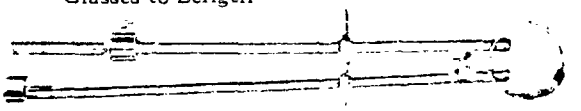


Dimensions, in Inches

Length	Outside Dia. ½	⅝	¾	1	Length	Outside Dia. ½	⅝	¾	1
8					18				
9					19				
10					20				
11					21				
12	*Prices on Application*				22	*Prices on Application*			
13					23				
14					24				
15					30				
16					36				
17									

Chesterton Gauge Glass Cutters

For Cutting Gauge Glasses to Length



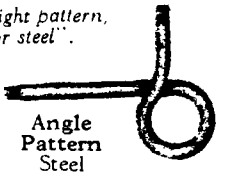
Prices on Application

One arm has a scale in inches and fractions of an inch, a slide stop with set screw and a rotary cutter at the end. This arm is inserted in the end of the glass tube to the required distance, against the slide stop or gauge, the outside of the glass tube resting in the circled end of the other arm. With a slight pressure of thumb and finger on the lever, and a rotation of the glass with the other hand, the rotary cutter makes an even cut around the inside of the tube and a very little pressure breaks it off. Extra cutter wheels are available.

Siphons for Steam Gauges



When ordering straight pattern, specify "brass or steel".



Straight Pattern
Brass or Steel

Angle Pattern
Steel

List Each	Straight Pattern		Angle Pattern	
	Brass	1.80	Steel	.80
			Steel only	.80

Made from ¼" Standard weight pipe: Wrought Steel for 475 lbs., 750° F. and Red Brass for 250 lbs. saturated steam. Straight pattern is 8" long. Center of loop to long end of angle type is 6", to short end, 4".

Extra Brass Guards for Water Gauges



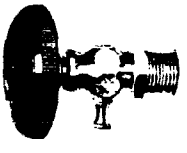
List Prices

*Overall Length In Inches	Price Each	*Overall Length In Inches	Price Each
9	.30	23	.54
11	.30	25	.60
13	.30	27	.66
14	.32	29	.72
15	.36	31	.80
17	.40	33	.88
19	.44	35	1.06
21	.48		

*Length includes acorn.

32

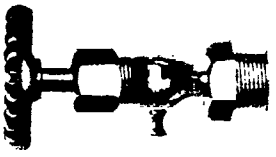
Brass Try Cocks



Low Pressure
No. 731, with Moulded Composition Wheel
15 pounds steam working pressure



125-Pound
No. 730
(Short Pattern)
125 pounds steam working pressure



250-Pound
No. 734
With Stuffing Box
250 pounds steam working pressure

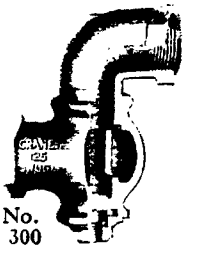
For list prices and description of Brass Cylinder Cocks, Gauge Cocks, and Pet Cocks, see page 67.

List Prices, Each

Size In.	⅜	½	¾
No. 730	3.10	3.20	
No. 731	2.60		
No. 734	3.50	3.80	4.20

Brass Swing Joints

WORKING PRESSURE
150 pounds
water, oil, or gas, 200° F.



No. 300

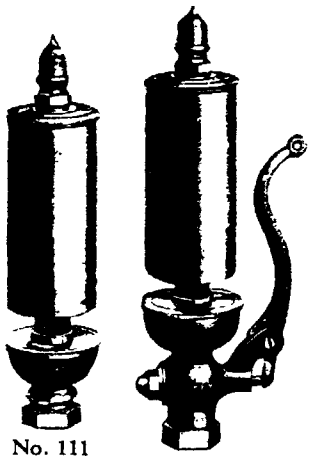
These swing joints are designed for use in making up adjustable connections in piping to tanks and other apparatus where permanently fixed connections cannot be made. Basically, the joints consist of an ell-shaped plug held into the body with a nut and washer. All parts are brass to eliminate binding of the plug by corrosion. Operation is similar to that of an ordinary plug cock. The design of port and body assures free fluid flow; there is no restriction of port area regardless of the angle at which the plug is turned. No packing is used.

List Prices, and Dimensions, in Inches

Size Inches	¼	⅜	½	¾	1
No. 300 Each	4.40	4.60	5.40	8.20	12.00
Center to end	13/16	⅞	1 1/16	1¼	1½
Center to center of pipe	1 5/32	1 5/16	1 9/16	1⅞	2¼

Buckeye Brass Whistles

Plain



No. 111 Without Valve

No. 109 With Valve

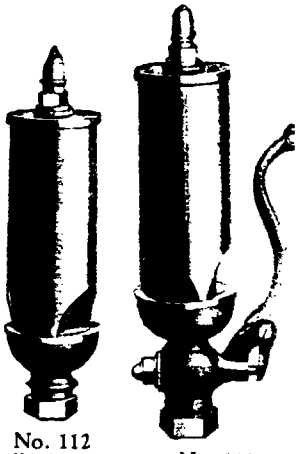
These all-brass whistles produce clear, emphatic signals. They are accurately designed and constructed to produce distinct, even tones with a minimum amount of compressed air or steam pressure. Ideal for use on factories and public buildings, they will work satisfactorily on steam or air pressures of 80 to 150 pounds.

The chime whistle is furnished with or without a valve in the base. The bell is cast in one piece and the chime construction gives a pleasing, composite tone.

The plain whistle is constructed with extra quality brass tubing in the bell which gives a clear, resonant sound and which can be adjusted by screwing the bell up or down.

The size of the whistle is determined by the diameter of the bell and not by the pipe connection. Orders should specify both the bell diameter and the size of the pipe connection wanted.

Chime



No. 112 Without Valve

No. 110 With Valve

Dimensions, in Inches

Diameter of Bell		Inches	1	1½	2	2½	3	4	6	8
Plain	No. 109 With Valve	Length of bell		3⅛	4¾	5½	6¼	8¼		
		Size of pipe		⅜ or ½	½ or ¾	¾ or 1	¾ or 1	1 or 1¼		
	No. 111 Without Valve	Length of bell	2	3⅛	4¾	5½	6¼	8¼		
		Size of pipe	⅜	⅜ or ½	½ or ¾	¾ or 1	¾ or 1	1 or 1¼		
Chime	No. 110 With Valve	Length of bell		4	5	6⅛	7¾	10¼	15	
		Size of pipe		⅜ or ½	½ or ¾	¾ or 1	¾ or 1	1 or 1¼	1¼or1½	
	No. 112 Without Valve	Length of bell		4	5	6⅛	7¾	10¼	15	20
		Size of pipe		⅜ or ½	½ or ¾	¾ or 1	¾ or 1	1 or 1¼	1¼or1½	1½ or

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Sherman Fusible Plugs

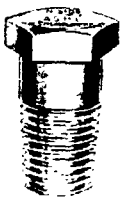
Short Pattern



No. 99 Fire Side Type (Outside)

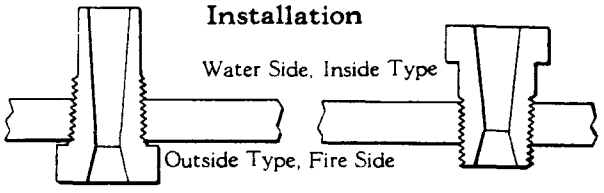
No. 99 A Water Side Type (Inside)

Tube Plugs



No. 99 F Tube Plug

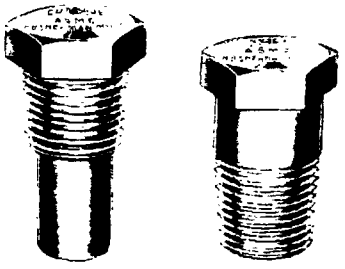
Installation



Minimum Diameter Core Size, in Inches

Plug Size		Inches	⅜	½	¾	1
Short Pattern	No. 99		⅜	½	½	½
	No. 99 A		⅜	½	½	½
Long Pattern	No. 99 B, Standard		¼	½	½	½
	No. 99 C, Standard		¼	½	½	½
	No. 99 D, High Pressure		⅜	⅜	⅜	⅜
	No. 99 E, High Pressure		⅜	⅜	⅜	⅜
Tube Plug	No. 99 F		⅜	⅜		

Long Pattern



No. 99 B Standard Fire Side Type (Outside)

No. 99 C Standard Water Side Type (Inside)

No. 99 D High Pressure Fire Side Type (Outside)

No. 99 E High Pressure Water Side Type (Inside)

Short Pattern Plugs are for low pressures only and do not conform to code. Standard Long Pattern Plugs are recommended for working pressures up to 175 pounds, and the High Pressure, for working pressures over 175 pounds up to 225 pounds. Tube Plugs are recommended for working pressures not exceeding 225 pounds.

The Plugs are made from standard high grade brass and filled with pure tin.

Massachusetts Standard: The tube plugs and the long pattern plugs [illegible] and larger comply with Massachusetts Steam Boiler Rules when marked "Mass. Std.", and will be so marked when specified.

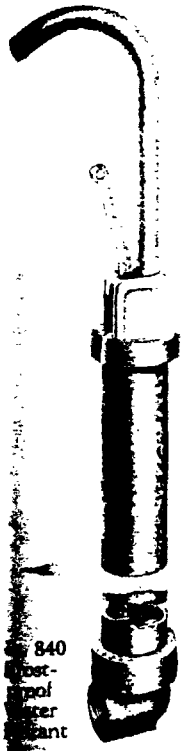
Prices on application

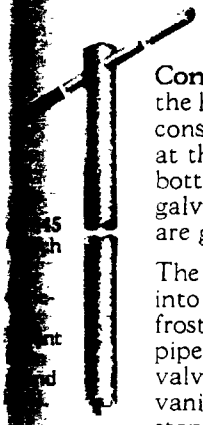
Frostproof Water Hydrant

Patent Pending

WORKING PRESSURE
100 pounds cold water

Simple—Sanitary—No Underground Contamination





This new Crane No. 840 Frostproof Hydrant is built on advanced principles of design to offer the user outstanding improvements and features. Sturdily constructed throughout, the hydrant is high in quality, moderate in cost. Operation is simple; the hydrant is opened by means of a lever; the closing action is automatic.

The hydrant is frostproof. It will not freeze in operation. An internal elastic expansion hose, an exclusive Crane feature, permits the hydrant to de-ice itself at low temperatures.

A high standard of sanitation is assured. The water passage-way is completely sealed off from underground contamination.

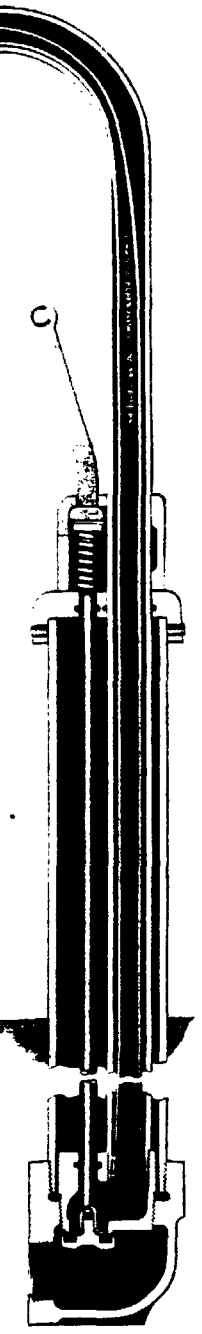
SERVICE RECOMMENDATIONS

The Crane No. 840 Hydrant is recommended for use wherever clean, uncontaminated water must be drawn from outdoor or indoor underground lines. It has a wide application in railroad yards and terminals, industrial plants, stock yards, garages, filling stations, farms, playgrounds, parks, cemeteries, and similar locations.

List Prices and Dimensions

No. 840, Hydrant, 48-inch bury	Each	Prices on request
No. 845, Wrench	Each	
Dimensions of Hydrant, in Inches — Size of female inlet		1½
Size of male outlet		1
Distance spout outlet above ground level		30
Top of standpipe to ground level, approx.		12

Hydrants for 36 or 60-inch bury are available.



Cross Section

Construction: The internal parts of the hydrant are encased within a shell consisting of a standpipe, connected at the top to a cap, and screwed at the bottom to a housing. The standpipe is galvanized steel; the cap and housing are galvanized cast iron.

The standpipe and housing extend into the ground to a depth below the frost line. Mounted within the standpipe and housing are the hydrant valve and the lower part of the galvanized steel spout. The top of the standpipe supports the valve operating mechanism and the upper part of the spout. Through the entire length of the spout is an elastic water tube to convey the water.

Hydrant valve: The hydrant valve is simple, rugged, and reliable. It has a brass disc holder fitted with a composition disc, which seats against a crowned machined surface in the brass body; the disc is held in place by a brass disc washer. The entire assembly is screwed tightly to a stem, made of silicon bronze for long wear; the holder will not loosen in service. The valve handle is Monel.

Elastic water tube: The elastic water tube assures this frostproof hydrant. When inserted in the spout, the tube is stretched and fastened under tension to the ends of the spout. This flattens the tube where it hugs the inner surface of the bend in the spout. When the valve is opened, incoming water expands the tube. When the valve is closed, the tube returns to its original contracted shape, allowing only a small amount of water to remain. Under freezing conditions, this water forms a "pencil" of ice in the tube, above the frost line. Opening the valve expands the elastic tube away from the ice, water flows around the ice, breaking and ejecting it through the top end of the spout. The elastic tube is protected from the deteriorating effect of light and is normally filled with water up to the bend in the spout. It has a long life.

Servicing with No. 845 Wrench: This Hydrant can be serviced without disturbing the standpipe or housing. By removing the spout and superstructure from the standpipe, the valve body can be unscrewed, using the No. 845 Wrench, and the entire valve assembly can then be lifted out.

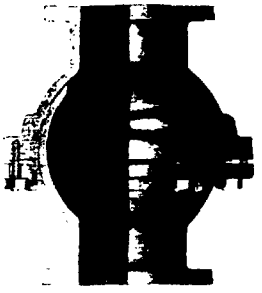
Shock: The valve in the Crane Hydrant closes quickly; this might cause "water hammer". When severe, water hammer must be eliminated by installing a suitable cushioning device in the piping. Otherwise, shock might damage valves or piping; see page 11.

Instructions: Complete instructions for installation and servicing are furnished with each hydrant

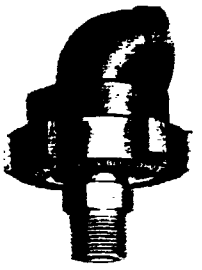
Barco Flexible Ball, Swivel, and Revolving Joints



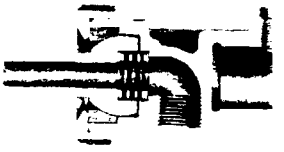
Flexible Ball Joint
Style 7-8



Flexible Ball Joint
Style 7-F, Flanged
125-Pound Standard



Swivel Joint
Style 7AS-8CS



Swivel Joint with Socket E
For Use on Pressing Machir
Style 7KS - 8CS (Illustrate
Style 7KS - 8BS (Not show
With Female 90° Angle B
When ordering, specify diame for casing socket. Shaft si. ¾ to 1½-inch are availab



Flexible Ball Joint
Style 7-8B
Swivel Joint
Style 7S-8BS



Flexible Ball Joint
Style 7A-8B
Swivel Joint
Style 7AS-8BS
*Style 7 A-8 C
Male Straight Ball
*Style 7A-8
Female Straight Ball
*Style 7S-8CS
Male Straight Ball

Flexible Ball Joints: Flexible Ball Joints provide for a substantial angular mov ment. They can be swiveled through an angle of 360°. Tight seating, they may l used on steam, water, oil, air, gasoline, tar, and similar fluids. Sizes 3-inch and small are recommended for 300 pounds steam and sizes 4 to 6-inch for 125 pounds stear

Sizes 3-inch and smaller are malleable iron; larger sizes are semi-steel. Extra heavy joints or brass joints (¼ to 2-inch) can be furnished, at an advance in price. Information on additional styles furnished on request.

Used in chemical, paper, roofing, rubber, and plastic plants; in oil refineries; on testing engines, boilers, pumps, etc.

Swivel Joints: Swivel Joints are spring seated, assuring tightness on both pressure and suction lines. The joints are recommended for 300 pounds steam, and are ideal for use where pressure fluctuates or where temperature varies, as when steam and cold water are used alternately.

Swivel Joints have a malleable iron casing, a bronze ball end, a stainless steel spring, and a hard non-metallic gasket. Extra heavy joints for higher pressures or brass joints can be furnished. at an advance in price.

(*Not illustrated)

Available Sizes

Flexible Ball Joints

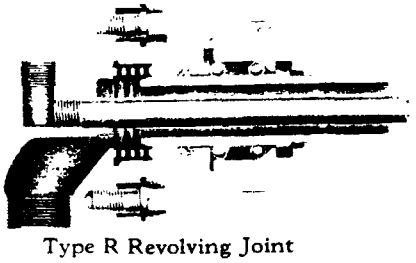
Style 7-8	Style 7-F Flanged F. & D.	Style 7-8B	Style 7A-8B	Style 7A-8C	Style 7A-8	Tota Safe Angul Move men
¼"	Sizes larger than 6-inch can be made to order	¼"	¼"	¼"	¼"	37½
⅜		⅜	⅜	⅜	⅜	37½
½		½	½	½	½	37½
¾		¾	¾	¾	¾	34°
1		1	1	1	1	35½
1¼		1¼	1¼	1¼	1¼	28½
1½		1½	1½	1½	1½	30°
2		2	2	2	2	28½
2½		2½	2½	2½	2½	27½
3		3	3	3	3	33°
4	4	4	4		4	28½
6	6	6	6		6	31

Swivel Joints

Style 7S-8CS	Style 7S-8BS	Style 7AS-8CS	Style 7AS-8BS	Style 7KS-8CS	Sty 7KS-8
½"	½"	½"	½"	½"	½"
¾	¾	¾	¾	¾	¾
1	1	1	1	1	1
1¼	1¼	1¼	1¼		
1½		1½			
2		2			

Revolving Joints

Revolving joints are recommended for the heating or cooling of all types of rolls drums, and dryers. They are suitable for steam, air, gas. and hydraulic services.



Type R Revolving Joint

Available in sizes, ½, ¾, 1, 1¼, 1½, and 2-inches.

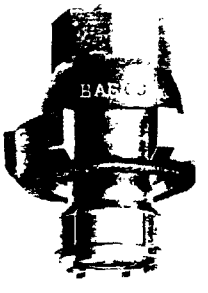
When so desired. the joints can be furnished with adapter 18R to hold spray or siphon pipe: orders should specify.

The joints are also furnished in left or right hand threaded sleeve as specified.

Prices on application

X Type Flexible Ball Joints

The design of center spring strea lined X Type Flexible Ball Jo assures no fluid or gas leakage.



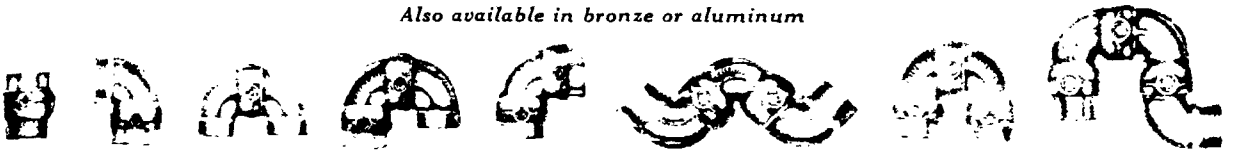
Providing 360° swivel movement plus 40° total angular movement, they are suitable for steam pressures up to 300 pounds. Data on request.

Chiksan Ball-Bearing Swivel Joints

These swivel joints have rotating members locked together by double rows of ball bearings to maintain a re-regulated load upon the packing element, assuring a pressure tight joint, and to carry all radial loads, holding the joint in perfect alignment under all conditions.

Low Pressure Malleable Iron or Steel Swivel Joints

Also available in bronze or aluminum



Style 20 Style 30 Style 40 Style 50 Style 60 Style 70 Style 10 Style 80

...nd connections are threaded or flanged. The joints ...an be furnished threaded at one end and flanged on ...e other. Standard line pipe thread is provided.

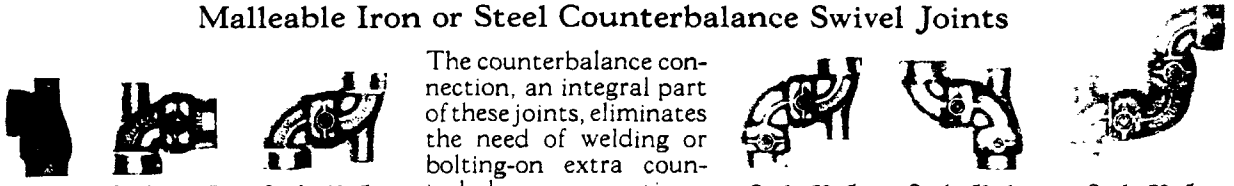
Malleable Iron Swivel Joints serve many piping requirements and are recommended for pressures up ...o 3co pounds and temperatures up to 225° F. Packing units are of a special design properly compounded ...r various services handling liquids, vapors, or gas.

The joints are available with threaded ends in sizes ...8, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3, and 4-inch; and with flanged ends in sizes 3 and 4-inch.

Steel Swivel Joints are recommended for pressures up to 1000 pounds and temperatures up to 225° F. They are available with threaded ends in sizes 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3, 4, 6, 8, 10, and 12-inch; and with flanged ends in sizes 2 to 12-inch.

Sizes 3/8 to 1 1/2-inch are forged steel; sizes 2 to 4-inch are cast steel; sizes 6 to 12-inch, with flanged ends or bored for welding, are made by welding swivel units to standard weld elbows.

Malleable Iron or Steel Counterbalance Swivel Joints



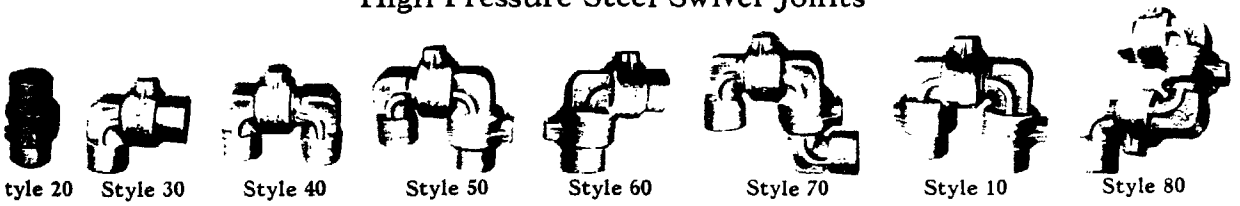
Style 30x4 Style 30x5 Style 40x5 Style 50x5 Style 50x1 Style 70x5

The counterbalance connection, an integral part of these joints, eliminates the need of welding or bolting-on extra counterbalance connections.

Malleable Iron Counterbalance Joints are recommended ...r pressures up to 300 pounds and temperatures up ...o 225° F. They are made with threaded or flanged ...nds in sizes 2, 2 1/2, 3, and 4-inch.

Steel Counterbalance Joints are recommended for pressures up to 1000 pounds and temperatures up to 225° F.; they are available with threaded or flanged ends in sizes 2, 2 1/2, 3, and 4-inch.

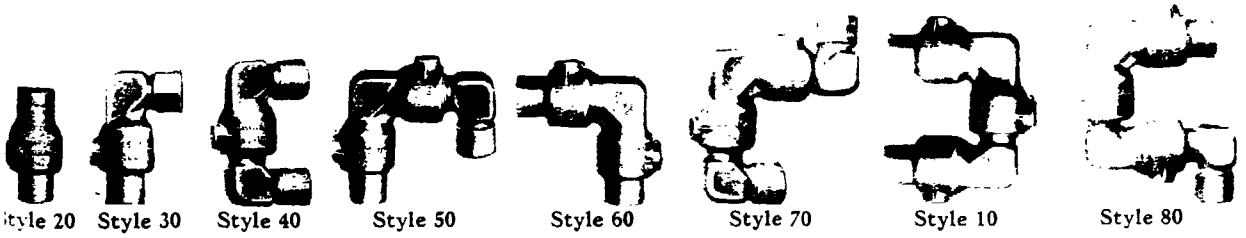
High Pressure Steel Swivel Joints



Style 20 Style 30 Style 40 Style 50 Style 60 Style 70 Style 10 Style 80

High Pressure Swivel Joints are recommended for pressures up to 3000 pounds and temperatures up to 25° F. They are available with threaded ends in sizes 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3, 4, and 5-inch, or bored for welding in 2 to 5-inch sizes. Sizes 3/8 to 2-inch are forged; larger sizes are cast.

High Temperature Steel Swivel Joints



Style 20 Style 30 Style 40 Style 50 Style 60 Style 70 Style 10 Style 80

High Temperature Swivel Joints are recommended for ...pressures up to 700 pounds and for temperatures up ...o 500° F. They are made with threaded ends, of forged steel, in sizes 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, and 2-inch, and of cast steel, in sizes 3 and 4-inch. Flanged ends are made in sizes 2, 3, and 4-inch of cast steel.

Prices on application

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Crosby Gauges and Recorders

Pressure, Vacuum, Compound, or Altitude

For ratings and miscellaneous data, see the next page.
Prices and additional information furnished on application.

Crosby Gauges and Recorders are high quality instruments designed for accuracy and durability. Illustrations on this page show, in part, the extent of the Crosby line. The table on the opposite page lists the various products available, working pressures, materials, etc.

Movements on Crosby Gauges and Recorders are mounted on a socket extension and are entirely independent of the case. Bronze movements have a hard phosphor bronze sector and pinion with milled teeth and lapped bushings. Steel movements have a hard Monel sector, hardened stainless steel pinion with milled teeth and stainless steel bushings, line reamed and lapped.

All tubes are heat treated. Drawn bronze tubes have soldered connections. Drawn alloy steel tubes have threaded connections for graduations of 200 pounds or more and welded connections for graduations below 200 pounds. Bored steel tubes, bored and turned from forged alloy steel billets, have threaded connections.

Test gauges are made in a variety of sizes and pressure classes for use in various services. Style **ACV,** for testing gasoline and related fluids by the Reid Vapor Test Method, conforms to A.S.T.M. Specifications.

Liquid level gauges have a diaphragm bell and are used to measure the height of liquids in tanks or reservoirs.

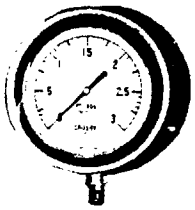
Protectors and diaphragms are available for gauges used in corrosive services. A special cleanout-type protector can be furnished where viscous matter such as paper pulp or soap accumulates and must be removed.

Illuminated dials can be furnished in sizes 10 and 12-inch. The metal dial is illuminated without shadows or glare by a circular neon-type tube attached to a reflector ring.

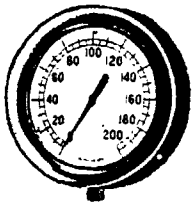
Pressure recorders with one, two, three, or four pens are offered in pressure graduations ranging to 10,000 pounds. The recorders feature interchangeable tubes, micrometer adjustments, one-piece stainless steel pens, push-pull chart hubs, and universal wall or flush mounted cases.

Dead weight testers are simply constructed, easily operated instruments for calibrating gauges used on pressures up to 2000 pounds.

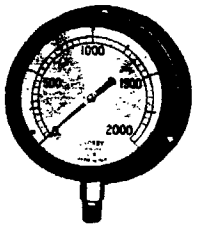
Fluid pressure scales are used to measure pressures beyond 2000 pounds. The weight of the fluid pressure (in one pound increments) is indicated and directly read from the balanced scale beam. This type of tester is recommended for high pressures where the use of a dead weight tester might prove awkward. Style **CD-1** has a range of 4000 pounds and Style **CD-2** has a range of 6000 and 25000 pounds.



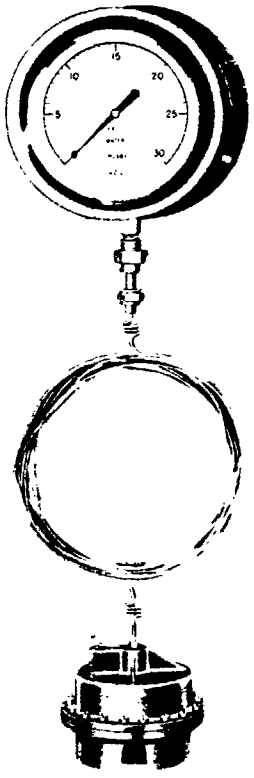
Bellows Gauge
Style **AZ**



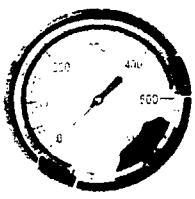
Standard Gauge
Style **AA**



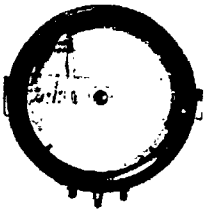
Heavy Duty Gauge
Styles **AID, AIH, AAO, ASO, ASH**



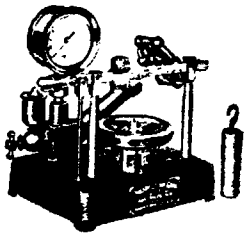
Liquid Level Gauge
Styles **AZL, AAL**



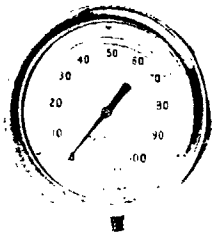
Illuminated Dial
Styles **AAO-E, AIH-E**



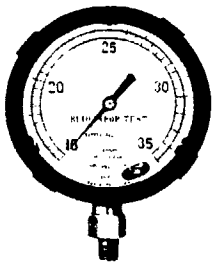
Recorders, Styles
AKA, AKIO, AKIH



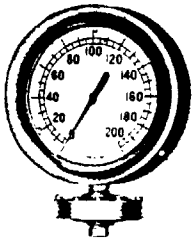
Fluid Pressure Scale
Style **CD-1**



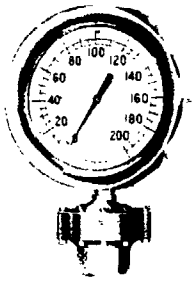
Standard Test Gauge
Style **AC**



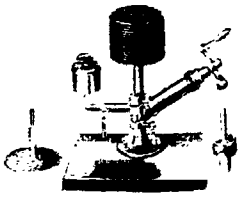
Reid Test Gauge
Style **ACV**



Protected Gauge
Chemical Type
Style **AA-P**



Protected Gauge
Cleanout Type
Style **AA-C**



Dead Weight Tester

Crosby Gauges and Recorders (Cont.)

Pressure, Vacuum, Compound, or Altitude

For general description, see the preceding page.

Styles, Sizes, Ratings, Services, and Materials

Type of Gauge and Recorders		Style No. and Description	Range of Sizes	Max. Graduation (Psi.)	Services	Materials: Case	Tube	Movement	Socket
Gauges	Bellows	AZ—Low Pressure	4½—8½"	15	Pressure, Vacuum, Compound, or Altitude	Same as AA	.....	[8]Bronze	Brass
	Single Tube	AA—Standard	3½—12"	600		Cast Iron, Brass, Nickel-Plated, or [1]Phenol	Brass	[8]Bronze	Brass
			4½—12"	1000					
		AAG—Duplex	4½"	600	Pressure		Brass	[8]Bronze	Brass
		AAO—Heavy Duty	4½—12"	1000	Pressure, Vacuum, or Compound		Brass	[3]Steel	Brass
		AIO—Heavy Duty	4½—12"	1000			[4]Steel	[3]Steel	Steel
		AIH—Heavy Duty	4½—12"	10000			[5]Steel	[3]Steel	Steel
		ASO—Heavy Duty	4½—12"	1000	Same as AIO		[6]Steel	[3]Steel	Steel
		ASH—Heavy Duty	4½—12"	10000			[7]Steel	[3]Steel	Steel
		AH—Hydrostatic	4½—12"	10000	Pressure		[5]Steel	[8]Bronze	Steel
	Test	ACV—Reid Vapor	4½"	250	Pressure	[2]Brass or Nickel-Plated	Brass	[8]Bronze	Brass
		ACU—Underwriters'	3½"	400	Pressure		Brass	[8]Bronze	Brass
		ACI—Inspectors	3"	1000	Pressure, Vacuum, or Compound		Brass	[8]Bronze	Brass
		AC—Standard	3—12"	1000			Brass	[8]Bronze	Brass
		ACSH—Bored Tube	6—12"	10000	Pressure	Cast Iron, Brass or Nickel-Plated	[7]Steel	[3]Steel	St
		ACIH—Bored Tube	4½—12"	10000	Pressure		[5]Steel	[3]Steel	St
	Liquid Level	AZL—With Bell	4½—8½"	35 ft.	Altitude		.....	[8]Bronze	Brass
		AAL—With Bell	4½—12"	100 ft.			Brass	[8]Bronze	Brass
	Illuminated	AAO-E—Aluminum Case	10, 12"	1000	Same as AIO and AIH				
		AIH-E—Aluminum Case		10000					
	Protector	AAP—Chemical Type	All	5000	Available on all types of Crosby Gauges				
		AAC—Cleanout Type	All	1000					
Recorders		AKA—1 to 4 Pens	10, 12"	600	Pressure, Vacuum, Compound, or Altitude	Aluminum	Brass	.....	Brass
		AKIO—1 to 4 Pens	10, 12"	1000			[4]Steel	.....	Steel
		AKIH—1 to 4 Pens	10, 12"	10000			[5]Steel	.....	Steel

[1]Phenol cases are only furnished on 4½, 6, and 8½-inch sizes. [2]Style ACV is also available with a Phenol case. [3]All stainless steel with hard Monel sector. [4]Drawn steel. [5]Bored steel. [6]Drawn stainless steel. [7]Bored stainless steel. [8]Phosphor bronze.

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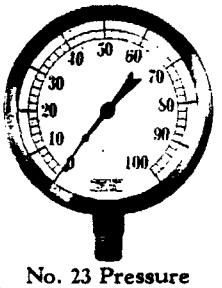
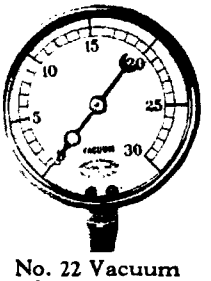
Marshalltown Gauges

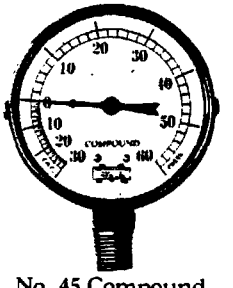
Pressure, Vacuum, Compound



No. 23 Pressure
Standard dial. Readings to 15, 30, 60, 100, 160, 200, 300, 400, or 600 pounds.

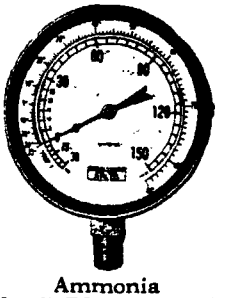


No. 22 Vacuum
Standard dial 0-30 inches of Mercury

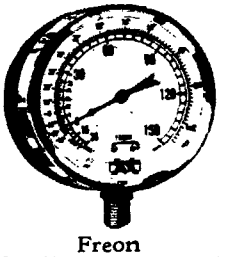


No. 45 Compound
Standard dial, 0-30". Pressure readings to 15, 30, 60, 100, 160, 200, or 300 pounds

Refrigeration



Ammonia
No. 52-RL; 150 pounds pressure, 30" vacuum.
No. 52-RH; 300 pounds pressure, 30" vacuum.



Freon
No. 56-RL; 150 pounds pressure, 30" vacuum.
No. 56-RH; 300 pounds pressure, 30" vacuum.

Pressure, Vacuum, and Compound Gauges: The pressure, vacuum, and compound gauges shown above are available in dial sizes 2, 2½, 3½, and 4½-inch. They are suitable for air, oil, gas, water, etc. When installed on steam lines, a siphon should be used. These gauges have a drawn steel case, a brass bourbon tube, and a white enameled dial. They are furnished with a ¼-inch male bottom connection unless otherwise specified.

Prices and additional information on application.

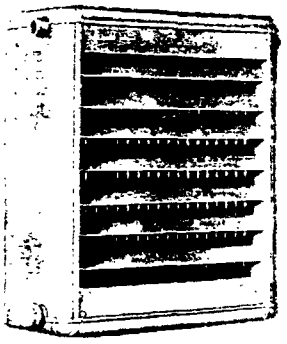
Refrigeration Gauges: These gauges are available in dial sizes 2½ and 3½-inch. They are regularly furnished with a ¼-inch male bottom connection, and have a flangeless steel case with black finish. Nos. 52-RL and 52-RH, for ammonia service, have a bourbon tube of chromium-molybdenum steel and a movement of Monel. Nos. 56-RL and 56-RH, for freon service, have a rebushed movement and hard soldered end and bottom pieces.

Siphons for steam gauges . . page 351

Sturtevant Unit Heaters

Design 14 Horizontal Heaters

Standard Steam Type—Single Speed



The Design 14 Heater is of the suspended type adapted to commercial and industrial installations to provide an even flow of heat over large areas.

Construction: This heater has a sturdy cabinet finished with a green lacquer, adjustable louvers, seamless copper tubes, aluminum plate fins, a three-blade propeller fan, and a resiliently mounted motor. Two-speed and multi-speed motor controls are available at extra cost.

Heating element: The heating element on the Standard Steam Type Heater will withstand pressures up to 200 psi. and temperatures up to 400° F. Other unit heaters with special heating elements are available.

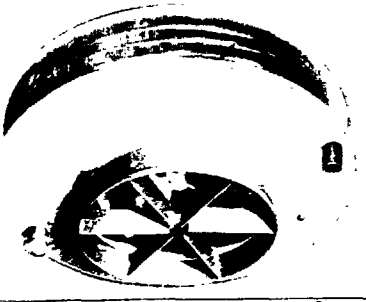
Steam Capacities, Motor Ratings, and Dimensions

(Standard Models—Showing Single High Speed R.P.M. and Capacities)

No.	Motor		Capacities at 2 Pounds Steam 60° Entering Air			Final Temp.	C.F.M. 70° Air Basis	Outlet Velocity	Height Inches	Width Inches	Maximum Depth Inches
	Hp.	Rpm.	Btu. per Hour	E.D.R. Sq. Ft.	Condensate Lbs. per Hour						
25	1/100	1080	25,800	108.5	26.7	119.7	398	431	20	17¾	16½
40	1/50	1080	41,500	172.8	43.0	114.5	700	526	22½	20¼	17⅜
55	1/30	1080	57,000	237.5	59.0	113.5	979	590	24¾	21½	21⅞
75	1/20	1080	76,000	316.5	78.6	112.3	1336	638	26¼	24	24
85	1/20	1080	85,600	357	88.6	124.5	1220	538	26¾	27	24¾
100	1/12	1080	100,500	419	104.0	118.5	1580	690	26¾	27	24¾
115	1/12	1080	114,500	478	118.5	120.5	1740	596	30⅝	28¼	25½
125	⅙	1080	125,500	523	129.8	116.3	2050	696	30⅝	28¼	27
135	⅙	1080	134,500	561	139.2	120.0	2060	632	32½	30	27⅝
150	⅙	1080	150,700	628	156.0	114.4	2550	772	32½	30	27⅝
175	¼	1080	176,600	736	182.5	113.0	3060	836	33¾	31¼	27⅞
200	¼	1080	200,700	837	207.5	111.0	3620	894	35⅞	33½	28½
250	¼	820	251,000	1045	259.5	115.2	4180	781	38⅞	38½	34⅛
300	⅓	820	300,500	1252	311.0	113.2	5200	838	40⅞	41	35¼

Design 12 Downblast Heaters

Standard Steam Type—Single Speed



Sturtevant Downblast Unit Heaters are of the suspended type for industrial and commercial installations.

Construction: Seamless copper tubes are brazed into cylindrical steel headers. The fins are made of aluminum plate. Equipped with a three blade propeller fan and a totally enclosed motor. Two-speed and multi speed motor controls are available at extra cost.

Heating element: The heating element on the Standard Steam Type Heater will withstand pressures up to 200 psi. and temperatures up to 400° F. Other Unit heaters with special heating elements are available.

Steam Capacities, Motor Ratings, and Dimensions

(Standard Models—Showing Single High Speed R.P.M. and Capacities)

No.	Motor		Capacities at 2 Pounds Steam 60° Entering Air			Final Temp.	C.F.M. 70° Air Basis	Outlet Velocity	Diameter Inches	Maximum Depth Inches
	Hp.	Rpm.	Btu. per Hour	E.D.R. Sq. Ft.	Condensate Lbs. per Hour					
D40	⅙	1725	40,000	167	41.5	113	695	1230	21	19
D55	⅙	1725	55,000	229	57.0	110	1010	1380	26½	19
D75	⅙	1725	75,000	312	77.5	113	1300	1650	29¼	18 7/16
D100	⅙	1725	100,000	417	104.0	113	1735	1900	32¼	19½
D125	⅙	1725	125,000	520	130.0	126	1740	1240	32¼	18¼
D105	¼	1140	150,000	625	155.0	126	2090	1340	32¼	21 1/16
D175	¼	1140	175,000	730	181.0	126	2440	1440	37¼	21 1/16
D200	⅓	1140	200,000	833	207.0	125	2830	1545	37¼	23⅛
D250	½	1140	250,000	1040	259.0	125	3540	1605	42½	23 3/16
D300	½	1140	300,000	1250	310.0	125	4250	1750	44⅜	24 7/16
D350	¾	1140	350,000	1460	362.0	125	4980	1885	52⅜	21 7/16
D400	¾	1140	400,000	1665	414.0	123	5800	2040	52⅜	22 11/16

Prices on application

Trane Unit Heaters

Model H Horizontal Heaters



This unit heater will fit many applications ranging from railroad round-houses to modern stores and institutions.

Construction: The sides, top, and bottom of the casing are of one-piece construction. The bonderized casing is finished with brown enamel.

Equipped with a quiet four-blade fan. Furnished with louvers as standard. Trane Free-Flo Grilles are also available. Also available with Constant-Speed, Two-Speed, and Three-Speed motors in Standard and High CFM Models.

Steam Capacities, Motor Ratings, and Dimensions

([1]Standard Models—Showing Constant High Speed R.P.M. and Capacities)

No.	Motor			Capacities at 2 Pounds Steam 60° Entering Air				C.F.M. 70° Air Basis	Outlet Velocity	Height Inches	Width Inches	[3]Depth Inches
	Speed	Hp.	[2]Rpm.	Btu. per Hour	E.D.R. Sq. Ft.	Condensate Lbs. per Hour	Final Temp.					
71 H	3	1/30	1500	22,000	92	23	106	438	577	19	16	15 5/8
72 H	3	1/30	1500	36,000	150	37	125	511	702	19	16	15 5/8
74 H	3	1/30	1500	44,000	183	46	129	587	811	19	16	15 5/8
76 H	3	1/30	1500	53,000	220	55	135	648	702	20 1/2	17 1/2	15 7/8
78 H	3	1/30	1500	63,000	262	65	139	736	506	23 1/2	20 1/2	20 3/8
80 H	3	1/20	1500	78,000	325	82	135	955	678	23 1/2	20 1/2	20 3/8
82 H	2	1/8	1140	86,000	358	88	126	1205	842	23 1/2	20 1/2	20 3/8
84 H	2	1/8	1140	125,000	521	130	130	1648	818	26 1/2	23 1/2	20 3/8
86 H	2	1/6	1140	144,000	600	150	122	2150	1050	26 1/2	23 1/2	21 3/8
88 H	2	1/6	1140	180,000	750	188	130	2370	843	29 1/2	26 1/2	22 1/2
90 H	2	1/6	1140	200,000	833	207	131	2600	758	32	29 1/2	26 1/4
92 H	2	1/4	1140	240,000	1000	250	127	3310	952	32	29 1/2	26 1/4
94 H	2	1/4	1140	297,000	1235	310	136	3590	637	40	35 1/2	26 1/4
96 H	2	1/2	1140	352,000	1465	367	129	4700	826	40	35 1/2	26 1/4

[1]Also available in High CFM Models. [2]Constant High Speed R.P.M. [3]Depending on type of motor used.

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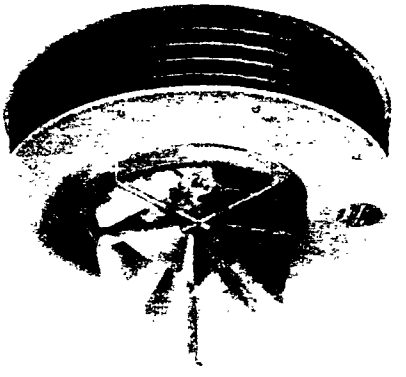
Model P Vertical Heaters



The Model P is a draw-through, vertical discharge propeller unit heater which can be suspended at heights from 10 to 40 feet.

Construction: This heater consists of an extended surface circular coil sandwiched between two circular plates, a four-blade propeller fan, and a standard motor mounted out of the air stream. Standard units utilize a two-row coil. High CFM Models have a one-row coil.

This heater can be equipped with Cloverleaf Diffuser (illustrated), cone attachments, louvers, Free-Flo Grilles, and Anemostats.

Also available with two and three-speed motors in Standard and High CFM Models.

Steam Capacities, Motor Ratings, and Dimensions

([1]Standard Models—Showing Constant High Speed R.P.M. and Capacities)

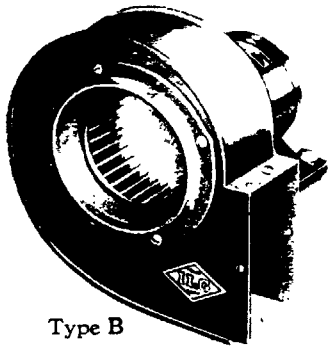
No.	Motor			Capacities at 2 Pounds Steam 60° Entering Air				C.F.M. 70° Air Basis	Outlet Velocity	Diameter Inches	Depth Inches
	Speed	Hp.	[2]Rpm.	Btu. per Hour	E.D.R. Sq. Ft.	Condensate Lbs. per Hour	Final Temp.				
10 P	3	1/30	1500	50,000	208	52	131	650	1263	23 3/4	10 1/8
12 P	3	1/8 1/20	1725 1140	95,000 75,000	396 313	98 78	121 132	1450 960	1757 1185	24 3/4	14 3/8
15 P	3	1/3 1/8	1725 1140	150,000 118,000	625 492	155 122	114 121	2570 1700	2025 1355	33 1/4	15 1/8
18 P	3	1/2 1/6	1725 1140	230,000 183,000	958 763	238 189	112 122	4080 2700	2390 1610	33 1/4	16 7/8
20 P	2	1/3	1140	260,000	1083	269	123	3800	1847	33 1/4	17 3/8
22 P	2	1/2	1140	356,000	1483	368	122	5250	1935	42 1/2	18 3/8
25 P	2	1	1140	460,000	1917	476	125	6500	2042	47	20 1/8
30 P	2	1	1140	550,000	2290	569	119	8500	1830	47	24 1/2

[1]Also available in High CFM Models. [2]Constant High Speed R.P.M.

Prices on application

Ilg Heating and Ventilating Equipment

Volume Centrifugal Fans



Type B

Type B Volume Centrifugal Fans are used for all types of blow-in or exhaust duty requiring low pressure, small volume, and quiet operation, and where a small volume of air must be handled quietly through ducts.

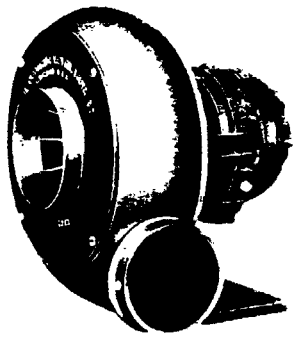
Rotation is clockwise or counter-clockwise.

Discharge is easily changed by rotating housing.

Available with the following motor ratings:

Single-Phase, 60 Cycle A.C., 110-220 Volts.
Three-Phase, 60 Cycle A.C., 220-440 Volts.
Direct Current, 115-230 Volts.

Type P Volume Centrifugal Fans handle small quantities of air over a pressure range of ¼ to 6½ inches. They are used to exhaust fumes from chemical laboratories, handle light dust from polishing wheels and grinders, exhaust steam and vapors, and other exhaust purposes.



Type P

Available with the following motor ratings:

Single-Phase, 60-Cycle, A.C. (Constant Speed), 110-220 Volts
Single-Phase, 25-Cycle, A.C., 110-220 Volts
Three-Phase, 60-Cycle, A.C., 220-440 Volts
Direct Current, 110-220 Volts

Dimensions, in Inches

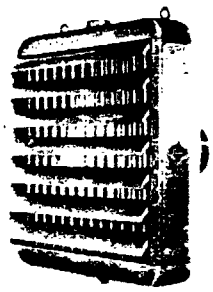
Size	B 9	B 12	B 15	B 18	B 21
Wheel diameter	4¾	6¼	7¾	9¼	10¾
Height	9¼	12 1/16	14¾	17⅝	20 9/16
Width	11 5/16	13⅞	17 15/16	22	26⅛
Length	8 5/16	10⅞	13½	16 1/16	18¾

Dimensions, in Inches

Size	7½ P	10 P	15 P	20 P
Wheel diameter	6¾	8 5/16	9⅞	14
Height	12⅛	14⅞	15⅞	21 9/16
Width	11⅝	12	14 5/16	18 5/16
Length	10 3/16	11⅝	14 7/16	19¾

Note: Height and width for Type P and Type B Fans will vary with discharge. Tables show bottom horizontal discharge.

Horizontal Unit Heaters



Dimensions, in Inches

Size	Height	Width Across Face	Width Louver to Motor	Pipe Tap
10	18	12½	15 1/16	1¼
13	21	15½	18⅜	1¼
17	24	18½	20 5/16	1½
19	27	21½	26	1½
25	35	27¾	28	2½

Ilg Heaters give efficient, constant heat. Furnished with a self-cooled motor, balanced fan wheel, two-piece header, copper core, and adjustable louvers.

Propeller Fans



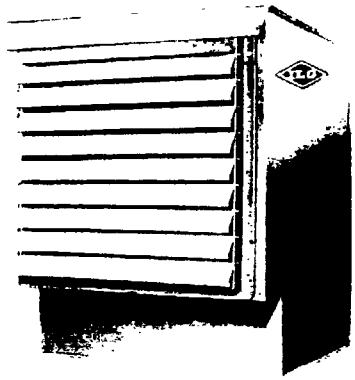
Ilg Propeller Fans are used to ventilate locations where a rapid change of air is needed.

Fan sizes from 6 to 72 inches are available. The fans feature a self-cooled motor and permanent alignment of the fan wheel by direct connection to the motor shaft.

When so specified, Ilg Propeller Fans can be furnished with a coating of black asphaltum base paint in order to counteract excessive moisture or mild acid conditions.

Power Roof Ventilators

Ilg Power Roof Ventilators exhaust air laden with steam, moisture, smoke, gases or fumes. The Ilg Automatic Shutter protects fan and interior of building from rain and snow, and prevents motor overloading from wind pressure. The penthouse is made of steel, with a door at the back providing access to fan. Furnished insulated at extra cost.



Dimensions, in Inches

No.												
	Standard	73499	73501	73503	73505	73507	73509	73511	513	515	517	519
	Insulated	73500	73502	73504	73506	73508	73510	73512	514	516	518	520
Fan size		10	12	16	18	21	24	30	36	42	48	54
Height		19	22	28	32	36	41	50	54¾	59¼	70½	82
Width across face		17	19	24	27	30	34	42	46½	52½	59½	66½
Width front to back		23½	26	28	30	32¼	34¼	38¼	38¼	43½	48	52
Metal gauge		20	20	20	18	18	18	18	18	18	18	16

Prices on application

Reznor Gas-Fired Unit Heaters

Suspended Fan Type

Reznor Gas-Fired Unit Heaters are suitable for commercial and industrial installations. These heaters are made in nine sizes. The smallest heater has an input rating of 55,000 Btu. per hour and the largest, a rating of 400,000 Btu. per hour.

Construction: The cabinet is made of cold rolled steel with a brown wrinkle finish. The heat exchange tubes are non-ferrous, corrosion-resisting plymetal. The heater is equipped with an electric gas valve to control the supply of gas to the manifold. The gas line pressure regulator is a spring-loaded type, A.G.A. approved.

The propeller fan motor is a quiet operating split-phase induction type, rubber mounted; it is available in ratings of 1/50 to 1/6 horsepower. Fan blades are made of aluminum with stamped steel spider and brass hub. The fan is equipped with a wire guard.

Cold rolled steel rod hangers are mounted to the unit, and horizontal louvers direct the flow of heat.

Safety features: The heaters have a high limit control to automatically shut off the gas supply if the fan fails. An automatic shut-off valve stops the gas supply if the pilot light should go out. Wiring is incased in BX cable to conform to Underwriters' specifications.



Accessories: Numerous accessories such as a low limit control, thermostatic control, hanger boards, floor bases, vertical louvers and return air boot are available to suit installation requirements, at an additional cost.

Available types: In addition to the Propeller Fan Type, Duct and Blower Type Unit Heaters are available with same sizes and capacities.

The Duct Type is simply a suspended unit heater to be used with a remotely located blower. It is equipped with standard controls but without a motor or fan.

The Blower Type, similar to the Propeller Type, has air moving power furnished by a multiblade or squirrel cage blower instead of a propeller fan.

Capacities, Motor Ratings, and Dimensions

No.	Number of Units	Input Btu. per Hour	Output Btu. per Hour	Outlet Velocity Fpm.	[1]Motor		[3]Fan Diameter Inches	Height Inches	Width Inches	Depth Inches	Pipe Hanger Size Inches
					[2]Hp.	Rpm.					
US 55	Single	55,000	45,650	540	1/50	1000	14	30 1/8	23 1/4	21	3/4
US 75		75,000	62,250	675	1/20	1140	16	37 1/4	23 1/4	24 7/8	3/4
US 90		90,000	74,700	675	1/20	1140	16	39 3/8	22 3/4	27 3/4	3/4
US 110		110,000	91,300	850	1/8	1140	16	39 3/8	22 3/4	27 3/4	3/4
US 130		130,000	107,900	850	1/8	1140	16	39 3/4	24	31	3/4
US 150		150,000	124,500	850	1/8	1140	16	39 3/4	24	31	3/4
US 200		200,000	166,000	1110	1/6	1140	18	42	24	37 5/8	3/4
US 300	Double	300,000	249,000	850	1/8	1140	16	39 3/4	46 1/4	31	1
US 400		400,000	332,000	1110	1/6	1140	18	42	46 1/4	37 5/8	1

[1]No. US 55 has Shaded Pole Type Motor; Nos. US 75 through US 400 have Split Phase Type Motor. [2]No. US 300 has two 1/8 hp. motors. No. US 400 has two 1/6 hp. motors. [3]No. US 300 has two 16-inch diameter fans. No. 400 has two 18-inch diameter fans.

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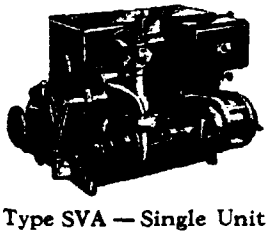
Hoffman-Economy Heating Pumps

Vacuum Type



Type SVA — Single Unit

Type SVA: This vacuum pump employs the jet type of vacuum producer to rapidly remove air from a heating system. It is available in capacities up to 300,000 square feet E.D.R.

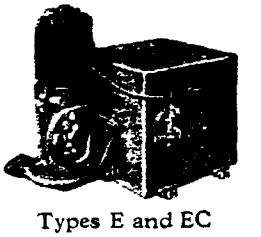
There are no moving parts to wear or score.

The Type SVA is made in standard ratings for the ordinary installation operating between three and twelve inches of vacuum, and also in special ratings for jobs where conditions require carrying higher vacuums of ten to sixteen inches.

Condensation Pumps

Types E and EC: These units have a cast iron tank on which is mounted a bronze fitted, flexible-coupled pump.

The motor is placed on top of the pump so that the unit may be installed in shallow pits with less danger of submergence in case of flood.



Types E and EC

Type E units operate at 1750 rpm. with capacities to 05,000 square feet E.D.R. and discharge pressures to 30 pounds. Type EC units operate at 3450 rpm. with discharge pressures to 60 pounds. Both are available in single or duplex styles.

Prices on application

Steam Jet Pumps or Ejectors



Dimensions and Capacities

Size of Pump Inches	Capacity Gallons per Minute	Suction Pipe Inches	Discharge Pipe Inches	Steam Pipe Inches	Steam Opening Inches	H.P. Required to operate
3/4	8	3/4	1/2	3/8	3/16	2
1	15	1	3/4	1/2	1/4	3
1 1/4	20	1 1/4	1	1/2	5/16	4
1 1/2	30	1 1/4	1 1/4	3/4	3/8	6
2	40	2	1 1/2	3/4	7/16	8
2 1/2	50	2 1/2	2	1	1/2	10
3	60	3	2 1/2	1	9/16	15
4	250	4	3	2		

Note: The above capacities are based on 50-pound steam pressures.

These Jet Pumps or Ejectors are used for filling tanks, transferring liquids from one part of a building to another, substituting for water tank on railroads, and unwatering shallow mines, pits, cellars, coffer-dams, quarries, wells, etc.

Liquids may be forced to an elevation equal to about one foot to each pound of steam pressure; however, it is recommend that two pumps be used, one placed above the other, for elevations above 50 feet.

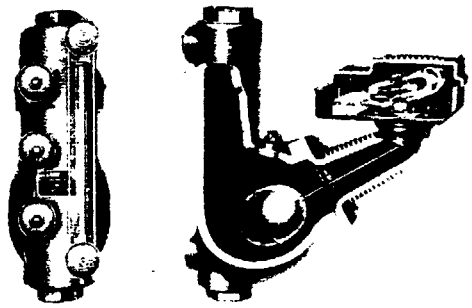
The limit of perpendicular suction is 14 feet and will require a steam pressure of at least 25 pounds; special pumps are furnished for higher suction power.

These pumps will work in any position.

McDonnell Boiler Controls

Low Water Column Type

The No. 157 McDonnell Pump Control, Low Water Cut-Off, and Alarm is used to control boiler water level, increase boiler efficiency, and promote safety in boilers of any size operating at pressures up to 150 pounds.



No. 157
Pump Control and Low Water Cut-off.
(Try-cocks and water glass are not furnished.)

Dimensions, in Inches

No	Equalizing Pipe Tap	Try-Cock Tap	Water Glass Tap	Overall Height	Overall Width
157	1	1/2	1/2	16	13 5/8
*157A	1 1/4	3/4	3/4	16	13 5/8
*157B	1	1/2	1/2	18 1/16	13 5/8
*157C	1 1/4	1/2	1/2	18 1/16	13 5/8
*157D	1 1/4	3/4	3/4	18 1/16	13 5/8

*All have automatic reset. If manual reset is required, order No. 157M, 157AM, 157BM, 157CM, 157DM.

Construction: The No. 157 is built to stand up under the arduous conditions imposed by high temperature and pressure. All operating parts are isolated from the float chamber, and heat reduced by radiating fins on the housing. The float is Monel of extra heavy construction and is sealed from the switch compartment by an extra heavy bellows which totally eliminates packing.

Installation: To simplify installation, this control is made an integral part of the water column, using the water glass and trycocks removed from the old column. By making the No. 157 integral with the water column, practically all equalizing pipe and fittings are eliminated.

This control also eliminates the need for a separate blow-off valve. Since the float chamber actually is the water column, the No. 157 is directly and effectively blown down by the blow-off valve below it.

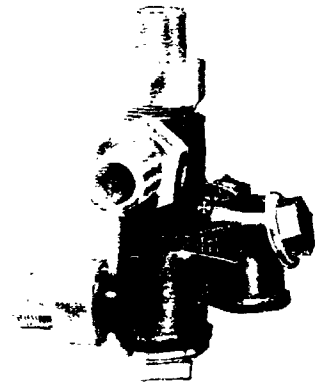
Switches: The two switches used have five terminals which may be wired to provide a pump control circuit, a low water cutoff circuit, a low water alarm circuit, or any combination of these functions. Both switches are the dependable mercury type especially designed for high temperature service. "Cut-off" and "cut-in" points of both switches can be adjusted within the range of practical requirements to meet individual needs.

Electrical ratings: Electrical rating (Underwriters Laboratories approved) of cut-off and pump control: A.C. 1/2 h.p. 115-230 volts; D.C. 1/4 h.p., 115-230 volts; pilot duty service, 125 volts amps. 115 volts and 23 volts; of alarm circuit A.C. 1 amp., D.C. 1/2 amp., 115 Volts; A.C. 1/2 amp., D.C. 1/4 amp 230 volts.

Prices on application

Penberthy Automatic Injector

Size No.	Horsepower: Based on Ordinary Tubular Boiler	Horsepower: Based on 30 lbs. Water per H.P. per Hour	Pipe Connection Inches	Capacity per Hour 1 to 3 feet lift 60 to 110 pounds steam pressure: Maximum Gallons	Capacity per Hour 1 to 3 feet lift 60 to 110 pounds steam pressure: Minimum Gallons
OO-21	4 to 8	6 to 12	3/8	80	45
AA-21	12 to 22	15 to 30	1/2	180	100
BB-21	20 to 45	25 to 60	3/4	360	180
CC-21	45 to 80	50 to 100	1	600	325
DD-21	75 to 135	85 to 165	1 1/4	1000	525
EE-23	115 to 255	130 to 320	1 1/2	1900	850
FF-23	200 to 400	250 to 500	2	3000	1600
GG-21	375 to 600	400 to 750	2 1/2	4200	2150



Stock Model Injector

The Penberthy Automatic Injector is an efficient restarting automatic boiler feeding pump. It is designed to give efficient service over the whole range of lower and medium steam pressures from 25 pounds up to 160 pounds.

In installations where cold water is handled, the Penberthy Injector offers: delivery of hot water, no moving parts, compactness, low first cost, return of operating steam to boiler, minimum attention.

The Injector has many industrial uses, and is well adapted to steam processing boilers, vulcanizing shops, boats, laundries, portable boilers, sawmills, etc.

Where mechanical pumps may be used in hot water installations, the Injector often makes a dependable reserve unit for emergency use with cold water.

The Penberthy Automatic Injector is designed for suction lift, but will work well with water under pressure. Better service, however, will be had at the lower steam pressures if a special steam jet is substituted when connecting directly to a city pressure line.

Stock Model Injectors are of the "Suction Left Overflow Front, Delivery Back" design. Injectors with special connections or those for higher or lower pressures can be furnished when so ordered.

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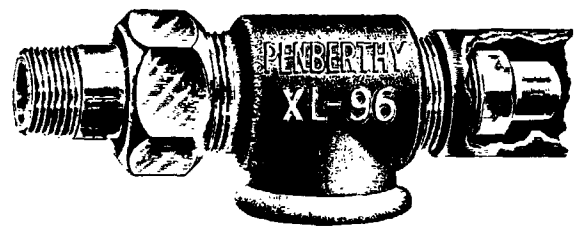
Penberthy "XL-96" Ejector

A forcing Ejector of sufficient power to elevate 1 foot per each 1 1/4 to 1 3/4 pounds of steam. This Ejector has both lifting and elevating power, but on deep suction lifts with slight elevation, the water can be delivered cooler with the Penberthy Series 20 or 40 Ejectors.

Available in all bronze in Size Numbers 1 to 10, inclusive. Available with iron body and brass jets in Size Numbers 5 to 10, inclusive. When ordering specify whether bronze or iron body ejector is wanted.



Series 1, Stock Model, Siphon or Steam Jet Pump

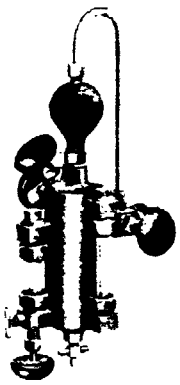
Size No.	Pipe Connection, Steam Inches	Pipe Connection, Suction and Delivery Inches	Capacity, Gallons per Hour: 40 to 65 pounds Steam 3 Feet Lift	20 to 40 pounds 65 to 100 pounds	40 to 65 pounds 50 Feet Elevation	40 to 65 pounds 25 Feet Elevation	Vertical Lift: 40 to 75 pounds Steam Feet	25 to 40 or 75 to 100 pounds Feet
1	3/8	1/2	240	235	120	180	23	20
2	1/2	3/4	500	450	250	375	25	22
3	3/4	1	840	700	420	625	25	22
4	1	1 1/4	1,350	1,300	650	950	25	22
5	1	1 1/2	1,950	1,850	975	1,450	25	22
6	1 1/4	2	3,500	3,000	1,750	2,600	25	22
7	1 1/2	2 1/2	5,700	4,350	2,500	3,750	25	22
8	2	3	9,500	8,160	4,750	7,200	25	22
9	2	3 1/2	13,600	12,400	6,800	10,200	25	22
10	2 1/2	4	18,400	17,100	9,200	13,800	25	22

When Ejector is lifting 10 feet or over, suction pipe should be one size large than suction connection of Ejector enlarging close to Ejector. A foot valve should be used on deep lifts.

When Ejector is elevating more than 20 feet, the discharge pipe should be one size larger than coupling on Ejector enlarging close to Ejector

Prices on application

Lubricators, Oilers, and Grease Cups



Single Connection

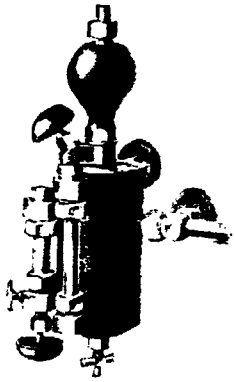
"Genuine Detroit"

Improved Standard Lubricators

Detroit Lubricators are made in a variety of styles and kinds to properly lubricate the valves and cylinders of all types of steam engines, steam pumps, gas engines, air compressors, and similar operating units. Standard Lubricators are not to be used for pressures in excess of 150 pounds. The support arm is threaded for ½-inch pipe.

All metal parts are made of brass. Handles are made of a durable, non-heating composition.

When ordering specify single or double connection and capacity.



Double Connection

Single connection: The single connection lubricator can be connected either above or below the throttle or into the steam chest direct.

Capacities: ½-pint, 1 pint, and 1 quart.

Double connection: The double connection lubricator is installed with both connections between the boiler and the throttle.

Capacities: ½-pint, 1 pint, and 1 quart.

Glass Body Oil Cups

These glass body oil cups are used on machinery; gas, gasoline, or oil engines; and bearings of all kinds

No. 200 Series Oil Cups are used on gas, gasoline, or oil engines. They are furnished with a screw filler cap. An equalizing tube, to overcome back pressure from engine and a ball check in base are provided to meet all requirements where back pressure is apt to occur.

No. 500 Series Oil Cups are for use on machinery and all types of bearings. They have set feed and sight feed features. Cap and base are pressed brass and the sight feed post is made of rod brass.

No. 600 Series Oil Cups (illustrated) are for use on machinery and bearings. They have set feed, sight feed, and stop feed features. The stop feed consists of a lever at the top of the cup, which permits the oil to be shut off, fed at a regular rate or in a stream, without disturbing the set feed adjustment.

Cap and base are pressed brass and the sight feed post is made of rod brass. When ordering specify the catalog number.

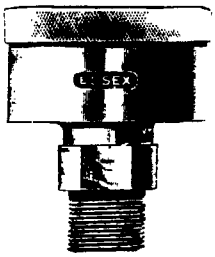


No. 600 Glass Body Oil Cup

Dimensions and Capacities

Size Number		500	600	501	601	201½	501½	601½	202	502	602	204	504	604	205	505	605	206	506	606
Outside diameter of glass	Inches	1¼	1¼	1½	1½	1¾	1¾	1¾	2	2	2	2½	2½	2½	3	3	3	3½	3½	3½
Height of glass	Inches	1⅛	1⅛	1⅜	1⅜	1⅝	1⅝	1⅝	1⅞	1⅞	1⅞	2⅜	2⅜	2⅜	3	3	3	4	4	4
Oil capacity	Ounces	⅝	⅝	1⅛	1⅛	1½	1½	1½	2½	2½	2½	5	5	5	10	10	10	18	18	18
Pipe thread of shank	Inches	⅛	⅛	¼	¼	¼	¼	¼	⅜	⅜	⅜	⅜	⅜	⅜	½	½	½	½	½	½

Plain Compression Grease Cups



No. 75 Grease Cup

A plain brass compression grease cup is a very satisfactory lubricating device in many applications, and is particularly suited for rough work.

The No. 75 Brass Compression Grease Cup is available in six sizes with grease capacities of ¼-ounce up to 5 ounces and inside cup diameters, ¾ to 3 inches.

Dimensions and Capacities

Size Number		000	00	0	1	2	3	4
Inside diameter	Inches	13/16	1	1¼	1½	2	2½	3
Grease capacity	Ounces	¼	½	⅔	1	2	3½	5
Pipe thread on shank	Inches	⅛	⅛	⅛ or ¼	¼	⅜	½	½

Prices on application

Corrosion-Resistant Alloy Valves and Fittings

Service Recommendations.....pages 365 and 366

18-8 Mo and Monel Gate Valves
Plug Type, Outside Screw and Yoke.....page 367
Wedge, Outside Screw and Yoke.....page 368
Wedge, Non-Rising Stem.....page 370

18-8 Mo and Monel Globe Valves
Outside Screw and Yoke, Bolted Bonnet.....page 369
Union Bonnet.....page 370

18-8 Mo and Monel Swing Check Valves.....page 371
18-8 Mo Relief Valves and Liquid Level Gauge.....page 372

Ni-Resist Cast Iron Gate Valves.....page 374
Alloy Cast Iron Gate Valves.....page 375
Chlorine Valves.....page 376
Monel Trimmed Gate and Globe Valves.....page 377
All-Iron Valves.....page 378

18-8 Mo Fittings, Flanges, and Unions.....page 373
Other Corrosion-Resisting Products.....page 379
Corrosion Questionnaire.....page 380

Metals and materials....pages 1 to 9

Service Recommendations

Crane Corrosion-Resistant Alloy Valves are regularly made of 18-8 Mo Alloy Steel and Monel. The fittings are regularly made of 18-8 Mo.

All castings made of corrosion-resistant metals and alloys are produced in Crane foundries under the constant supervision of expert metallurgists. Bar stock used in valves and fittings is purchased under rigid specifications which assure the use of material adequate in both physical and chemical properties. This page and the following page are devoted to service recommendations for 18-8 Mo and Monel.

It should be remembered that service recommendations are tentative in nature, and obscure factors often greatly alter circumstances and thus alter recommendations. These recommendations can be followed in most instances, however, and Crane engineers are always available to make specific recommendations based on a detailed study of the individual corrosion problem.

Marking: Crane 18-8 Mo Valves and Fittings can be identified by the marking "18-10 M"; and Monel, by the marking "NICU".

* * * * * * * * *

Crane 18-8 Mo Alloy Steel
(Casting Equivalent of A.I.S.I. Type 316)

Crane 18-8 Mo Alloy Steel is an exceptionally high grade stainless steel that is highly resistant to many forms of corrosive action. It contains 18 to 22% chromium, 10 to 12% nickel, and 2.5 to 3% molybdenum; and conforms to but exceeds the minimum requirements of A.S.T.M. Specification A-296, Grade 4, and A.I.S.I. (American Iron and Steel Institute) Type 316 wrought stainless steel.

Crane 18-8 Mo Alloy Valves and Fittings have a wide range of application in the food, pulp, paper, textile, dye, chemical, and related industries.

Crane 18-8 Mo Alloy Steel Valves and Fittings are recommended for service in handling acetic acid, nitric acid, alkalies (such as caustic soda, soda ash, etc.), bleaching solutions, corrosive mine waters, fatty acids, food products, fruit juices, sulfate and sulfite liquors and vapors in paper mills, sulfurous acid, tanning liquors, and a large number of other industrial chemicals.

18-8 Mo Alloy Steel is satisfactorily resistant under most conditions to all fatty acids both pure and in the presence of customary organic impurities; but it may not be completely resistant when salt and/or other inorganic impurities are present. It can be used with these acids at temperatures up to 500° F., but processing at such temperatures introduces special problems other than corrosion. Valves and fittings for this high temperature service should receive special consideration.

(Continued on the following page)

Crane 18-8 Mo Alloy Steel

(*Continued from the preceding page*)

For services with chromic acid, 18-8 Mo alloy is often recommended when contamination with iron must be avoided, also in many services with nitric acid it is recommended, although there are some cases where it gives inferior corrosion resistance to that of the straight chromium alloy steels. It is apparently satisfactory for handling pure phosphoric up to 85 per cent acid at ordinary temperatures, but should not be offered for use with crude acid under any circumstances. Again it shows excellent resistance to hot 98 per cent sulfuric acid and to dilute solutions (less than 10%) at ordinary temperatures. When used with cold full strength acid and with the intermediate concentrations, the results are not so good.

18-8 Mo is practically immune to corrosion by many food products and should be acceptable, although not necessarily required, in most cases. It can also be used in service with carbonated beverages. It resists well all organic acids in the concentrations which are apt to be present; is not attacked by carbonic and sulfurous acid under similar circumstances, and in addition, is capable of resisting corrosion by the small amounts of phosphoric acid which are occasionally encountered. It is also resistant to alkaline cleaning solutions and to some of the chemical sterilizers.

Thread lubricants: Crane 18-8 Mo Alloy has such excellent resistance to corrosion that it will be used in contact with a wider variety of fluids than are the more common piping materials. Some of these fluids either dissolve or react chemically with the lubricating and sealing compounds that are normally used in making up screwed joints. It is essential, therefore, that suitably compounded thread lubricants be used when assembling 18-8 Mo Alloy screwed pipe, valves, and fittings. Crane Thread Lubricant has given excellent results in many applications. Specific recommendations will be furnished upon request.

Monel

Monel is a nickel-copper alloy containing approximately two-thirds nickel and one-third copper. It has high tensile strength, ductility, and offers excellent resistance to corrosion. This alloy finds many applications in the bottling, brewing, canning, ceramic, chemical, dyestuffs, food, paint, refining, rubber, soap, sugar, tanning, textile, and related industries.

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Monel may be used in handling hydrochloric acid in low concentrations when air is absent; higher concentrations are strongly corrosive. Caution should be exercised in using it in contact with hot or highly aerated solutions of this acid. Monel resists phosphoric acid over a wide range of concentrations; however, it is corroded appreciably by oxidizing impurities present in the crude acid when made by the treatment of phosphate rock with sulfuric acid. Its resistance to this crude concentrated acid is probably not quite so good as that of the copper-base alloys. Sulfuric acid solutions in concentrations up to 80 per cent sulfuric acid may not corrode this alloy to a great extent; however, the limiting concentration with which this material should be used is in the neighborhood of 50 per cent sulfuric acid. It has good corrosion resistance to organic acids such as acetic, formic, and butyric, and is apparently less affected by the presence of oxidizing agents than the copper-base alloys. In all of the foregoing cases, the corrosion rate of Monel is apt to be affected adversely by the presence of air and/or other oxidizing acids. Best results are obtained from this metal when oxygen is absent or present in very small concentrations. Monel is not recommended for use with chromic acid, nitric acid, or other oxidizing acids.

Monel has excellent resistance to corrosion by solutions of fixed alkalis, such as sodium hydroxide and potassium hydroxide, but should not be used with ammonium hydroxide. Caution should be used when the service involves the handling of the fixed alkalis in high concentrations and at high temperatures as contamination with copper may be an important consideration in some cases, Nickel may be required in preference to Monel in some cases. Monel is widely used for handling a variety of neutral, alkaline, and acid salts.

This alloy is very useful in the handling of food products due to the fact that it shows good resistance to the acids, cleaning solutions, organic acid salt mixtures, and brines encountered in the food industry. However, before any material is specified in the handling of food products, the stage of the process at which the equipment is to be used should be known.

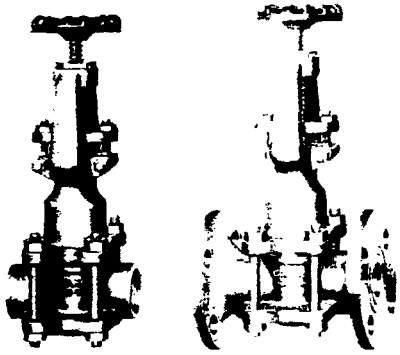
Alloy Trimmed Valves

There are many services in which the corrosion rate of common metals, i.e iron, steel, and brass is not objectionable from the standpoint of the fluid being handled, but is sufficient to cause the seats to leak and the rubbing surfaces to wear rapidly. For these services Crane offers various regular products in which these critical parts are made of corrosion-resistant materials. In most cases these valves are offered for specific service conditions, e g the No 1644 Valve for chlorine service, the No. 1447 Valve for use with kraft liquors in paper mills, and the No 3642 A for handling hydrofluoric acid in oil refineries

It should be borne in mind, however, that all of these types of valves have application in other services as well. Further, other commercial valves frequently can be trimmed with these same corrosion-resistant alloys Recommendations will be supplied on request

18-8 Mo and Monel Plug Gate Valves

WORKING PRESSURES
150 pounds liquid or gas, non-shock
350° F. maximum temperature



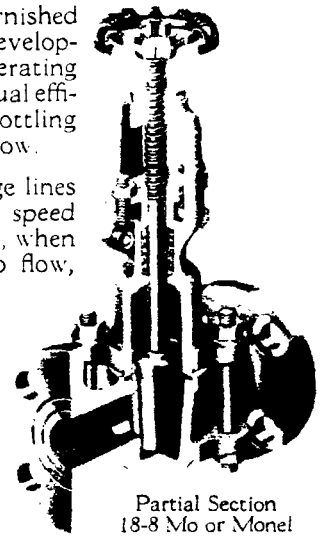
Outside Screw and Yoke

Screwed	Flanged
No. 18850 18-8 Mo Alloy	No. 18851 18-8 Mo Alloy
No. 17750 Monel	No. 17751 Monel

For Unrestricted Flow! For Throttling!

Crane Alloy Plug Gate Valves, regularly furnished in 18-8 Mo and Monel, offer a major development for efficient valve control. New in operating principle, these valves will perform with equal efficiency whether used as a globe valve for throttling or as a gate valve to provide unrestricted flow.

In some services, particularly on discharge lines in the handling of fluids where constant speed pumps are used, a conventional gate valve, when wide open, offers minimum resistance to flow, but when used for throttling is subjected to rapid wear. A globe valve in the same service, while suited for throttling, introduces high resistance to flow even when wide open, consequently reducing the maximum capacity of pumps. Crane Plug Gate Valves perform perfectly for unrestricted flow or throttling. They are excellent for two-way flow; either end serves as the inlet.



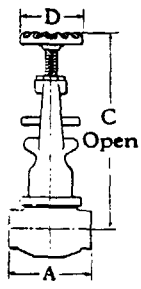
Partial Section
18-8 Mo or Monel

Materials: In 18-8 Mo Valves, the body, bonnet, disc, stem, disc-stem plug, and gland are made of Crane 18-8 Mo Alloy Steel, a material equivalent to A.I.S.I. Type 316 wrought stainless steel. In Monel Valves, these parts are made of Monel. In all valves the yoke bushing is made of Cast Manganese Bronze, and the bonnet gasket is Cranite.

List Prices, Each

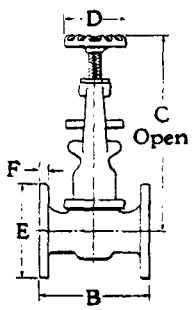
Size	Inches	½	¾	1	1¼	1½	2
18-8 Mo	No. 18850, Screwed	64.00	71.00	83.00	103.00	130.00	160.00
	No. 18851, Flanged, F.D. & S.F.	77.00	85.00	100.00	124.00	156.00	192.00
Monel	No. 17750, Screwed	67.00	75.00	87.00	108.00	137.00	168.00
	No. 17751, Flanged, F.D. & S.F.	80.00	90.00	104.00	130.00	164.00	202.00

Body: These are outside screw and yoke valves. The stem threads, being on the outside of the valve, can be lubricated easily and are not exposed to corrosion or sediment in the line. The body features straight-through ports, circular in shape and full in area. When the valves are wide open, the disc is entirely clear of the seat opening, providing a clear, unobstructed passageway through the valve. Curved seat-faces, cast as part of the body, are accurately machined to match the curved surface of the disc.



Screwed

Bolted bonnet: The yoke and bonnet are cast in one-piece to assure strength and stiffness. The bonnet is bolted to a flange at the bottom of the valve body by four bolt-studs spaced close to each other to provide compactness and a uniform pressure on the gasket.



Flanged

Dimensions, in Inches

Size	½	¾	1	1¼	1½	2
A	3	3¼	3¾	4¼	4¾	5½
B	4¼	4½	5	5½	6	7
C	7⅛	8	9⅝	10¾	12¾	15
D	2 9/16	2 9/16	2¾	3 1/16	3⅝	4 1/16
E	3½	3⅞	4¼	4⅝	5	6
F	5/16	11/32	⅜	13/32	7/16	½

Tapered plug disc: The disc, a tapered plug riding loosely on the end of the stem, is held in place by a collar on the stem and by a threaded plug screwed into the bottom of the disc. The connection is strong, serviceable, and provides accurate seating. The disc will not fall off the stem in service, even though the disc-stem plug should accidentally loosen.

The curved surface of the disc seats against two curved faces in the body when the valve is closed. Two sides of the disc are flat, permitting the disc to fit between similarly shaped faces on the inside of the bonnet. The disc rises into the bonnet but the flat faces keep it from turning. Even wear on the seating surfaces during operation, and freedom from foreign matter when the valve is closed, assure long-time seat tightness.

Stuffing box; repacking: The stuffing box, unusually large and deep, is equipped with a one-piece bolted gland, and is filled with high grade packing. The gland is pulled up by means of two eye-bolts hinged to the bonnet.

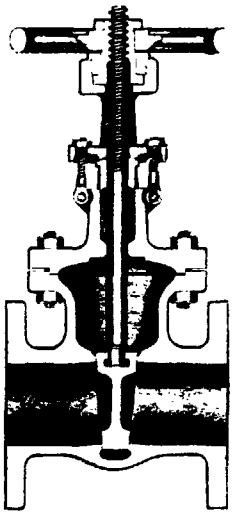
Although sometimes considered inadvisable on chemical services, these valves when wide open can be repacked while under pressure. The yoke is designed with liberal space above and around the gland.

Flanged valves: End flanges conform to the MSS 150-Pound SP Bronze Flange Standard (No. SP-2-1946). They are plain faced with two V-shaped concentric grooves between the port and bolt holes. Prices include drilling to this Standard, and spot facing; no deduction for valves ordered faced only. Use full face gaskets: see page 452.

Templates for drilling . . page 438

33

18-8 Mo and Monel Wedge Gate Valves



Cross Section
18-8 Mo or Monel

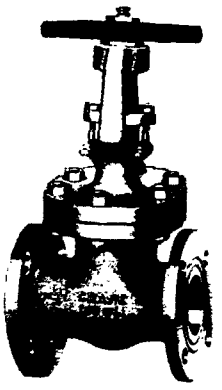
WORKING PRESSURES
150 pounds liquid or gas, non-shock
350° F. maximum temperature

New Design Large Size Wedge Gates In 18-8 Mo Alloy Steel or Monel

To provide chemical and process industries with a more complete selection of efficient, trouble-free valves for corrosive fluids, Crane offers this newly-designed, improved line of Wedge Gate Valves in either 18-8 Mo Alloy Steel or Monel.

Except for the materials, the valves are alike. They are of the outside screw and yoke type construction and have a bolted bonnet and a wedge disc.

For screwed or flanged gate valves in sizes smaller than 2½-inch, use the Crane 18-8 Mo and Monel Plug Gate Valves shown on page 367.



Outside Screw and Yoke, Flanged
No. 18843
18-8 Mo Alloy Steel
No. 17743
Monel

List Prices

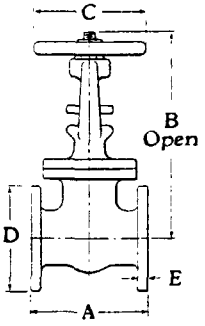
Size		Inches	2½	3	4	6
Flanged, F.D. & S.F.	No. 18843, Gate, 18-8 Mo	Each	210.00	250.00	338.00	537.00
	No. 17743, Gate, Monel	Each	263.00	311.00	424.00	671.00

Materials: All parts of the valves coming into contact with the fluid in the line, including the body, one-piece bonnet and yoke, disc, stem, and gland are made of Crane 18-8 Mo Alloy Steel in the No. 18843 Valves, and of Monel in the No. 17743 Valves. Crane 18-8 Mo Alloy Steel is a material equivalent to A.I.S.I. Type 316 wrought stainless steel.

The yoke sleeve is made of Crane Cast Manganese Bronze, a material having superior strength and wear-resistance. The wheel is malleable iron.

Construction: The valves are the outside screw and yoke type. This construction is often preferred in chemical and process industries. The stem threads being on the outside of the valve eliminate the danger of damage to the threads by corrosion and sediment from the fluid in the line, stem-thread lubrication is simplified, and the rising stem effectively indicates the position of the disc.

The body seats are cast as part of the body and are carefully machined to match the seating surfaces of the disc.



Bolted bonnet: The yoke and bonnet are cast in one-piece to assure maximum strength and rigidity. The bonnet features a male and female joint for added tightness. The bonnet joint is strong and secure, yet it can be easily dismantled and reassembled without danger of injury to the valve.

Dimensions, in Inches

Size	2½	3	4	6
A	7½	8	9	10½
B	15⅜	17⅞	22⅜	31⅜
C	7	8	9	10
D	7	7½	9	11
E	9/16	5/8	11/16	13/16

Templates for drilling page 438

Disc: The valves have a solid wedge disc. The disc is carefully directed throughout its travel by long, accurately fitted guides; this minimizes "drag" and wear on the seating faces and reduces the possibility of damage to the seats.

The disc-stem connection is in the form of a T-head on the end of the stem which fits loosely into a matching slot in the disc, permitting the disc to be raised and lowered easily and safely.

Stuffing box and gland: The stuffing box is filled with high grade packing and is unusually large and deep to assure pressure-tightness.

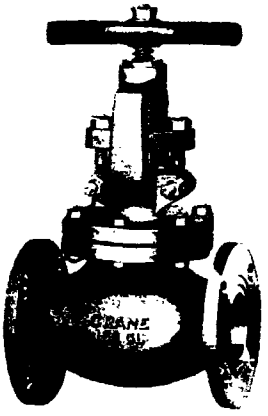
The stuffing box is equipped with a two-piece bolted gland consisting of a steel gland flange and a ball-type gland follower. The gland flange is held securely by two eye-bolts hinged to the bonnet. The ball-type gland follower prevents binding the stem if the eye-bolts are drawn up unevenly.

Repacking: The valves, when wide open, can be repacked while under pressure.

End flanges: End flanges conform to the MSS 150-Pound SP Bronze Flange Standard (No. SP-2-1940). They are plain faced with two V-shaped concentric grooves between the port and bolt holes. Prices of flanged valves include drilling to the MSS 150-Pound Standard, and spot facing; no deduction will be made if valves are ordered faced only.

Full face gaskets should be used; see page 452.

18-8 Mo and Monel Globe Valves



Outside Screw and Yoke Flanged

No. 18807
18-8 Mo Alloy Steel

No. 17707
Monel

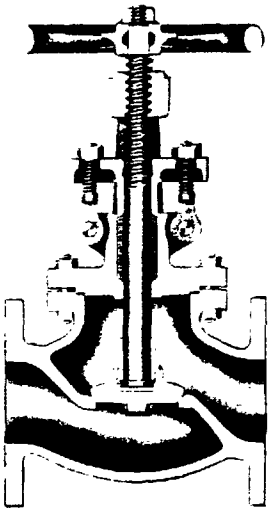
WORKING PRESSURES
150 pounds liquid or gas, non-shock
350° F. maximum temperature

New Design Large Size Globe Valves In 18-8 Mo Alloy Steel or Monel

These new large size Globe Valves have been especially designed for corrosive fluids. The valves are available in either 18-8 Mo Alloy Steel or Monel.

Except for materials, the valves are alike. They embody the same fine features, such as, outside screw and yoke construction—a bolted bonnet for maximum rigidity—smooth flowing contours within the body, with full port area to reduce pressure drop and to minimize flow resistance—and a ball-shaped seating surface for seat tightness.

For screwed or flanged globe valves in sizes smaller than 2½-inch, use the Crane 18-8 Mo and Monel Plug Gate Valves shown on page 367.



Cross Section
18-8 Mo or Monel

List Prices

Size		Inches	2½	3	4	6
Flanged, F.D. & S.F.	No. 18807, Globe, 18-8 Mo	Each	237.00	303.00	422.00	657.00
	No. 17707, Globe, Monel	Each	247.00	309.00	482.00	741.00

Materials: All parts in contact with the fluid in the line, including the body, one-piece bonnet and yoke, disc, stem, disc stem ring, and gland are made of Crane 18-8 Mo Alloy Steel in the No. 18807 Valve, and of Monel in the No. 17707 Valve. Crane 18-8 Mo Alloy Steel is a material equivalent to A.I.S.I. Type 316 wrought stainless steel.

The yoke bushing is made of Crane Cast Manganese Bronze, a material having superior strength and high resistance to wear. The wheel is malleable iron.

Construction: The valves are the outside screw and yoke type. This construction is often preferred in chemical and process industries. The stem threads are on the outside of the valve, eliminating the danger of damage to the threads by corrosion and sediment from the fluid in the line; stem-thread lubrication is simplified; and the rising stem effectively indicates the position of the disc.

Bolted bonnet: The yoke and bonnet are cast in one-piece to assure maximum strength and rigidity. The bonnet features a male and female joint for added tightness. The bonnet joint is strong and secure, yet it can be easily dismantled and reassembled without danger of injury to the valve.

Ball-to-35° seat: The disc in these valves has an accurately machined, ball-shaped seating surface. The seating surface in the body (seat cast integral with body) is finished at a 35 degree taper. The contact between the two surfaces results in a narrow line bearing. When the valves are used to handle fluids that leave a deposit of heavy or crusty substance, the narrow line bearing breaks through such deposits and helps to maintain seat tightness.

Disc-stem connection: The disc swivels on the stem. The disc and stem are attached by means of a disc stem ring screwed tightly into the disc. The ring will not loosen in service. The disc is amply guided. Seating is quick and accurate.

Stuffing box and gland: The stuffing box is filled with high grade packing and is unusually large and deep to assure pressure-tightness. It is equipped with a two-piece bolted gland consisting of a steel gland flange and a ball-type gland follower. The gland flange is held securely by two eye-bolts hinged to the bonnet. The ball-type gland follower prevents binding the stem if eye-bolts are drawn up unevenly.

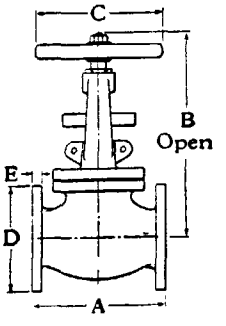
Repacking: The valves, when wide open, can be repacked while under pressure.

End flanges: End flanges conform to the MSS 150-Pound SP Bronze Flange Standard (No. SP-2-1946). They are plain faced with two V-shaped concentric grooves between the port and bolt holes. Prices include drilling to the MSS 150-Pound Standard, and spot facing; no deduction will be made for valves ordered faced only. Full face gaskets should be used; see page 452.

Dimensions, in Inches

Size	2½	3	4	6
A	8½	9½	11½	14
B	13⅞	15⅞	18½	21⅜
C	8	9	10	12
D	7	7½	9	11
E	9/16	⅝	11/16	13/16

Templates for drilling.....page 438



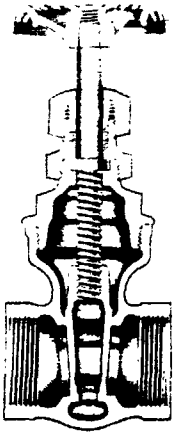
33

18-8 Mo Gate and Globe Valves

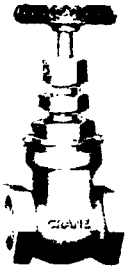
Gate Valves
Wedge Disc—Non-Rising Stem

Globe Valves
Union Bonnet

WORKING PRESSURES
150 pounds liquid or gas, non-shock
350° F. maximum temperature



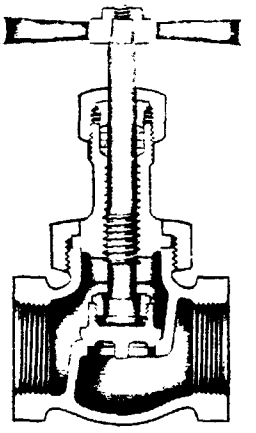
Cross Section



No. 18840
Gate, Screwed
18-8 Mo Alloy Steel



No. 18801
Globe, Screwed
18-8 Mo Alloy Steel



Cross Section

List Prices

Size		Inches	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2
Screwed	No. 18840, Gate	Each	33.00	34.00	36.50	40.00	49.00	60.50	75.50	100.00
	No. 18801, Globe	Each	24.50	28.00	34.00	41.00	50.00	62.50	78.00	106.00

These valves are carefully designed and assembled to assure efficient operation and long life. Metal sections are more than ample.

Materials: In these gate and globe valves, all parts which come in contact with the fluid in the line are made entirely from Crane 18-8 Mo Alloy Steel, a material equivalent to A.I.S.I. Type 316 wrought stainless steel.

In the 1/4 and 3/8-inch sizes, globe valves are made of bar stock.

Gate valve: Crane No. 18840 Gate Valves are the non-rising stem, wedge disc type. They have a screwed bonnet and are similar in design to the Crane No. 437 Brass Gate Valve. The seats are cast integral with the body. All sizes are equipped with a Style F Wheel.

Globe valve: Crane No. 18801 Globe Valves on sizes 1/2-inch and larger have a union bonnet and are equipped with a cross handle (illustrated). The union bonnet type construction utilizes a union ring which reinforces the bonnet joint and facilitates dismantling and reassembling without danger of injuring the valve. Valves smaller than 1/2-inch have a screwed bonnet and are equipped with a tee handle.

On 1/4 to 1/2-inch globe valves, the disc is integral with the stem; in larger sizes, the disc swivels on the stem as illustrated in the cross section.

Stuffing box: Both the gate and globe valves have a stuffing box equipped with a gland. The stuffing box is of ample depth and is filled with high grade packing.

Repacking: These valves, when wide open, can be repacked while under pressure.

Dimensions, in Inches

Size		1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2
Gate Valve	End to end	1 7/8	1 15/16	2 1/8	2 3/8	2 13/16	3 3/16	3 7/16	3 7/8
	Center to top	3 3/4	3 3/4	4 1/8	4 3/4	5 5/8	6 1/2	7 1/4	8 3/4
	Diameter of wheel	1 3/4	1 3/4	2 1/16	2 9/16	2 3/4	3 1/16	3 5/8	4 1/16
Globe Valve	End to end	1 7/8	2 7/16	2 1/4	2 3/4	3 5/16	3 7/8	4 1/2	5 1/4
	Center to top of stem, open	3 1/8	3 1/2	4 1/4	5	5 5/8	6 1/2	7 1/2	8 1/4
	Distance across handle	2 9/16	2 9/16	3 3/4	3 3/4	4 3/4	4 3/4	6	7

18-8 Mo and Monel Swing Check Valves

Y-Pattern
Sizes ½ to 2-inch



Cross Section

Flanged



Screwed
No. 18826
18-8 Mo Alloy Steel
No. 17726
Monel



Flanged
No. 18827
18-8 Mo Alloy Steel
No. 17727
Monel

WORKING PRESSURES
150 pounds liquid or gas, non-shock
350° F. maximum temperature

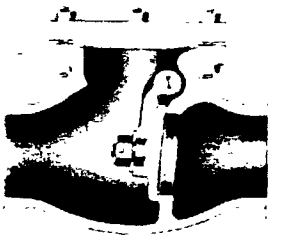
New Design Swing Check Valves In 18-8 Mo Alloy Steel or Monel

These newly designed Crane Swing Check Valves for use on services handling corrosive fluids are regularly furnished in 18-8 Mo Alloy Steel or Monel.

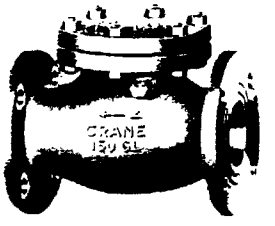
In sizes ½ to 2-inch, inclusive, the valves are the regrinding type. They feature an improved Y-pattern body design. Because of the wide usage of small flanged valves in chemical and process industries, flanged as well as screwed valves are included in this group.

In sizes 2½ to 6-inch, inclusive, the valves are the straightway design, permitting straightway flow with a minimum of flow-resistance and pressure drop.

Straightway
Sizes 2½ to 6-inch



Cross Section



Flanged
No. 18829
18-8 Mo Alloy Steel
No. 17729
Monel

Materials: In 18-8 Mo Valves, the body, cap, disc, hinge, and disc nut are made of Crane 18-8 Mo Alloy Steel, a material equivalent to A.I.S.I. Type 316 wrought stainless steel. In Monel valves, these parts are made of Monel.

List Prices, Each

Size	Inches	½	¾	1	1¼	1½	2	2½	3	4	6
18-8 Mo	No. 18826, Screwed	25.00	29.50	37.00	49.00	68.00	89.00				
	No. 18827, Flanged, F.D. & S.F.	37.50	44.50	55.50	73.50	102.00	133.00				
	No. 18829, Flanged, F.D. & S.F.							222.00	281.00	369.00	591.00
Monel	No. 17726, Screwed	27.50	32.50	41.00	54.00	75.00	97.50				
	No. 17727, Flanged, F.D. & S.F.	41.50	49.00	61.00	81.00	112.00	146.00				
	No. 17729, Flanged, F.D. & S.F.							281.00	354.00	517.00	857.00

Y-Pattern valves: These are regrinding type valves. The body, Y-pattern in shape, has a smooth contour at all points to allow swift, easy flow. The cap, screwed into the body with long, accurately machined threads, is on the same center line as the seat opening. The cap is large and permits ready access to the internal parts when it is removed.

Seating surfaces, integral with the body, can be reground without removing the body from the line; a slot in the end of the disc-spud enables rotating the disc with a screwdriver.

Straightway valves: These valves feature a straightway type body with a seat-face at only a slight angle from vertical so as to permit full flow. The bolted cap construction provides a very strong, tight joint; yet, it can be easily dismantled for cleaning and repairing. The seat is integral with the body.

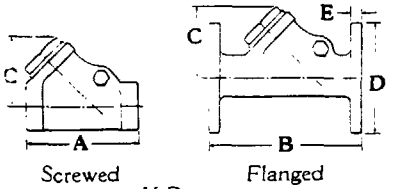
Disc and hinge: On all valves, the disc and hinge, suspended from the body by means of a hinge pin, swing freely. The disc is designed to close of its own weight and to rest on the seat when there is no flow. This prevents back-flow from gaining sufficient velocity to cause slamming or "water hammer".

Outside lever and weight: Valves 2½-inch and larger can be furnished with an outside lever and adjustable weight when orders so specify; prices on application. The lever and weight can be applied to assist the disc in closing, or to balance the disc so that the valve will open under minimum pressure.

End flanges: End flanges conform to the MSS 150-Pound SP Bronze Flange Standard (No. SP-2-1946). They are plain faced with two V-shaped concentric grooves between the port and bolt holes. Prices include drilling to the MSS 150-Pound Standard, and spot facing; no deduction made for flanged valves ordered faced only. Full face gaskets should be used; see page 452.

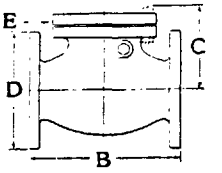
Dimensions, in Inches

Size	½	¾	1	1¼	1½	2	2½	3	4	6
A	3	3½	4¼	5	5½	6½				
B	4½	5	5¾	6½	7¼	8½	8½	9½	11½	14
C	1⅞	2⅛	2¾	3⅛	3½	4¼	5⅛	5½	6½	8½
D	3½	3⅞	4¼	4⅝	5	6	7	7½	9	11
E	5/16	11/32	⅜	13/32	7/16	½	9/16	⅝	11/16	13/16



Screwed Flanged
Y-Pattern

Templates for drilling . . . page 438



Straightway, Flanged

33

18-8 Mo Relief Valves



No. 18859
Relief Valve
Female Inlet
Side Outlet
18-8 Mo Alloy Steel

MAXIMUM SET PRESSURE
250 pounds
600° F. maximum temperature

When ordering, be sure to specify set pressure.

Materials: All parts of these relief valves coming in contact with the fluid in the line, including the body, bonnet, stem, disc, disc nut, regulating ring, gland, bonnet bushing, seat ring, and locking plug are made of Crane 18-8 Mo Alloy Steel, a material equivalent to A.I.S.I. Type 316 wrought stainless steel.

The ⅜-inch size valves do not have a regulating ring and locking plug.

Gas service: When specifically ordered for manufactured gases, the valve seat is ground special.

Construction: The valves are ruggedly constructed. They are the outside spring type and have a screwed bonnet and a lifting lever.

A stuffing box around the stem prevents the escape of the fluid while the valve is discharging.

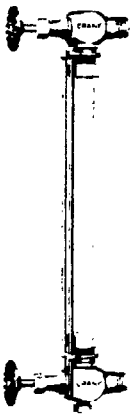
A blow-back regulating ring is provided for adjusting the blow-down of pressure when changing or regulating the set pressure. The adjustment of this ring may be made from the outside, without interfering with the setting of the valve.

List Prices and Dimensions

Size	Inches	⅜	½	¾	1	1¼	1½	2
No. 18859, Relief Valve	Each	70.00	76.00	84.00	100.00	122.00	150.00	185.00
Dimensions, in Inches	Size of inlet	⅜	½	¾	1	1¼	1½	2
	Size of outlet	½	½	¾	1	1¼	1½	2
	Center to top of cap	5⅝	5⅝	5⅞	7	8¼	9¼	11½
	Center to end of female inlet	1 11/16	1 11/16	2	2 3/16	2⅝	2⅞	3 7/16
	Center to end of side outlet	1 1/16	1 1/16	1 5/16	1⅝	2 1/16	2⅜	2¾

33

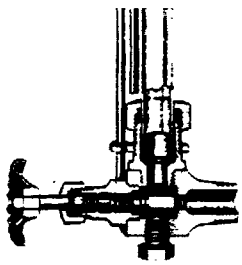
18-8 Mo Liquid Level Gauge



No. 18898
Liquid Level Gauge
(With Guard and
Glass Tube)
18-8 Mo Alloy Steel

For **150** pounds liquid, **350°** F. maximum temperature

Materials: These Crane No. 18898 Liquid Level Gauges are sturdy and well-constructed.



Sectional View

All parts which come in contact with the fluid in the line including the bodies, bonnets, stems, packing nuts, glands, glass retainers, and drain plug are made of Crane 18-8 Mo Alloy Steel, a material equivalent to A.I.S.I. Type 316 wrought stainless steel.

Construction: The gauges are regularly made in the ½-inch size and with 14-inch centers.

Gauges with other centers can be furnished when ordered.

The valve bodies are square type and have an integral seat. The disc and stem also are integral. The Gauges have ⅝-inch O.D. glass and are equipped with two guard rods.

Special gauges: When ordered with a drain, the bottom valve will be fitted with a ¼-inch short nipple and a ¼-inch No. 18840 (see page 370) Gate Valve. An extra charge is made for the drain.

Gauges with an automatic check can be furnished when ordered, at a special price. The bottom valve is made with a special adapter, a special stem, and a 9/16-inch diameter ball.

List Price

Size	Inches	½
No. 18898, Liquid Level Gauge with 14" centers	Each	148.00

18-8 Mo Fittings

Screwed Fittings



No. 18860
90° Elbow



No. 18862
45° Elbow



No. 18868
Tee

WORKING PRESSURE
150 pounds
liquid or gas, non-shock
350° F.
maximum temperature

Flanged Fittings



No. 18861
90° Flanged Elbow



No. 18863
45° Flanged Elbow

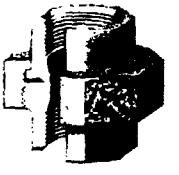


No. 18878
Cap



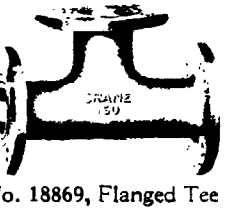
No. 18882
Coupling

Unions



No. 18890, Union

18-8 Mo Alloy Steel Unions are regularly made with a galvanized malleable iron union ring unless specifically ordered with an 18-8 Mo ring, for which an extra charge is made.



No. 18869, Flanged Tee



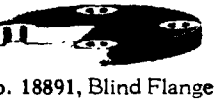
No. 18884
Plug



No. 18886
Bushing



No. 18889, Screwed Companion Flange



No. 18891, Blind Flange

Prices of bushings (larger opening determines the price) apply only to the following stock sizes:

¼×⅛	1 ×¾	1½×1¼
⅜×¼	×½	×1
½×⅜		
×¼	1¼×1	2 ×1½
¾×½	×¾	×1¼

18-8 Mo Alloy Steel

Except for the plugs, bushings, ¼ and ⅜-inch caps and couplings, and the ¼ and ⅜-inch union tail-piece and thread-piece which are A.I.S.I. Type 316 bar stock, the fittings, flanges, and union shown on this page are made of Crane 18-8 Mo Alloy Steel, a casting material equivalent to A.I.S.I. Type 316 wrought stainless steel.

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List Prices, and Dimensions, in Inches

Size		Inches	¼	⅜	½	¾	1	1¼	1½	2	2½	3	4	6
Screwed Fittings and Unions	Prices Each	No. 18860, 90° Elbow	2.60	2.90	3.30	3.90	5.00	6.40	8.40	12.30				
		No. 18862, 45° Elbow	2.60	2.90	3.30	3.90	5.00	6.40	8.40	12.30				
		No. 18868, Tee	3.00	3.60	4.50	5.50	7.00	9.30	12.00	17.50				
		No. 18878, Cap	1.60	2.00	2.40	3.00	3.90	5.30	7.20	10.00				
		No. 18882, Coupling	2.00	2.30	2.70	3.40	4.40	6.00	8.20	11.30				
		No. 18884, Plug	1.30	1.60	2.10	3.30	5.30	9.00	12.50	20.00				
		No. 18886, Bushing	1.80	2.10	2.60	3.40	5.00	7.50	12.00	18.50				
		No. 18890, Union	7.00	7.50	8.00	9.00	12.00	16.50	22.00	29.50				
	Center to end	90° Elbow or Tee	13/16	15/16	1⅛	1⅝	1½	1¾	1 15/16	2¼				
		45° Elbow	¾	13/16	⅞	1	1⅛	1 5/16	1 7/16	1 11/16				
	End to end	Coupling	1	1⅛	1 5/16	1½	1 11/16	1 15/16	2⅛	2½				
		Union	1⅝	1 13/16	1 15/16	2¼	2 7/16	2 13/16	3	3⅜				
	Over-all height, Cap		11/16	¾	⅞	1 1/16	1 3/16	1¼	1 5/16	1 7/16				
	*Thread engagement		⅜	⅜	½	9/16	11/16	11/16	11/16	¾				
Flanged Fittings and Flanges	Prices Each	No. 18861, 90° Elbow					34.50	39.00	45.00	57.00	72.00	90.00	124.00	215.00
		No. 18863, 45° Elbow					34.50	39.00	45.00	57.00	72.00	90.00	124.00	215.00
		No. 18869, Tee					48.00	60.00	73.50	88.50	105.00	135.00	180.00	318.00
		No. 18889, Scrd. Flange					12.50	14.00	17.00	21.00	26.50	34.00	45.00	90.00
		No. 18891, Blind Flange					13.50	16.00	19.50	24.00	30.00	39.00	52.50	98.00
	Center to face	90° Elbow or Tee					3½	3¾	4	4½	5	5½	6½	8
		45° Elbow					1¾	2	2¼	2½	3	3	4	5
	Diameter of flanges						4¼	4⅝	5	6	7	7½	9	11
	Thickness of flanges						⅜	13/32	7/16	½	9/16	⅝	11/16	13/16

Flanges: Flanges conform to the MSS 150-Pound SP Bronze Flange Standard (No. SP-2-1946). They are plain faced with two V-shaped concentric grooves between the port and bolt holes.

Prices of flanged fittings and flanges include drilling to this Standard, and spot facing; no deduction will be made if flanges are ordered faced only. Full face gaskets should be used; see page 452.

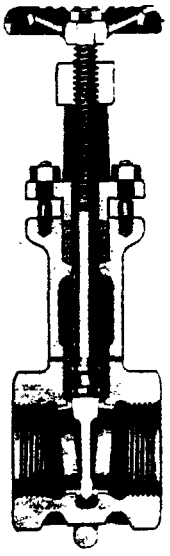
*For explanation of thread engagement, see page 474.

Templates for drilling, see page 438.

Ni-Resist Cast Iron Gate Valves

Wedge Disc—Outside Screw and Yoke

Sizes 3-inch and smaller



Cross Section



No. 1670
Screwed



No. 1671
Flanged

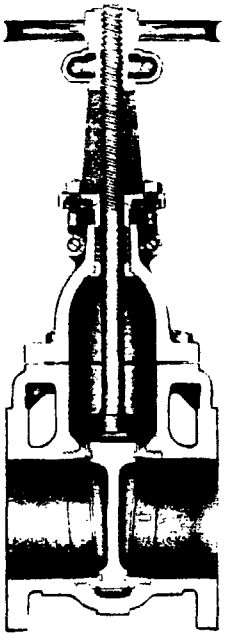
Templates for drilling, page 439.

WORKING PRESSURES

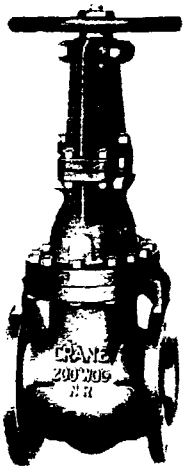
Screwed valves—**225** pounds cold water, oil, or gas, non-shock
Flanged valves—**200** pounds cold water, oil, or gas, non-shock

Air tested

Sizes 4-inch and larger



Cross Section



No. 1671
Flanged

SERVICE RECOMMENDATIONS

Crane Ni-Resist Valves are safely used where the strength of ordinary cast iron is adequate. They are especially suitable for soda and sulfate pulp mill service, for creosote used in wood preserving, for handling sour distillates and crudes in petroleum refineries, and for kindred services.

Materials: In valves 3-inch and smaller, the body and bonnet are made of Ni-Resist Cast Iron. The disc, stem, and body seat rings are Crane 18-8 Mo Alloy Steel.

In 4-inch valves and larger, the body, bonnet, and disc are made of Ni-Resist Cast Iron. The seating faces and the stem are Crane 18-8 Mo Alloy Steel.

Ni-Resist (sometimes called Monel Cast Iron) is an alloy cast iron containing approximately 14% nickel, 2½% chromium, and 6% copper. Its strength and physical characteristics are similar to ordinary cast iron, but its resistance to erosion and wear is definitely superior to ordinary cast iron; its corrosion resistance is substantially greater. Ni-Resist parts are stamped "NR".

Crane 18-8 Mo Alloy Steel is a material equivalent to A.I.S.I. Type 316 wrought stainless steel.

Construction: The valves are of the outside screw and yoke type. Stem threads, on the outside of the valve, are readily lubricated and are not exposed to the corrosive action of the fluid in the line. On valves ½ to 4-inch, the yoke is integral with the bonnet; on 6 and 8-inch valves, the yoke is bolted to the bonnet.

Valves 3-inch and smaller have a clamp type bolted bonnet and a one-piece bolted gland. Larger sizes have the conventional bolted bonnet and a two-piece bolted gland, consisting of a malleable iron gland flange and a ball-type gland follower. Both types of bolted bonnets are easily disassembled for cleaning or repairs.

The valves have a solid wedge disc. The seating faces are integral with the disc in sizes 3-inch and smaller and rolled into the disc in sizes 4-inch and larger. The disc-stem connection is in the form of a T-head on the end of the stem which fits loosely into a matching slot in the disc, permitting the disc to be operated easily and safely.

Stuffing box: The deep stuffing box is filled with high grade packing. The valves when wide open can be repacked while under pressure.

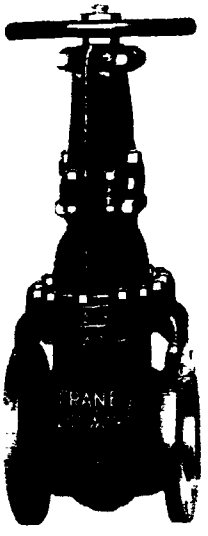
End flanges: End flanges conform to the American Cast Iron Flange Standard, Class 125 (B16.1-1948). Prices of flanged valves include facing and drilling to this Standard; no deduction is made for valves ordered faced only. Flanges are plain faced with a smooth finish.

List Prices, Each, and Dimensions

Size Inches		½	¾	1	1¼	1½	2	2½	3	4	6	8
No. 1670, Screwed		27.00	30.00	33.00	38.00	42.00	55.00					
No. 1671, Flanged, F. & D.				39.00	48.00	54.00	70.00	90.00	110.00	170.00	310.00	500.00
Dimensions in Inches	End to end	2 1/16	2 5/16	2 9/16	2 7/8	3 1/8	3 5/8					
	Face to face			3 3/16	3 1/2	3 3/4	4 1/4	4 15/16	5 1/16	9	10 1/2	11 1/2
	Center to top, open	6 5/8	7 5/8	9 1/8	10	12 1/8	14 1/8	16 1/4	19	23 3/4	32 3/4	42 1/8
	Diameter of wheel	2 9/16	2 9/16	2 3/4	3 1/16	3 5/8	4 1/16	4 3/4	5 3/8	10	12	16
	Diameter of flanges			4 1/4	4 5/8	5	6	7	7 1/2	9	11	13 1/2
	Thickness of flanges			7/16	1/2	9/16	5/8	11/16	3/4	15/16	1	1 1/8

Alloy Cast Iron Wedge Gate Valves

For Process Industries



Outside Screw & Yoke
18-8 Mo Trimmed

No. 14477
Flanged

WORKING PRESSURE
200 pounds cold water, oil, or gas, non-shock

HYDROSTATIC TEST PRESSURES
350 pounds shell 225 pounds seat

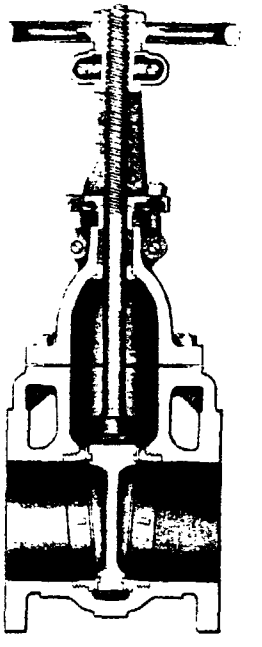
18-8 MO ALLOY TRIMMED
18-8 Mo Body Seat Rings 18-8 Mo Stem
18-8 Mo Faced Alloy Cast Iron Disc
Alloy Cast Iron Body Nickel-Plated Steel Gland

SERVICE RECOMMENDATIONS

Crane No. 14477 Wedge Gate Valves are offered for use in services where the conventional "all-iron" and "brass trimmed" valves fail because of corrosion of seating surfaces.

The valves are used in the petroleum industry handling oils which contain traces of mineral acids. They are also used in the wood treating industry handling creosote vapors and oils, and in the pulp and paper industry handling alkaline liquors of various kinds.

No. 14477 Valves are similar in design to the Crane 125-Pound Iron Body Wedge Gate Valves shown on page 79.



Cross Section
No. 14477

List Prices

Size	Inches	2	2½	3	4	6	8	10	12
No. 14477, Flanged, F. & D.	Each	95.00	105.00	125.00	168.00	260.00	400.00	650.00	975.00

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Alloy cast iron: The valve body and disc are made of a nickel low alloy cast iron, developed to meet the need for an iron having better physical properties and resistance to corrosion when subjected to services where ordinary gray iron is not adequate.

Body and bonnet: The body and bonnet are made with liberal metal sections to assure maximum strength. Tie ribs between the bonnet flange and the end flanges provide exceptional resistance to line strains. The body has straight through ports to minimize turbulence and thereby obtain a more uniform flow through the valve.

Disc: The valves have a solid web disc, with extra long disc guides in order to minimize drag on the seating surfaces.

Stem: Stem threads have long engagement in the yoke sleeve; the valves have a tee-head disc-stem connection.

Gland and stuffing box: A two-piece ball-type gland maintains an even load on the packing and prevents binding on the stem even when the gland bolts are not pulled up evenly.

The valves have swinging gland eye bolts which move out of the way when the stuffing box is being repacked, but which do not become detached or lost.

Standards: These valves conform to the American Petroleum Institute (API) Standard 6-D, Fifth Edition, June, 1947 (Tentative) and Supplement 1, issued October, 1948, for 175-Pound Iron Pipe Line Gate Valves. The valves also conform to the American Standard for Face to Face Dimensions (B16.10-1939), for 125-Pound Iron Wedge Gate Valves.

Flange dimensions and facing: The dimensions and drilling of end flanges conform to the American Cast Iron Flange Standard, Class 125 (B16.1-1948). The flanges are plain faced with smooth finish.

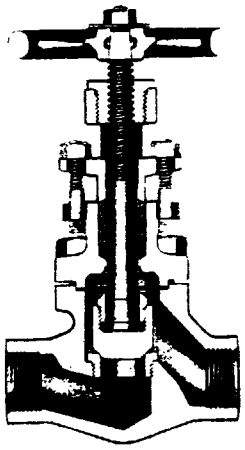
Dimensions, in Inches

Size	2	2½	3	4	6	8	10	12
Face to face	7	7½	8	9	10½	11½	13	14
Center to top, open	14⅞	17	19½	23⅝	32⅝	41⅞	50⅛	58
Diameter of wheel	8	8	9	10	12	16	20	20
Diameter of flanges	6	7	7½	9	11	13½	16	19
Thickness of flanges	⅝	11/16	¾	15/16	1	1⅛	13/16	1¼
No. of turns to open	7	8½	10½	9	13	17	21	25½

Drilling: Flanges are furnished faced and drilled unless ordered faced only. No deduction is made when valves are ordered faced only.

Templates for drilling, page 439.

Forged Steel Globe and Angle Valves
For Chlorine Service



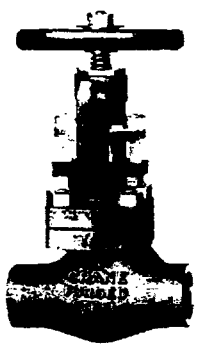
Cross Section
Globe

Tested 300 pounds air-under-water

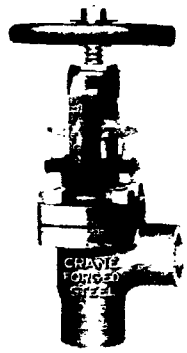
SERVICE RECOMMENDATIONS

These valves are recommended for chlorine gas and liquid service, free from water, at temperatures not to exceed 300° F. They are strong, durable, compact valves—suitable for severe service conditions.

The valves have proven unusually satisfactory for chlorine work. They are fully dependable, providing maximum safety, long packing life, easy servicing, high corrosion resistance, and tight seating.



No. 1644, Globe
Screwed



No. 1645, Angle
Screwed

List Prices and Dimensions

Size		Inches	½	¾	1	1¼	1½	2
No. 1644, Globe		Each	51.00	57.50	65.50	89.00	115.00	148.00
No. 1645, Angle		Each	51.00	57.50	65.50	89.00	115.00	148.00
Dimensions, in Inches	End to end, Globe		3⅝	4⅜	5⅛	6¼	7	8⅜
	Center to end, Angle		1 13/16	2 3/16	2 9/16	3⅛	3½	4 3/16
	Center to top, open	Globe	7 5/16	8⅞	9 7/16	11 1/16	12	14 1/8
		Angle	6¾	8	8 5/16	9⅝	10 3/16	12 1/16
	Diameter of wheel		3½	4	5	6	7	9

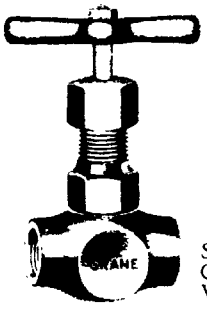
Materials and construction: These Globe and Angle Valves for chlorine service are of the bolted bonnet, outside screw and yoke type. The body and one-piece bonnet and yoke are forged carbon steel. The disc, disc stem ring, and body seat ring are made of Hastelloy "C" to resist the corrosive action of chlorine.

The valves have a 45° narrow bearing seat. The gland is forged steel, and the bonnet bolt studs are Triplex steel. The stem is made of Monel and is fitted with a malleable iron handwheel.

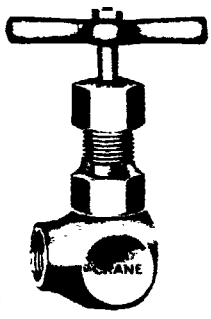
The bonnet joint is fitted with a corrugated soft Monel gasket. These valves, when wide open, can be repacked while under pressure.

33

18-8 Mo Bar Stock Valves



Bar Stock Globe Valve



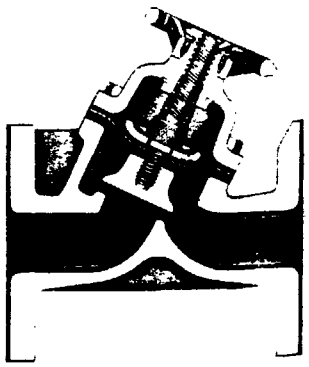
Bar Stock Angle Valve

These valves are suitable for many corrosive services, being made with Crane 18-8 Mo Alloy Steel body, bonnet, packing nut, gland, and stem. Thread chambers are extra long. The plug type disc accurately regulates flow and resists wear very well.

The line includes, in addition to the female end valves illustrated above, globe and angle valves with male and female ends, and valves made of steel and of Exelloy. See page 234 for prices, dimensions, and complete description.

Y-Pattern Diaphragm Valves

Sectional View
Neoprene Lined
Y-Pattern
Diaphragm Valve

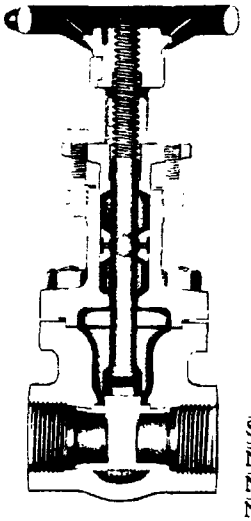


The new Crane Iron Body Y-Pattern Diaphragm Valves are described and illustrated on pages 106 and 107.

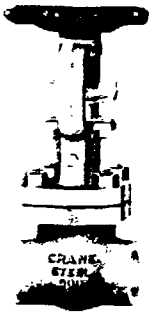
In addition to screwed and flanged valves with neoprene faced disc, the line includes a flanged valve in sizes ½ to 4 inches, inclusive, having a neoprene lined body and neoprene coated disc. The valves can be used for many services that are corrosive to brass or iron body brass trimmed valves; they are recommended for 150 pounds water, oil, or gas, at temperatures up to 18[illegible] F

Steel Gate and Globe Valves

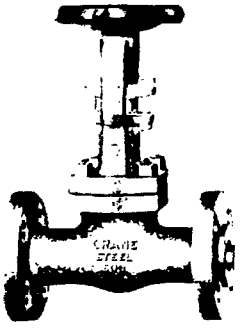
Monel Trimmed



Cross Section
No. 3609 A
Gate Valve
Screwed
Bolted Bonnet



No. 3609 A
Screwed



No. 3617 A
Flanged

Gate Valves

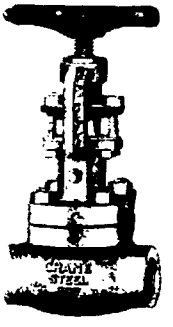
These are unusually sturdy and rugged valves, patterned after the Crane small size 600-Pound Steel Gate Valves shown on page 225. They have a heavy but compact cast steel body and bonnet, tee-head disc-stem connection, male and female bonnet joint with soft iron gasket, bolted gland, and long disc guides. The disc, stem, and body seat rings are made of Monel. The valves have an extra deep stuffing box, providing a tighter stem seal, longer packing life, and greater protection against leakage. The No. 3008 A Valves (not illustrated) have a union bonnet.

List Prices, Each, and Dimensions, in Inches

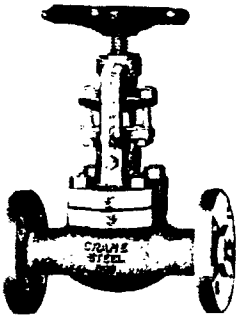
Size, Inches	¼	⅜	½	¾	1	1½	2
No. 3608 A, Union Bonnet, Screwed	20.00	20.00					
No. 3609 A, Bolted Bonnet, Screwed			28.20	34.20	40.80	66.00	90.00
No. 3617 A, Bolted Bonnet, Flanged, F.D. & S.F.			48.00	56.00	69.00	106.00	136.00
End to end, Screwed	2¾	2¾	3	3½	4⅛	4½	5¼
Face to face, Flanged			6½	7½	8½	9½	11½
Center to top, open	6⅛	6⅛	7¼	8¾	10¼	13	15½
Diameter of wheel	3	3	3½	4	5	6	7

Globe Valves

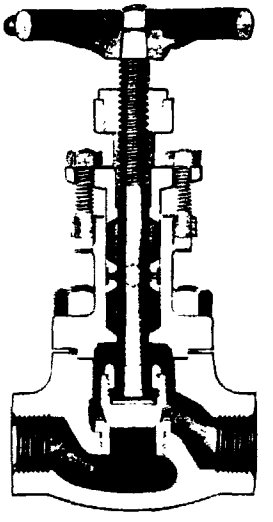
These globe valves are exceptionally sturdy and rugged, being patterned after the Crane small size 600-Pound Steel Valves shown on page 237. The body and bonnet are cast or forged steel with male-female joint, soft iron gasket. The valves have a ball to 35° seat. The disc, body seat ring, disc stem ring, and stem are Monel. They have an extra deep stuffing box, providing a tighter stem seal, longer packing life, and greater safety. The No. 3642 A Valves (not illustrated) have a union bonnet.



No. 3646 A
Screwed



No. 3658 A
Flanged



Cross Section
No. 3646 A
Globe Valve
Screwed
Bolted Bonnet

List Prices, Each, and Dimensions, in Inches

Size, Inches	¼	⅜	½	¾	1	1½	2
No. 3642 A, Union Bonnet, Screwed	22.30	22.30					
No. 3646 A, Bolted Bonnet, Screwed			29.50	34.40	40.70	80.40	108.00
No. 3658 A, Bolted Bonnet, Flanged, F.D. & S.F.			56.30	68.00	80.50	123.00	155.00
End to end, Screwed	3	3	3⅜	4⅜	5⅛	7	8⅜
Face to face, Flanged			6½	7½	8½	9½	11½
Center to top, open	7⅛	7⅛	8	9½	9⅞	12⅜	14⅜
Diameter of wheel	3	3	3½	4	5	7	9

Stuffing box; packing: These valves have a special design, extra deep stuffing box. A tapped and plugged hole is provided in the bonnet which opens to the spacer between the upper and lower packing; this enables the user to properly lubricate the packing, a necessity on hydrofluoric acid service. These valves are regularly furnished without packing (must be packed in the field); if a packing is specified, prices are quoted on application.

Service recommendations: The valves are used on refining units by the petroleum industry and for various processes in chemical plants where high quality steel valves with Monel trim are desired. They give good service in hydrofluoric alkylation units handling anhydrous H.F., and where mixtures of the acid and hydrocarbons are found. They are not recommended for aqueous solutions of hydrofluoric acid where the concentration drops below 80% H.F.

Flanged valves: The end flanges on flanged valves conform to the 600-Pound American Standard (B16e-1939). They have a large male face, ¼-inch high, finished with concentric grooves and known as a "serrated" finish. Prices include drilling to the 600-Pound Standard; drilling templates, see page 442.

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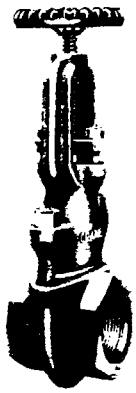
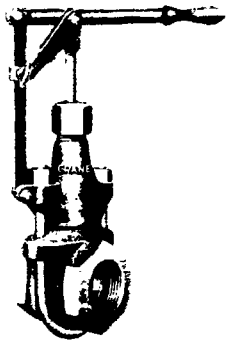
All-Iron Valves



Inside Screw Valve

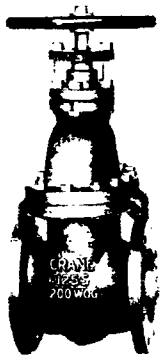


O.S. & Y. Valve

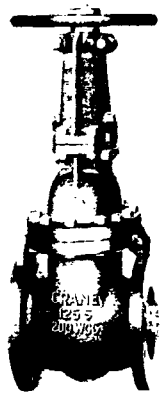


Quick Opening Valve

For All-Iron Clamp Gate Valves, see pages 74 and 75.



Non-Rising Stem Valve



O.S. & Y. Valve

For All-Iron Wedge and Double Disc Gate Valves, see pages 79, 83, and 97.

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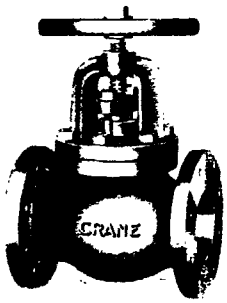
Union Bonnet Globe Valve

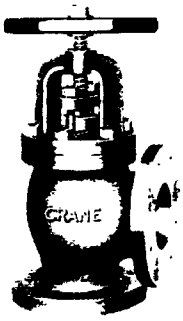


Union Bonnet Angle Valve

For All-Iron Union Bonnet Globe and Angle Valves, see page 109.

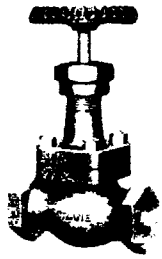


Bolted Bonnet Globe Valve



Bolted Bonnet Angle Valve

For All-Iron Bolted Bonnet Globe and Angle Valves, see page 112.



Ferrosteel Bolted Bonnet Globe Valve With Lead-Faced or Steel Disc

For Ferrosteel Globe and Angle Valves, see page 395.



Relief Valve

For All-Iron Relief Valves, see page 321.

Crane manufactures an unusually complete assortment of All-Iron Gate, Globe, Angle and Check Valves, including a wide variety of types and a full range of sizes.

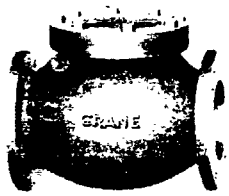
Although cast iron cannot be listed specifically as one of the corrosion resisting metals, all-iron valves find wide application in many services where brass or brass trimmed valves are not entirely suited. Without good inherent resistance to corrosion, cast iron frequently depends for its general serviceability upon the fact that, in many situations, the initial corrosion is followed by the formation of protective coatings which slow up the rate of corrosion or entirely prevent it.

For greater convenience, All-Iron Valves are listed with related products in other sections of this catalog. A few of the common types are illustrated above, together with page references.



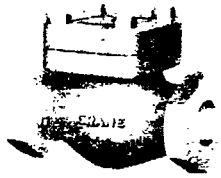
Malleable Iron Swing Check Valve

For Malleable Iron Swing Check Valves, see page 118.



All-Iron Swing Check Valve

For All-Iron Swing Check Valves, see page 121.



Ferrosteel Lift Check Valve

For Ferrosteel Lift Check Valves, see page 396.

Corrosion Questionnaire

Information Required for Developing Recommendations

The behavior of metals and alloys in contact with corrosive fluids is often affected by factors which are not obvious. Because of this, it is difficult to submit a sufficiently comprehensive questionnaire without appearing unduly inquisitive. The questions below are those which apply to practically any installation; and the answers to them will, in many cases, provide all the necessary information. It is not to be expected, however, that the information so obtained will be sufficient in all cases; and it is hoped that the questions will be considered as a guide to the type of information desired rather than as a limitation to the amount that is needed.

Since apparently extraneous physical factors often exert a tremendous influence on the progress of corrosion, it is also desirable to know something about the installation itself. This is particularly true when there is a background of previous experience; and when a rough sketch of the layout of tanks, piping, etc. can be accompanied by notations showing the locations at which corrosion has been the most severe. An opportunity to examine corroded pipe, valves, or fittings will often aid materially in the making of recommendations.

1. What is the name or composition of fluid to be handled?
2. What is the concentration (percentage strength, specific gravity, pH value, etc.)?
3. What is the operating temperature and pressure in pipe lines?
4. If the fluid is not a water solution but a gas, organic fluid, etc., is water or water vapor apt to be present at any time or at any particular location? If so, explain.
5. If the fluid is a water solution, are substances other than water (abrasive solids, oil, etc.) present at any time or at any particular location? If so, explain.
6. Is there much opportunity for air in-leakage?
7. Is the flow through the system intermittent or continuous?
8. If intermittent, is the system ever drained entirely of fluid and allowed to dry?
9. Is the piping system washed or rinsed at regular intervals, and if so, with what materials?
10. Is a slight amount of corrosion objectionable from the standpoint of contamination or discoloration of product?
11. If so, what metals are particularly objectionable?
12. What materials are being used or proposed for piping, tanks, etc.?
13. Has any specific trouble been experienced with these materials?
14. What materials have been used for valves and fittings?
15. In general, what is the comparative life of the different materials which have been used?
16. What packings give the best service?

Valves and Fittings For Marine Service

Regulations and Material Specifications.....page 382
General Requirements.....pages 382 and 383

Recommendations for Class I and Class II Piping
- Brass and Iron Valves.....page 384
- Fittings and Flanges.....page 383
- Steel Valves.....page 385

Brass Valves
- Gate.....page 388
- Globe and Angle.....page 388
- Check.....page 388
- Hose Gate.....page 387
- Chronometer.....page 387

Iron Valves
- Gate.....page 389
- Globe and Angle.....page 390
- Check.....page 390

Steel Valves
- Gate.....page 391
- Globe and Angle.....page 391
- Check.....page 391
- Pressure-Temperature Ratings.....page 386

Main Injection Valves.....page 390
Manifold Valves.....page 392
Screw-Down Check Valves.....page 392

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Part of this section is devoted to comments on the "Marine Engineering Regulations and Material Specifications" issued April, 1948 by the United States Coast Guard, and its requirements in general. In addition, there are recommendations of Crane Valves, Fittings, and Flanges as regularly manufactured for commercial purposes, which also conform to the requirements for marine service, valves made especially for marine service, and valves most commonly used in marine piping.

The extra quality built into Crane Valves and Fittings makes them accepted everywhere. It is this quality that has long maintained for Crane its enviable position for meeting marine requirements—safety, ruggedness, and durability. Then too, the completeness of the Crane line is important. Whether it be the smallest tug or the largest passenger liner—a vessel for river, lake, or ocean service—a wide selection of Crane products is available.

General Requirements (Cont.)

Marking: Regular Crane markings comply with marine requirements, except that 150-Pound Malleable Iron and 125-Pound Cast Iron Screwed Fittings and Brass Screwed Fittings are not marked to show the pressure rating, this being manufacturers' standard practice.

Valve design: For Class I Piping, brass and steel valves sizes 2-inch and smaller can have screwed bonnets but they must be of the union type, except that check valves can have ordinary screwed caps. Sizes 2½-inch and larger and all sizes of cast iron valves must have bolted or pressure-seal bonnet. Non-rising stem valves must have approved indicators. Disc, disc faces, seats, stems, and other wearing parts should be made of noncorrosive material.

For Class II Piping, brass valves can have ordinary screwed bonnets on all sizes, and non-rising stem valves for oil transfer and filling systems need not have an indicator

Boiler mountings and attachments: All valves, fittings, and flanges must be cast or forged steel, except that Crane Special Brass may be used where the temperature does not exceed 450° F. and cast iron may be used where the pressure is 30 pounds or less. Sizes 1½-inch and larger must be flanged end. Main and auxiliary globe stop valves must be installed with the pressure under the disc, and sizes larger than 6-inch require a by-pass.

Fuel oil service piping: Valves and fittings for fuel oil pressure piping from pumps to burners (not including cargo oil transfer or discharge piping) must conform to Class I requirements and, in addition, be designed for at least 250 pounds steam working pressure. Cast iron valves and fittings are not permitted; bushings and street elbows are not permitted.

Cocks: For Class I Piping, cocks must be designed so that the cap holds the plug in place; the conventional type with a nut holding the plug is not allowed. There are no restrictions on cocks for Class II Piping.

Specialties: Relief valves, safety valves, expansion joints, fusible plugs, and similar specialties must be of approved design.

Fittings and Flanges for Class I and Class II Piping

Numerous Crane Valves and Fittings as regularly manufactured conform to the requirements for marine service, and these fill the need for a large majority of Class I and Class II Piping. The valves most commonly used are itemized on pages 384 and 385. In addition, the following Crane Fittings are acceptable, within the limitation mentioned.

Brass screwed fittings: 125-Pound Brass Screwed Fittings are suitable for a maximum of 125 psi, 353° F. All sizes can be used for Class II Piping, and sizes 2-inch and smaller for Class I Piping except for gases or vapors. See pages 190 and 191.

250-Pound Brass Screwed Fittings are suitable for a maximum of 150 psi, 366° F. All sizes can be used for Class II Piping, and sizes 2-inch and smaller for Class I Piping except gases or vapors. See page 192.

Brass screwed unions: Brass screwed unions, page 193, can be used for Class II Piping in all sizes and for Class I Piping in sizes 2-inch and smaller except the No. 523½ and No. 524½ which are not suitable on gases or vapors. Maximum ratings for unions are as follows: Nos. 523½ and 524½, 150 psi—366° F.; and No. 696 E, 300 psi—450° F.

Brass flanges: Brass flanges, page 194, can be used in all sizes on Class II Piping. For Class I Piping, the flanges are permitted in sizes 2-inch and smaller only except on gases or vapors. The 150-Pound are suitable for a maximum of 150 psi, 366° F.; and the 300-Pound, 300 psi, 450° F.

Cast and malleable iron screwed fittings: 125-Pound Cast Iron Screwed Fittings (pages 152 to 158) and 150-Pound Malleable Iron Screwed Fittings (pages 142 to 145) are suitable for a maximum of 125 psi and 353° F., but when used on temperatures over 150° F., they must be specially tested. All sizes of the cast iron and sizes 4-inch and smaller of the malleable iron can be used for Class II Piping. Malleable iron fittings can be used in sizes 2-inch and smaller for Class I Piping, except on gases or vapors.

Cast iron flanged fittings and flanges: 125-Pound Cast Iron Flanged Fittings and Flanges (pages 200 to 207) are suitable for a maximum of 125 psi, 353° F. on sizes 12-inch and smaller, and 100 psi, 338° F. on sizes 14-inch and larger. On Class II Piping, both the fittings and flanges are acceptable.

Steel screwed fittings: All sizes of Crane Steel Screwed Fittings (pages 256 to 259) are suitable for Class II Piping, and sizes 2-inch and smaller are also suitable for Class I.

Steel flanged fittings and flanges: Crane Cast Steel Flanged Fittings (pages 261 to 267) and Crane Forged Steel Flanges (pages 285 to 292) are suitable for both Class I and Class II Piping, but they are not suitable for gases or vapors for Class I. For Class I Piping, screwed, slip-on welding, and socket-welding flanges can only be used in sizes 2-inch and smaller. See page 386 for ratings.

Welding fittings: Crane Forged Steel Socket-Welding Fittings, which are made in sizes 2-inch and smaller (see pages 270 to 273), and Steel Butt-Welding Fittings (see pages 274 to 280) can be used for either Class I or Class II Piping.

Valves for Class I and Class II Piping

Explanation: The tables on this and the following page show the Crane Brass, Iron, and Steel Valves most commonly used in marine service. For the "Class" of piping indicated and within the pressure and temperature ratings shown, all of these valves comply with the †"Marine Engineering Regulations and Material Specifications" issued by the United States Coast Guard. The tables show not only the type of valve and catalog number but also whether suitable for Class I or Class II Piping, and the maximum pressure-temperature ratings for each of the several fluids involved. The ratings are not necessarily the same as those for ordinary commercial service; marine ratings are governed by valve design, materials, end connections, and other limitations as set forth in the Marine Engineering Regulations.

Brass and Iron Valves for Class I or Class II Piping

Class I Piping				Crane Valves Recommended					Class II Piping			
Steam Over 150 Psi	Hot Water Over 300° Fahr.	Hot Oil Over 150° Fahr.	Cold Water, Oil, or Gas	Sizes for Class I	Valve Type and Catalog Numbers			See Page	Sizes for Class II	Steam 150 Psi *Max.	Hot Water 300° Fahr. *Max.	Hot Oil 150° Fahr. *Max.	Cold Water, Oil, or Gas
Maximum Ratings				Brass Valves						Maximum Ratings			
...	...	...	...	...	Hose Gate		No. 4448	387	1½-2½*	..	...	..	100 psi
...	...	...	...	....	Hose Gate		No. 4449	387	1½-2½	...	...	...	
...	...	...	...	....	Hose Gate		No. 453	60	1½, 2½	...	...	...	150 psi
...	...	...	...	....	Angle Hose		No. 117	61	¾-2	...	...	...	
...	...	...	...	....	Gate	Scrd.	No. 4436	15	2-3	100 psi	100 psi		100 psi
...	100 psi-388° F.		...	2-10"	Gate	Flgd.	No. 4437	15	2-10	338°F.	...	...	
...	...	...	...	....	Gate	Q.O.	No. 432	56	2½, 3		100 psi		
...	..	...	...	....	Gate	Q.O.	No. 432	56	½-2				
...	...	...	...	....	Gate	Scrd.	No. 428, 430, 440	16	¼-3	125 psi 353°F.	125 psi		125 psi
...	...	...	...	....	Globe	Scrd.	No. 1	26	⅛-3				
..	..	...	...	..	Angle	Scrd.	No. 2	26	⅛-3				
...	...	...	..	....	Gate	Scrd.	No. 431	17	¼-3		150 psi		
..	...	...	...	...	Globe or Angle	Scrd.	No. 85, 88, 89	27	⅛-¾		...	...	
...	150 psi-366° F.		...	⅛-2	Globe or Angle	Scrd.	No. 7	28	⅛-2		...	...	
...			...	⅛-2	Globe or Angle	Scrd.	No. 14½ P, 16½ P	29	⅛-2				
...	...	...	...	....	Globe or Angle	Scrd.	No. 7	28	2½, 3	150 psi 366°F.	150 psi		150 psi
...			...	....	Globe or Angle	Scrd.	No. 14½ P, 16½ P	29	2½, 3				
...			...	1-3	Globe or Angle	Flgd.	No. 9	28	1-3		...	...	
...			...	1-3	Globe or Angle	Flgd.	No. 71	32	1-3		...	...	
..	150 psi-366° F.		...	1-3	Check	Flgd.	No. 35½	48	1-3		...	...	
...			..	2-6	Check	Flgd.	No. 4033, 4063	50	2-6		...	...	
200 psi-388° F.			...	⅜-1	Radiator		No. 4270	58		...	...	...	...
200 psi-388° F.			200 psi	¼-2	Gate	Scrd.	No. 422, 423	18	2½, 3	150 psi 366°F.	150 psi		
...	...	...	...	....	Gate	Flgd.	No. 429	17	1-3				
300 psi-450° F.			1000 psi	¼-2	Globe or Angle	Scrd.	No. 382 P, 384 P	35	2½, 3				
				⅛-2	Globe or Angle	Scrd.	No. 70	32	2½, 3				
				¼-2	Globe or Angle	Scrd.	No. 212 C, 214 C	31	...	...	...	...	...
				¼-2	Globe or Angle	Scrd.	No. 212 P, 214 P	31	2½, 3	150 psi 366°F.	150 psi		
200 psi-388° F.			200 psi	1½-2	Globe or Angle	Scrd.	No. 4196, 4198	33	2½, 3				
				1½-2	Globe or Angle	Scrd.	No. 4296, 4298	392	2½, 3				
				1½-6	Globe or Angle	Flgd.	No. 4197, 4199	33	...	...	...	...	...
				1½-6	Globe or Angle	Flgd.	No. 4297, 4299	392	...	...	...	...	...
				¼-2	Check	Scrd.	No. 35, 72	48	2½, 3	150 psi 366°F.	150 psi		
				1½-2	Check	Scrd.	No. 4032, 4062	50	2½, 3				
			1000 psi	¼-2	Gate	Scrd.	No. 622 E, 623 E	21	2½, 3				
			300 psi	1-3	Gate	Flgd.	No. 623½ E	21	...	...	...	...	...
300 psi-450° F.				1½-3	Glo.or Angle	Flgd.	No. 87 P, 87½ P	39	...	...	...	...	...
			500 psi	1-3	Glo.or Angle	Flgd.	No. 383 P, 385 P	35	...	...	...	...	...
			1000 psi	¼-2	Check	Scrd.	No. 74 E, 366 E	51	2½, 3	366°F.	150 psi		
			500 psi	1-3	Check	Flgd.	No. 75 E	51	..	...	...	...	...
				Iron Valves						Maximum Ratings			
				Gate		Flgd.	No. 4461, 4465	389	2-12	125 psi 353°F.	125 psi 200°F.	....	125 psi
				Gate		Flgd.	No. 4467	389	3-12			....	
				Globe		Flgd.	No. 351	112	2-10			...	
				Angle		Flgd.	No. 353	112	2-10			...	
				Check		Flgd.	No. 373	121	2-24			...	

†April, 1948 issue

*Brass Valves for Class II Piping are recommended for the maximum ratings if not otherwise indicated.

Valves for Class I Piping can also be used for Class II.

(Continued on the page following)

Valves for Class I and Class II Piping (Cont.)

Boiler feed or blow-off service: For boiler feed or blow-off service, the Marine Engineering Regulations specify that valves and fittings can only be used for working pressures up to 83⅓ per cent of the recommended steam working pressure.

Iron valves: Iron valves can be used on steam, water, and oil transfer and filling systems (not fuel oil pumps to burners), and for boiler mountings where the maximum pressure does not exceed 30 pounds.

Fuel oil service piping: For fuel oil pressure piping from pumps to burners (not including cargo oil transfer or discharge piping), valves and fittings must conform to Class I requirements and be designed for at least 250 pounds steam working pressure; cast iron valves and fittings, and bushings and street elbows, are not permitted.

Steel valves: Crane Steel Valves in sizes 2-inch and larger also can be furnished with screwed ends, with butt-welding ends, and in the 900 and 1500-Pound pressure classes.

Flanged end Steel Valves in sizes ½ to 2-inch are available with 150-Pound end flanges; these are made special from the patterns of the Nos. 3615 XW, 3056 W, 3657 W, and 3686 X, which are shown as 600-Pound Valves in the left hand portion of the table below.

Body and bonnet materials: The body and bonnet of all of the 600-Pound Valves shown in the left hand portion of the table below except the No. 174 X Swing Check Valves are made of carbon steel. The No. 174 X and the 1500-Pound Valves have these parts made of Crane No. 4 Carbon-Molybdenum Alloy Steel.

Of the valves shown in the right hand portion of the table, the 150-Pound Valves have a carbon steel body and bonnet and the 300, 400, and 600-Pound Valves have Crane No. 4 Carbon-Molybdenum Alloy Steel bodies and bonnets.

Flange facings: Crane 150 and 300-Pound Flanged Steel Valves are regularly furnished with 1/16-inch raised "serrated" faces. The 400 and 600-Pound Valves are regularly furnished with ¼-inch large male "serrated" faces.

Other types of facing, such as ring joint, can be supplied when ordered, but those just mentioned are most commonly used on marine piping.

Other valves for marine service: The tables on this and the preceding page show the Crane Valves that are most popular for marine piping. Other sizes, types, and designs also are available; additional information will be furnished on request.

Steel Valves for Class I Piping

Sizes ¼ to 2-inch, inclusive (Screwed, Socket-Welding, and Flanged Valves)

Pressure Class and Type of Valve		Type of Ends	Crane Valves Recommended: Catalog Nos. With Union Bonnet	Catalog Nos. With Bolted Bonnet	Range of Sizes	For ratings, see page 386	For data, see page
600 Pound	Gate	Screwed	3602XW		¼-2"	Col. 1	223
				3607 XW	½-2	Col. 1	225
		Socket-Weld.		3611 XW	½-2	Col. 1	225
		Flanged		3615 XW	½-2	Col. 2	225
	Globe	Screwed	3640 W		¼-¾	Col. 1	237
				3644 W	½-2	Col. 1	237
		Socket-Weld.	3648 W		¼, ⅜	Col. 1	237
				3652 W	½-2	Col. 1	237
		Flanged		3656 W	½-2	Col. 2	237
	Angle	Screwed	3641 W		¼-¾	Col. 1	237
				3645 W	½-2	Col. 1	237
		Socket-Weld.	3649 W		¼, ⅜	Col. 1	237
				3653 W	½-2	Col. 1	237
		Flanged		3657 W	½-2	Col. 2	237
	Lift Check	Screwed	3670 X		¼-¾	Col. 1	248
				3674 X	½-2	Col. 1	249
		Socket-Weld.	3678 X		¼, ⅜	Col. 1	248
				3682 X	½-2	Col. 1	249
		Flanged		3686 X	½-2	Col. 2	249
	Swing	Screwed		174 X	½-2	Col. 12	253
1500 Pound	Globe	Screwed		3844 U	½-2	Col. 3	239
		Socket-Weld.		3852 U	½-2	Col. 3	239
	Angle	Screwed		3845 U	½-2	Col. 3	239
		Socket-Weld.		3853 U	½-2	Col. 3	239

For marine ratings of steel valves, see page 386.

Sizes 2-inch and larger (Flanged Valves Only)

Pressure Class	Crane Valves Recommended: Type of Valve and Catalog Nos.		Range of Sizes	For ratings, see page 386	For data, see page
150 Pound	Gate	47 XR	2-24"	Col. 4	229
	Globe	143 XR	2-8	Col. 4	244
	Angle	145 XR	2-8	Col. 4	244
	Check	147 X	2-8	Col. 4	253
300 Pound	Gate	33 XR	2-24	Col. 10	229
		33 U	2-24	Col. 10	229
	Globe	151 XR	2-8	Col. 10	244
		151 U	2-8	Col. 10	244
	Angle	153 XR	2-8	Col. 10	244
		153 U	2-8	Col. 10	244
	Check	159 X	2-12	Col. 10	253
400 Pound	Gate	61 XR	4-24	Col. 11	229
		61 U	4-24	Col. 11	229
	Globe	161 XR	4-8	Col. 11	244
		161 U	4-8	Col. 11	244
	Angle	163 XR	4-8	Col. 11	244
		163 U	4-8	Col. 11	244
	Check	169 X	4-12	Col. 11	253
600 Pound	Gate	76 XR	2-24	Col. 12	229
		76 U	2-24	Col. 12	229
	Globe	171 XR	2-6	Col. 12	244
		171 U	2-6	Col. 12	244
	Angle	173 XR	2½-6	Col. 12	244
		173 U	2½-6	Col. 12	244
	Check	175 X	2-12	Col. 12	253

34

Pressure-Temperature Ratings—Steel Valves for Marine Service

Based on Marine Engineering Regulations—U.S. Coast Guard

The pressure-temperature ratings shown below apply to Crane Steel Valves and also to Crane Steel Flanged Fittings and Flanges when used in piping aboard ship. They were taken from the Marine Engineering Regulations issued April, 1948 by the United States Coast Guard, and they are the same as ratings published in ASA B16e-1939. The ratings are lower than those now recognized for commercial work, which are covered by Supplement No. 1 to American Standard B16e-1939. No ratings are shown in the Marine Engineering Regulations for steel screwed and socket-welding valves, and those shown in Columns 1 and 3 are, therefore, Crane ratings.

Flanged fittings and flanges: Flanged fittings in the 150-pound class are carbon steel and have 1/16-inch raised faces, and in the 300 to 1500-pound classes are Crane No. 4 Carbon-Molybdenum Alloy Steel, and have 1/16-inch raised faces on the 300-pound, and 1/4-inch high large male faces on the higher pressure classes. Flanges in all pressure classes are carbon steel with a 1/16-inch raised face on the 150 and 300-pound and either a 1/4-inch large male or 3/16-inch large female face on the 400 to 1500-Pound, as ordered. When so specified, 300, 400, 600, 900, and 1500-Pound Flanges can be furnished of Crane No. 4 Carbon-Molybdenum Alloy Steel.

Valve trim recommendations: ***Valves with XR trim*** (Exelloy to No. 49 Nickel Alloy) are particularly satisfactory for steam, water, air, gas, and other non-lubricating and relatively non-corrosive fluids such as gasoline, fuel oil, etc. They also are well suited for oil having low viscosity such as used in hydraulic systems especially where seating loads are extremely high. Maximum recommended temperatures for "XR" trimmed valves are: 850° F. on steam and 500° F. on all other services.

W and XW trim ("W" is hardened stainless steel), supplied only in the small 600-Pound Gate, Globe, and Angle Valves, may be used for the services mentioned below; the maximum recommended temperature is 850° F. on the "W" and "XW".

U trim (Stellite) is provided primarily for high temperature steam lines, 1000° F. maximum.

X trim (Exelloy) as used in Check Valves, because of the particular operating conditions to which check valve seating surfaces are subject, is recommended for any fluid requiring "W", "XR", "U", "XW", or "X" trimmed Gate, Globe, and Angle Valves. The maximum temperature limitation is 1000° F. on steam, on all except the 150-Pound Valves which are limited to 850° F.

Since "X" trimmed Gate, Globe, and Angle Valves are infrequently used in marine service, they are not covered in the table or on page 385; for details, refer to Section 22 for Gate Valves and Section 23 for Globe and Angle. "X" trimmed Gate, Globe, and Angle Valves should be used for all oil and oil vapor service at temperatures over 500° F. and for most corrosive and unrefined oils, regardless of temperature. For lubricating oils up to 500° F., either "X" or "XR" trim should give equal satisfaction.

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Temperature Limitation on Valve Trim	Temp. Deg. F.	Maximum Non-Shock Working Pressures—Pounds per Square Inch														
		Valves 1/4 to 2-inch			Valves 2-inch and Larger											
		Carbon Steel		No. 4 Steel	Carbon Steel 150-Pound Flanged Valves Also 150-Pound Flanged Fittings and 150-Pound and higher Flanges						No. 4 Alloy Steel Flanged Valves Also Flanged Fittings and Flanges				
		Screwed and Socket-Welding	Flanged with 1/4-inch Male Face	Screwed and Socket-Welding	1/16" Raised Face		1/4" Large Male Face				1/16" Raised Face	1/4" Large Male Face			
See explanation above		600 Lb. Col. 1	600 Lb. Col. 2	1500 Lb. Col. 3	150 Lb. Col. 4	300 Lb. Col. 5	400 Lb. Col. 6	600 Lb. Col. 7	900 Lb. Col. 8	1500 Lb. Col. 9	300 Lb. Col. 10	400 Lb. Col. 11	600 Lb. Col. 12	900 Lb. Col. 13	1500 Lb. Col. 14
	100	2000	1000	3600	230	500	670	1000	1500	2500	600	800	1200	1800	3000
Class XR 850° F.	150	1910	960	3550	220	480	640	960	1440	2400	590	775	1180	1770	2950
	200	1820	930	3500	210	465	620	930	1395	2325	580	750	1160	1740	2900
	250	1730	900	3450	200	450	600	900	1350	2250	560	725	1120	1680	2800
Class X 1000° F.	300	1640	870	3415	190	435	580	870	1305	2175	540	700	1080	1620	2700
	350	1550	840	3375	180	420	560	840	1260	2100	520	675	1040	1560	2600
For Check Valves on Steam	400	1460	810	3330	170	405	540	810	1215	2025	500	650	1000	1500	2500
	450	1370	780	3295	160	390	520	780	1170	1950	480	625	960	1440	2400
	500	1280	750	3125	150	375	500	750	1125	1875	460	600	920	1380	2300
	550	1190	720	2955	140	360	480	720	1080	1800	440	575	880	1320	2200
	600	1110	690	2770	130	345	460	690	1035	1725	420	550	840	1260	2100
	650	1030	660	2580	120	330	440	660	990	1650	400	525	800	1200	2000
Class U 1000° F.	700	940	630	2350	110	315	420	630	945	1575	380	500	760	1140	1900
	750	850	600	2125	100	300	400	600	900	1500	360	475	720	1080	1800
	800	780	500	1875	85	250	335	500	750	1250	340	450	680	1020	1700
Class W or XW 850° F.	850	700	400	1750	70	200	270	400	600	1000	320	425	640	960	1600
	900			1625							300	400	600	900	1500
	950			1500							265	350	530	795	1325
	1000			1170							190	250	380	570	950

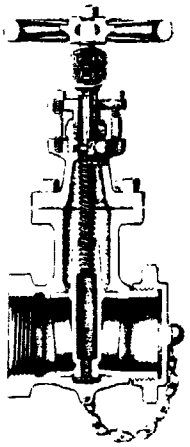
For limitations on boiler feed service, see page 385.

Ratings for steel flanged valves with other types of flange facings will be furnished on request.

Brass Hose Gate Valves

Non-Rising Stem Type with Indicator

100 pounds cold water working pressure



Cross Section
No. 4448
Screwed

These are strong, durable valves with non-rising stems. An approved type indicator shows whether the valve is open or closed.

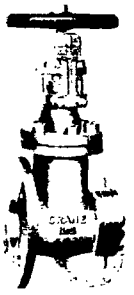
The body, bonnet, stem, body seat rings, and solid wedge disc are brass. Sizes 1½ and 2-inch have a screwed bonnet and integral seats; their hexagonal packing nut and gland are brass. The 2½-inch size has a bolted bonnet, renewable seats, and a brass bolted gland.

Stuffing box; repacking: The stuffing box is deep, and is filled with high grade packing. The valves, when wide open, can be repacked while under pressure.

Flanged valves: End flanges conform to the MSS 150-Pound SP Bronze Flange Standard (No. SP-2-1946). They are plain faced, with two V-shaped concentric grooves between the port and the bolt holes. Prices include drilling; no deduction for valves faced only. Use full face gaskets; see page 452.

Hose Thread: These valves will be regularly furnished with any recognized standard hose thread used in marine work; see page 59. Orders must specify the type of hose thread desired. When other hose threads are required, send detailed information or a sample, preferably the male end of a hose coupling, and special prices will be quoted.

Globe and angle hose valves: Brass globe and angle hose valves made from the patterns of the No. 7 and No. 9 valves shown on page 28 can be made to order; prices on application.



No. 4449
Flanged

List Prices, Each, and Dimensions, in Inches

Size Inches	1½	2	2½
No. 4448, Screwed	53.50	80.50	107.00
No. 4449, Flanged, F. & D.	62.50	98.00	134.00
Center to female end, Screwed	1⅝	1⅞	2¾
Center to face, Flanged	2 3/16	2¾	2½
Center to hose end	2 1/16	2 5/16	2⅝
Center to top	8⅝	9¾	11½
Diameter of wheel	3⅝	4 1/16	6
Diameter of flanges	5	6	7
Thickness of flanges	7/16	½	9/16

Brass Chronometer Valves

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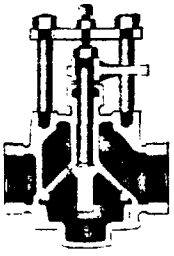
250 pounds saturated steam working pressure

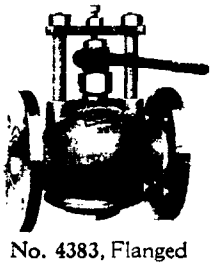


Cross Section
No. 4382, Screwed

Service recommendations: Crane Brass Chronometer Valves are designed for regulating and governing purposes and should not be used as stop valves. They open or close completely in one-eighth turn of the lever. The pressure of the disc against the seat bearing can be adjusted with the screw at the stem end, for easy operation when desired. With proper adjustment the valves can be operated by a float.

Materials and construction: The valves have a brass body, cap, disc, stem, gland, and packing nut, and a malleable iron lever. Sizes 1½-inch and smaller have a screwed cap; larger sizes have a bolted cap.

Flanged valves: End flanges conform to the MSS 250-Pound SP Bronze Flange Standard (No. SP-2-1937). They are plain faced, with two V-shaped concentric grooves between the port and the bolt holes. Prices include drilling; no deduction made for valves faced only. Full face gaskets should be used; see page 452.



No. 4383, Flanged

Larger sizes: Valves 3-inch and larger can be furnished to order; prices on application.

List Prices, Each, and Dimensions, in Inches

Size Inches	½	¾	1	1¼	1½	2	2½
No. 4382, Screwed	82.50	82.50	82.50	121.00	121.00	242.00	363.00
No. 4383, Flanged, F. & D.				161.00	161.00	314.00	468.00
End to end, Screwed	5¼	5¼	5¼	6½	6½	8¾	10¾
Face to face, Flanged				7	7	9¾	11¾
Center of valve to top	5¾	5¾	5¾	7	7	8½	9¾
Center of stem to end of handle	4¾	4¾	4¾	6¼	6¼	7½	8¾
Diameter of flange				5¼	6⅛	6½	7½
Thickness of flange				17/32	9/16	⅝	11/16

Templates for drilling . . . page 438

Comments

Illustrated on this and the following pages are some of the valves regularly manufactured for commercial use, which also conform to the requirements for Class I or Class II Piping in marine service.

For information on maximum pressure-temperature ratings to which these valves may be subjected, as defined in the Marine Engineering Regulations, see pages 382 to 386. Commercial service ratings other than those referred to will be found on the pages on which these valves are regularly listed.

Regularly manufactured valves used primarily for marine installations—hose gate valves and chronometer valves—are illustrated and listed on page 387. Other valves furnished especially to order, such as: iron body gate valves with cleanouts; steel main injection valves; manifold valves of brass, ferrosteel, or cast steel; screw-down check valves of brass, iron, or steel, are shown on pages 389, 390, and 392.

Brass Gate Valves

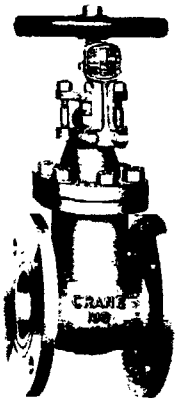


No. 428
Gate
Screwed

Crane Brass Gate Valves are liberally proportioned to assure a high factor of safety against pressure, operating strains, and expansion and contraction of piping.

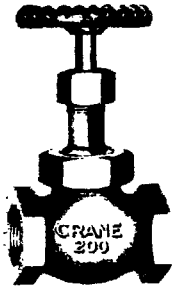
No. 428 Valves: These valves are of the inside screw, rising stem type, with screwed ends and solid wedge disc and are made in sizes ¼ to 3-inch. Recommended commercially for 125 pounds steam and 200 pounds cold water, oil, or gas pressure.

No. 4437 Valves: These valves are of the bolted bonnet, non-rising stem type, with flanged ends and solid wedge disc and are made in sizes 2 to 10-inch. They are regularly furnished with an indicator but are also available without this feature. The body seat rings are renewable. Valves with screwed ends (No. 4436), in sizes 2 to 3-inch are also available. All are rated commercially for 100 pounds steam, 125 pounds water at 200° F., and 125 pounds oil or gas at 150° F.



No. 4437 Gate, Flanged
with Indicator

Brass Globe and Angle Valves

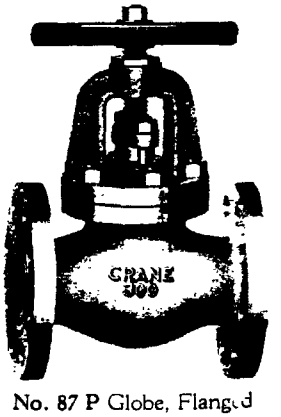


No. 70
Globe
Screwed

Both of the conventional types of valves illustrated are also available in the screw-down check type, shown on page 392.

No. 70 Valves: This line of union bonnet, integral seat, regrinding type valves consists of both the globe and angle patterns with screwed ends (No. 70), sizes ⅛ to 3-inch, and with flanged ends (No. 71), sizes 1 to 3-inch. They are rated commercially for 500° F. steam—at 200 pounds pressure on the screwed end valves and 150 pounds pressure on the flanged end valves.

No. 87 P Valves: These bolted bonnet, outside screw and yoke valves with renewable seat ring and plug type disc and seat combination are made in the globe (No. 87 P) and angle (No. 87½ P) patterns with flanged ends only, in sizes 1½ to 3-inch. They are rated commercially for 550° F. steam at 300 pounds pressure.



No. 87 P Globe, Flanged

Brass Swing Check Valves

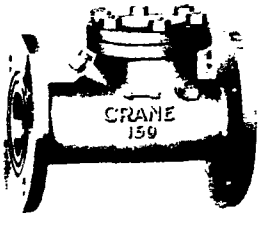


No. 35
Swing
Check
Screwed

The swing check valves illustrated have integral seats. The seats in all sizes on the No. 35 line with threaded cap, and sizes 4-inch and smaller on the No. 4033 line with bolted cap, can be reground without removing the bodies from the line. All sizes are rated commercially for 500° F. steam—at 200 pounds pressure on the screwed valves and 150 pounds pressure on the flanged valves.

No. 35 Valves: This line includes the screwed end pattern (No. 35) in sizes ¼ to 3-inch, and the flanged end pattern (No. 35½) in sizes 1 to 3-inch.

No. 4033 Valves: These valves are available with screwed ends (No. 4032) in sizes 2 to 3-inch, and with flanged ends (No. 4033) in sizes 2 to 6-inch.



No. 4033
Swing Check
Flanged

For prices, dimensions, complete descriptions, and other ratings on above valves, refer to the following:
Gate....pages 15 and 16 ***Globe and angle....pages 32 and 39*** ***Swing check ... pages 48 and 50***

Iron Body Wedge Gate Valves

WORKING PRESSURE
125 pounds saturated steam, water, or oil

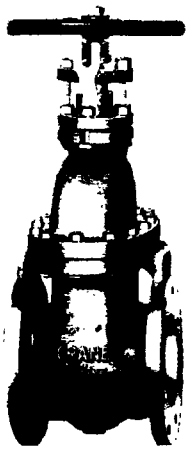
Prices on application

These valves are similar in design to the regular Crane 125-Pound Iron Body Wedge Gate Valves shown on pages 77 to 81, but are specially fitted for marine service.

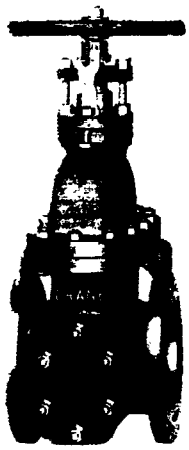
The Nos. 4461 and 4465 valves are regularly made in sizes 2 to 12-inch, inclusive, flanged end only.

The No. 4467 valve, recommended for marine cargo oil systems, is regularly made in sizes 3, 4, 6, 8, 10, and 12-inch, flanged end only.

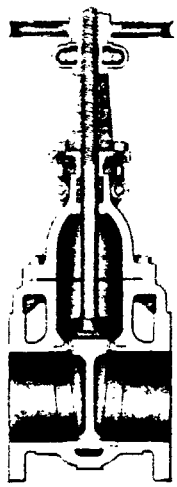
Screwed end valves, specially trimmed valves, other sizes, and other modifications of these valves can be furnished on special order.



No. 4461, Flanged Non-Rising Stem With Indicator



No. 4467, Flanged Non-Rising Stem With Cleanout and Indicator



Cross Section
No. 4465, Flanged Outside Screw and Yoke

Body and bonnet: The valves have an oval-shaped cast iron body and bonnet; liberal metal sections combined with proper metal distribution assure maximum strength. Straight through ports with tie ribs between the bonnet flange and the end flanges provide additional resistance to line strains.

No. 4467 valve bodies have a single side cleanout. Bottom cleanouts can be furnished when ordered. They have two tapped and plugged bosses, one on the side opposite the cleanout and one on the bottom, suitable for ¾-inch steaming out connections.

The gland bolts and nuts are brass.

Disc and seats: The body seat rings are brass and are screwed into the body. No. 4467 valves in sizes 10 and 12-inch have pressed-in body seat rings.

All of these valves are regularly furnished with a cast iron disc having brass seating faces; it is brass-bushed where it engages the stem threads. A solid brass disc can be furnished when so ordered.

Stem: The brass stem is of liberal diameter and amply strong. Stem threads have long engagement in the disc or yoke sleeve. Outside screw and yoke valves have a tee-head disc-stem connection.

Gland and stuffing box: These valves have a two-piece ball-type gland, consisting of a gland and a gland flange. This construction maintains an even load on the packing and prevents binding on the stem even when the gland bolt nuts are not pulled up evenly.

Non-rising stem valves have bronze gland bolts holding the gland flange to the stuffing box; the stem collar recess is brass-bushed, top and bottom, to minimize friction and to prevent corrosion. Outside screw and yoke valves have swinging gland eye bolts made of bronze, which move out of the way when the stuffing box is being repacked but which will not become detached and lost.

The stuffing box is exceptionally deep and is filled with high grade packing.

Repacking: These valves, when wide open, can be repacked while under pressure. Outside screw and yoke valves have a brass stem hole bushing, offering a better back seat for the stem and making this point non-corrosive.

Indicator on Non-Rising Stem Valves: No. 4461 Valves are regularly furnished with an approved type indicator to show whether the valve is open or closed. No. 4467 Valves, not regularly furnished with an indicator, will be so equipped when specified on orders.

Flange dimensions and facing: The dimensions and drilling of the end flanges conform to the American Cast Iron Flange Standard, Class 125 (B16.1-1948). The flanges are plain faced, with a smooth finish.

Drilling: Prices include facing and drilling to the American Cast Iron Flange Standard, Class 125. No deduction is made when valves are ordered faced only.

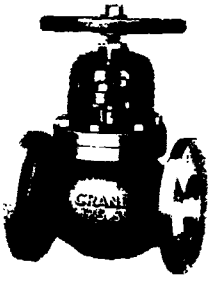
Standards: Flanged valves conform to the American Standard for Face to Face Dimensions of Ferrous Flanged Valves (B16.10-1939) for 125-Pound Cast Iron Wedge Gate Valves.

Flanged valves also conform to the American Petroleum Institute (A.P.I.) Standard for Valves for Pipe Line Service, No. 6-D, Fifth Edition, June, 1947 (Tentative) and Supplement 1, issued October, 1948, except for markings.

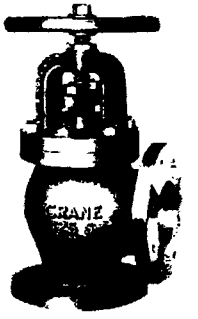
Dimensions: Dimensions of these valves are the same as given for the regular line of Crane 125-Pound Iron Body Wedge Gate Valves; see page 81.

For Marine specifications, boiler feed service, general requirements, etc., see pages 382 and 383.

Iron Body Globe and Angle Valves



No. 351
Globe, Flanged
Brass Trimmed



No. 353
Angle, Flanged
Brass Trimmed

These valves, made in sizes 2 to 10-inch, have a cast iron yoke-type bolted bonnet and cast iron body, and are brass fitted throughout. They have a screwed-in brass body seat ring, a solid brass disc on sizes 6-inch and smaller, an iron disc with brass seating face on larger sizes, a cast manganese bronze stem and yoke bushing, a brass stem hole bushing and gland, and bronze gland bolt nuts.

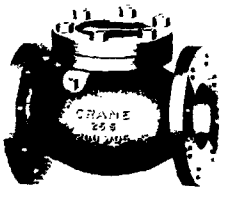
The disc is accurately guided throughout its travel by a guide stem through the bridge which is cast integral with the body seat ring. The gland is of the two-piece ball-type construction, consisting of a gland and a gland flange.

The valves are rated commercially for 125 pounds saturated steam, and 200 pounds cold water, oil, or gas working pressure.

For prices, dimensions, and complete description, see pages 111 and 112. Screw-down check valves can be made to order; see page 392.

34

Iron Body Swing Check Valves



No. 373
Swing, Flanged
Brass Trimmed

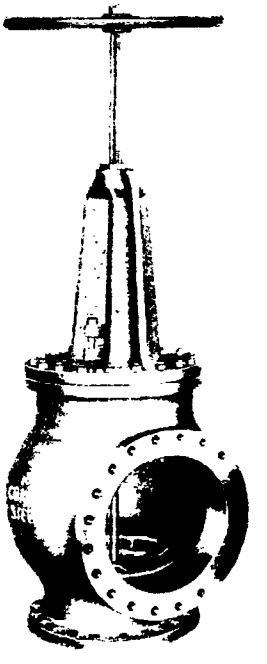
These valves, made in sizes 2 to 24-inch, are sturdily constructed and well proportioned. The body is oval or globular in shape, providing an ample flow area around the disc when the valve is wide open.

The body and cap are cast iron, the body seat ring is brass, screwed into the body; the disc is solid brass on sizes 3-inch and smaller, and cast iron with a brass seating face on larger sizes. Valves with solid brass disc in sizes larger than 3-inch can be made to order; prices will be furnished on application.

For prices, working pressures, dimensions, and complete description, see pages 120 and 121.

Steel Main Injection Valves

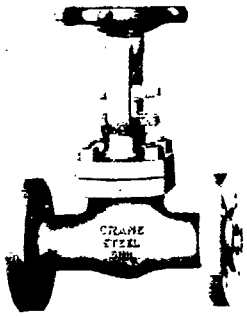
Cast Steel Angle
Main Injection
Valve



Illustrated at the right is a 20-inch Crane Cast Steel Main Injection Valve with the disc raised and the disc guide stem extending through the bridge of the body seat ring. Main injection angle valves are furnished in either cast steel or iron, with brass trimmings, in a wide range of sizes. They are available on special order only; prices on application.

For Marine specifications, boiler feed service, general requirements, etc., see pages 382 and 383.

Steel Gate Valves



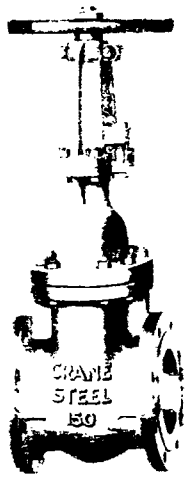
No. 3615 XW Gate Flanged

The bolted bonnet gate valves illustrated are of the outside screw and yoke type with cast carbon steel bodies, bonnets, and yokes. The discs are of the solid wedge type with close-fitting guides to maintain accurate seating and to reduce wear. A tee-head disc-stem connection prevents lateral strains on the Exelloy stems.

These valves are rated commercially for a maximum of 850° F. steam or water, at working pressures shown on pages 224 and 226.

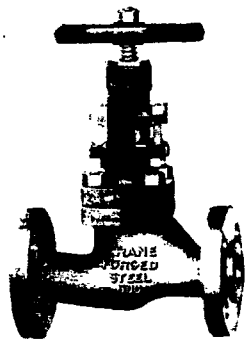
No. 3615 XW Valves: This line of sturdy, compact cast steel gate valves is made in sizes ½ to 2-inch—with screwed ends (No. 3607 XW), socket-welding ends (No. 3611 XW), and flanged ends (No. 3615 XW).

No. 47 XR Valves: This line is made with screwed ends (No. 46 XR) in sizes 2 to 6-inch; with butt-welding ends (No. 47½ XR) in sizes 2 to 3-inch and 4 to 24-inch, and with flanged ends (No. 47 XR) in sizes 2 to 24-inch.



No. 47 XR Gate Flanged

Steel Globe and Angle Valves



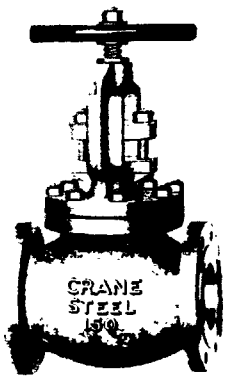
No. 3656 W Globe Flanged

These valves are all of the bolted bonnet, outside screw and yoke type. All have Exelloy stems; sizes 6-inch and smaller have plug type seats and discs; the 8-inch size has a flat seat and disc. They are rated commercially for a maximum of 850° F. steam or water, at working pressures shown on pages 236 and 241.

No. 3656 W Valves: The Crane line of small forged steel globe and angle valves includes the screwed type (No. 3644 W Globe, No. 3645 W Angle), the socket-welding type (No. 3652 W Globe, No. 3653 W Angle), and the flanged type (No. 3656 W Globe, No. 3657 W Angle), in sizes ½ to 2-inch.

No. 143 XR Valves: Crane 150-Pound Cast Steel Globe and Angle Valves are made with screwed ends (No. 142 XR Globe, No. 144 XR Angle) in sizes 2 to 4-inch; with butt-welding ends (No. 143½ XR Globe, No. 145½ XR Angle) in sizes 2 to 3-inch and 4 to 8-inch, and with flanged ends (No. 143 XR Globe, No. 145 XR Angle) in sizes 2 to 8-inch.

Screw-Down Check Valves: Refer to page 392 for 150-Pound Cast Steel Globe and Angle Valves made screw-down check type.



No. 143 XR Globe Flanged

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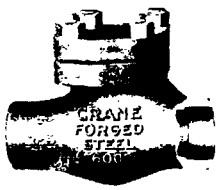
Steel Check Valves

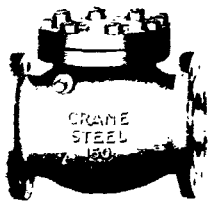


No. 3682 X Check Socket-Welding

These bolted cap check valves are recommended commercially for a maximum temperature of 850° F. steam or water, at working pressures shown on pages 248 and 250.

No. 3682 X Valves: This line, in sizes ½ to 2-inch, consists of the following forged steel lift check valves: screwed ends (No. 3674 X), socket-welding ends (No. 3682 X), and flanged ends (No. 3686 X).

No. 147 X Valves: This line of carbon cast steel swing check valves is made with screwed ends (No. 148 X) in sizes 2 to 6-inch; with butt-welding ends (No. 147½ X) in sizes 2 to 3-inch and 4 to 12-inch, and with flanged ends (No. 147 X) in sizes 2 to 12-inch.

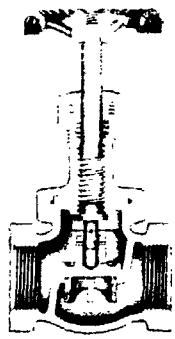


No. 147 X Check Flanged

Prices, dimensions, complete description, and ratings on valves:
Gate . . pages 221 to 232 Globe and Angle . . . . pages 233 to 246 Check . . . . pages 247 to 254

Special Valves for Marine Service

Screw-Down Check Valves

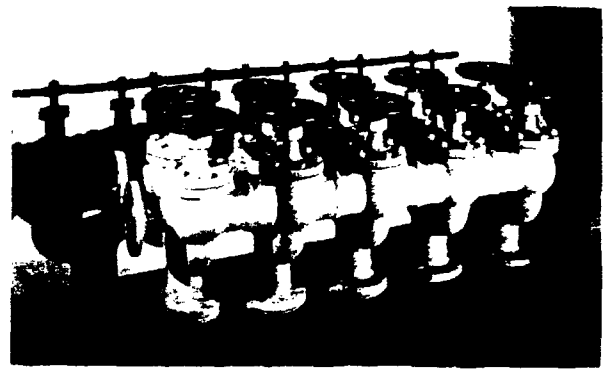


No. 4170 Brass Globe Screw-Down Check Valve

Illustrated above is a typical Crane Globe Type Screw-Down Check Valve with the stem raised. This construction makes it possible for one valve to serve the dual purpose of a stop valve and a check valve.

Screw-down check valves of brass, iron, or steel, and in the globe and angle patterns are available on special order only.

Manifold Valves



Cast Steel Manifold Valve

Above is an illustration of a 10-valve Crane 150-Pound Cast Steel Manifold Valve.

Manifold valves, made of brass, ferrosteel, or fabricated cast steel, are ideal for the transfer of cargo oil, bilge water, or salt water, from one point to another.

Complete details on types and sizes will be furnished on request.

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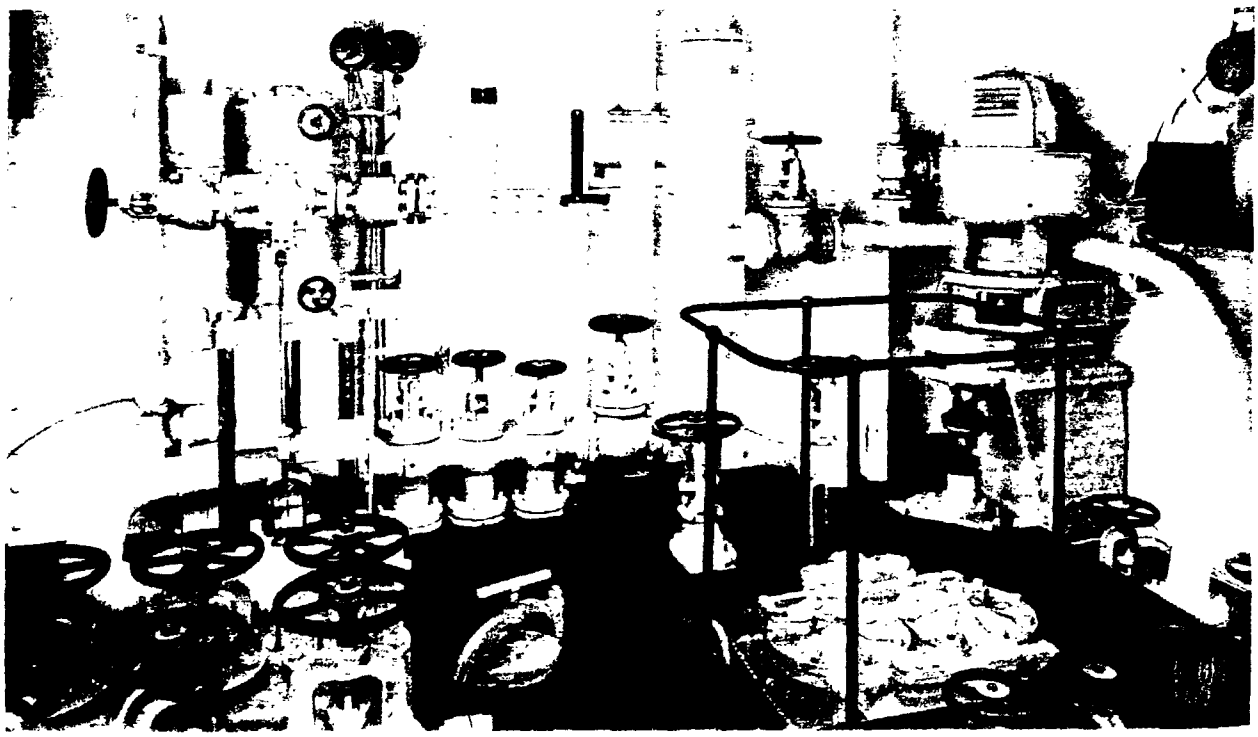


Crane valves for marine service are used extensively in piping installations aboard ship.

Valves and Fittings for Ammonia

General Description of Valves and Fittings . . . page 394

Valves
- Globe . . . page 395
- Angle . . . page 395
- Lift Check . . . page 396
- Expansion . . . page 396

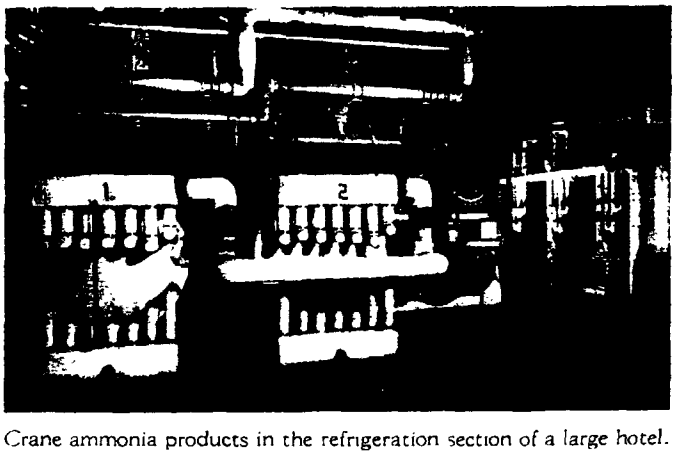
Fittings
- Flanged . . . page 397
- Double Pipe . . . page 398

Flanges . . . page 398
Liquid Gauges . . . page 396
Gaskets . . . page 399
Atmospheric Condensers . . . page 400
Pipe Stands . . . page 400

For greater convenience, the following valves and fittings, suitable for ammonia, are shown in other sections of this catalog because of their adaptability to general piping service:

Screwed Fittings . . . pages 148 and 149
Plugs . . . page 168
Bushings . . . page 169
Wrought Steel Nipples . . . pages 170 and 171
Steel Pipe Couplings . . . page 172
Screwed Unions . . . pages 179 and 183
Flange Unions . . . page 186
Combination Elbows . . . page 186
Welding Fittings . . . pages 269 to 280
Relief Valves . . . page 321
Pressure Gauges . . . pages 356 and 357

Fabricated Double Pipe Heat Exchangers . . . ***page 504***



Crane ammonia products in the refrigeration section of a large hotel.

Valves and Fittings for Ammonia

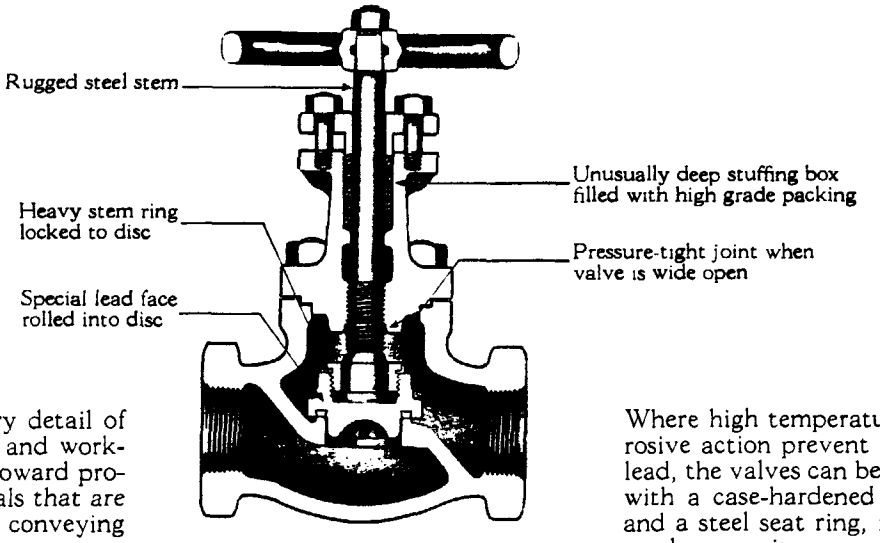
Pages 395 to 400 illustrate Crane piping equipment for ammonia refrigeration. The line includes valves, flanged or screwed fittings, flanges and unions, and return bends and other fittings for coils and condensers.

SERVICE RECOMMENDATIONS

The line was especially designed for high pressure (300 pounds) ammonia refrigeration service, but it is also admirably suited for use on air, gas, oil, or chemicals, or in special process work where very heavy, all-iron construction is desired.

The valves, in addition to being recommended for 300 pounds ammonia, are rated for 500 pounds oil (non-shock), gas, or air up to 100° F. and for 300 pounds oil (non-shock), gas, or air up to 300° F.

As heavy duty all-iron valves, they find wide application in pulp and paper mills, wood treating plants, tanneries, in paint and varnish manufacture, textile and dyeing plants, sugar refineries, and in many other plants, including those manufacturing chemicals.



Construction: Every detail of design, construction, and workmanship is directed toward producing piping materials that are uniquely adapted to conveying deadly or hazardous gases.

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All valves and fittings are unusually massive and rugged, to provide a high margin of safety.

Flanged valves and fittings have tongue and groove faces, to assure tightness at the joints and as an added precaution against blowing out gaskets.

Screwed valves and fittings have long threads, and are recessed to enable soldering the joints.

All valves and fittings for ammonia (except flanges) are tested to 300 pounds air-under-water.

Metals: Ammonia valves and fittings are made of Crane Ferrosteel, screwed fittings of malleable iron, and flanges of forged steel or malleable iron, depending on the size and style.

Valves are all-iron with steel stems, and have special lead disc faces or steel discs. Copper or brass, unsuitable for ammonia, is not used in their construction.

Disc and seat: The disc has a Special Lead face, securely rolled into a machined dovetail in the disc. The face seats upon a crowned face in the body, assuring tightness in service.

Where high temperature or corrosive action prevent the use of lead, the valves can be furnished with a case-hardened steel disc and a steel seat ring, illustrated on the opposite page.

On sizes ½-inch and smaller, the disc and stem are integral. On larger sizes, the disc is held to the stem by a threaded stem ring; the stem ring is locked to the disc, preventing the disc from becoming detached in service.

Stuffing box: The stuffing box is unusually deep, and is filled with high grade packing. Valves 1½-inch and smaller have a screwed packing nut; larger sizes have a bolted gland.

The stem is provided with a tapered, machined shoulder, which seats against a machined chamfer in the bonnet when the valve is wide open. This seals pressure from the packing, assures tightness at the stuffing box, and enables repacking the valve when wide open and under pressure.

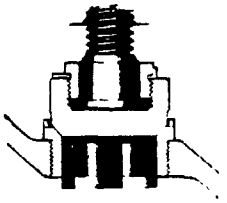
Interchangeability: Flanged valves have the same center to face and face to face dimensions as flanged fittings. A flanged globe valve, for example, can be substituted for a flanged tee.

This is important when quick changes are necessary.

Ferrosteel Globe and Angle Valves for Ammonia

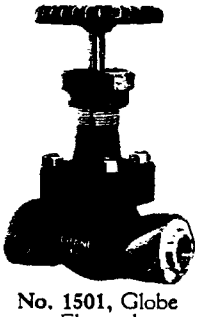
Bolted Bonnet With Special Lead Disc

300 pounds ammonia working pressure
300-pound air-under-water test

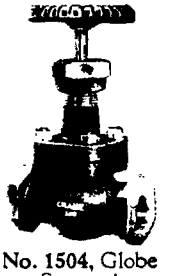


Section Showing Steel Disc and Seat

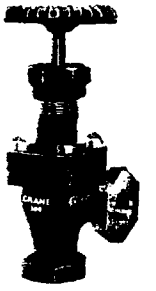
Bolted bonnet valves can be furnished with a case-hardened steel disc and a steel seat ring, as illustrated at the left; extra list prices are shown in the table below. When so equipped, and when a suitable stuffing box packing is used, the valves are recommended for air or gas working pressures up to 250 pounds at 500° F.



No. 1501, Globe Flanged Tongue and Groove



No. 1504, Globe Screwed



No. 1505, Angle Screwed

List Prices, and Dimensions, in Inches

Size		Inches	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Flanged Valves	Style of flanges				Oval				Square				Round
	*No. 1501, Globe	Each			19.00	21.50	24.00	29.50	35.00	44.50	56.50	80.50	121.00
Screwed Valves	No. 1504, Globe	Each	16.00	16.00	17.50	19.50	21.50	25.00	29.50	37.50	48.50	70.00	
	No. 1505, Angle	Each	16.00	16.00	17.50	19.50	21.50	25.00	29.50	37.50	48.50	70.00	
Extra for Steel Disc and Seat Ring		Per Valve	7.50	7.50	8.00	9.00	10.00	11.50	13.00	15.00	20.00	23.00	27.00
Bottom of groove to face of tongue, No. 1501					5 13/16	6 5/16	6 11/16	7 3/8	8 1/8	9 1/8	10 5/16	12 13/16	14 9/16
End to end, No. 1504			4 1/2	4 3/4	5	5 1/2	6 1/4	6 3/4	7 1/2	8 1/2	9 1/2	12	
Center to end, No. 1505			2 1/4	2 3/8	2 1/2	2 3/4	3 1/8	3 3/8	3 3/4	4 1/4	4 3/4	6	
Center to top, open, No. 1501 or 1504			7 1/4	7 1/4	7 1/4	9 1/4	9 1/4	11 1/4	11 1/2	12 1/4	12 3/4	14 1/4	16 1/4
Center to top, open, No. 1505			6 3/4	6 3/4	6 3/4	8 1/2	8 1/2	10 1/4	10 1/4	11	11 1/4	12 3/4	
Diameter of wheel			3 5/8	3 5/8	3 5/8	4 1/16	4 1/16	4 3/4	6	8	8	9	10

*List prices of No. 1501 Flanged Valves include facing and drilling but not companion flanges, bolts, or gaskets.

General description . . . page 394

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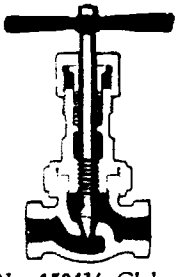
Union Bonnet With Plug Type Disc

300 pounds ammonia working pressure
300-pound air-under-water test

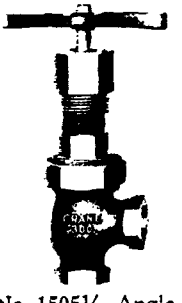


No. 1504½, Globe Screwed

These valves have a plug type disc, integral with the steel stem. They may be reground without removing them from the line.

List Prices and Dimensions

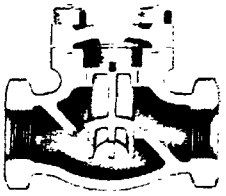
Size		Inches	1/4	3/8	1/2	3/4	1
No. 1504½, Globe		Each	15.50	15.50	16.00	17.50	19.00
No. 1505½, Angle		Each	15.50	15.50	16.00	17.50	19.00
Dimensions in Inches	End to end, Globe		3	3 1/4	3 1/2	4	4 1/2
	Center to end, Angle		1 1/2	1 5/8	1 3/4	2	2 1/4
	Center to top, open		6 9/16	6 5/8	6 7/8	8 1/4	8 1/2
	Length of tee handle		4 1/2	4 1/2	4 1/2	6	6

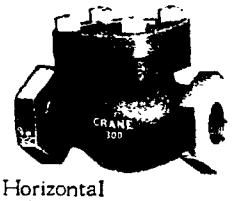


No. 1505½, Angle Screwed

Dimensions of end flanges and facing . . . . page 399 *Companion Flanges . . . page 398*

Ferrosteel Lift Check Valves for Ammonia





No. 1507½, Horizontal Screwed

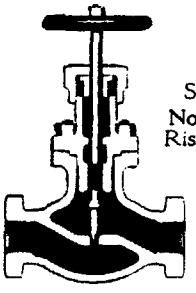
300 pounds ammonia working pressure
300-pound air-under-water test

List Prices and Dimensions

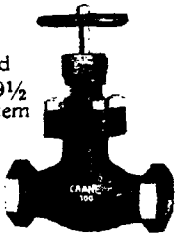
Size		Inches	½	¾	1	1¼	1½	2
No. 1507½ Screwed	List Price	Each	27.00	28.00	30.00	35.50	41.50	51.00
	End to end	Inches	5	5½	6¼	6¾	7½	8½
	Center to top	Inches	2⅝	3½	3⅝	4⅛	4⅜	5⅛

The No. 1507½ has a dash pot which cushions the disc in service, thereby increasing the life of the valve. Sizes 1½ and 2-inch have a piston ring; smaller sizes have a grooved piston without ring.

Ferrosteel Expansion Valves for Ammonia



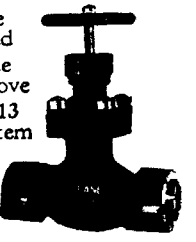
Globe Screwed No. 1519½ Rising Stem



300 pounds ammonia working pressure
300-pound air-under-water test

These valves have a needle-point stem with fine, close fitting threads, permitting very accurate adjustment. The valves are particularly recommended for short lines.

Globe Flanged Tongue and Groove No. 1513 Rising Stem





Angle Screwed No. 1519¾ Rising Stem

List Prices and Dimensions

Size		Inches	¼	⅜	½	¾	1
Flanged Valves	Style of flanges				Oval		Square
	*No. 1513, Globe	Each	19.00	19.00	20.00	21.50	24.00
Screwed Valves	No. 1519½, Globe	Each	18.00	18.00	18.50	19.50	21.50
	No. 1519¾, Angle	Each	18.00	18.00	18.50	19.50	21.50
Dimensions in Inches	Bottom of groove to face of tongue, No. 1513		5 5/16	5 9/16	5 13/16	6 5/16	6 11/16
	End to end, No. 1519½		4½	4¾	5	5½	6¼
	Center to end, No. 1519¾		2¼	2⅜	2½	2¾	3⅛
	Center to top, open, No. 1513 or No. 1519½		7½	7½	7½	7½	7½
	Center to top, open, No. 1519¾		7	7	7	7	7
	Diameter of wheel		3½	3½	3½	3½	3½

*List prices of flanged valves include facing and drilling but not companion flanges, bolts, or gaskets.

Dimensions of end flanges and facing .... *page 399* *Companion Flanges* .... *page 398*

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All-Iron Liquid Gauges for Ammonia

With Special Lead Seat

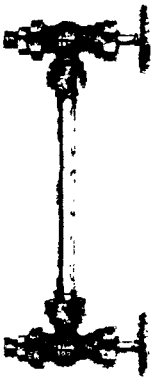
300 pounds ammonia working pressure — 300-pound air-under-water test

The gauge valves have a ball check valve in their inlet end. Should a glass tube be broken, the check valves close instantly and automatically, preventing the escape of ammonia.

List Prices

Size		Inches	½	¾
No. 1586½	Liquid Gauge, with 15″ centers, complete	Each	37.00	37.00
	Extra for each inch over 15″, up to 24″		.55	.55
Parts for No. 1586½	Upper or Lower Valve, only (*Specify which is wanted*)	Each	17.00	17.00
	Glasses, only (⅝″ outside diameter), for 15″ centers	Each	.50	.50
	Guards, only, for 15″ centers	Each	2.40	2.40
	Rubber Gauge Glass Gaskets, only	Each	.05	.05
	Flat Steel Gauge Glass Washers, only	Each	.08	.08
	Steel Stuffing Box Washers, only	Each	.08	.08

Ammonia Pressure Gauges .. *pages 356 and 357* *Ammonia Relief Valves* .... *page 321*



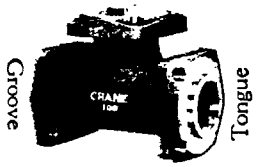
No. 1586½ Liquid Gauge

Fittings for Ammonia



No. 1521, 90° Elbow
Tongue and Groove
Flanged—Ferrosteel

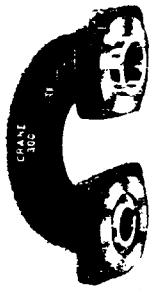
Tongue



Groove — Tongue

No. 1523, Tee
Tongue and Groove
Flanged—Ferrosteel

300 pounds ammonia working pressure
300-pound air-under-water test



No. 1559, Return Bend
Tongue and Groove
Flanged—Ferrosteel



No. 1563, Return Bend
Tongue
Flanged-Malleable Iron



No. 1570, Screwed
Divided
Return Bend
Tongue and Groove
Cranite Gasket
Malleable Iron

For Atmospheric Ammonia Condensers or Pipe Coils

Companion Flanges for No. 1563 Return Bends



No. 1556, Screwed
Groove—Malleable Iron



No. 1556½, Screwed
Tongue—Malleable Iron

List Prices, Each

90° Elbows and Tees				Return Bends						Companion Flanges For No. 1563 Return Bend				
Style of Flanges	Size	No. 1521 90° Elbow Flanged	No. 1523 Tee Flanged	Size	Center to center	Flanged			No. 1570 Divided Screwed	Size	No. 1556 Groove		No. 1556½ Tongue	
						No. 1559 Tongue & Groove	No. 1563 Tongue							
	Inches	Black	Black	Inches	Inches	Black	Black	Galv.	Black	Inches	Black	Galv.	Black	Galv.
Oval	½	5.50	8.25	1¼	4	7.50			13.00	2	1.70	2.80	2.60	3.70
	¾	6.00	9.00	1¼	6	8.50			13.50					
Square	1	7.00	10.50	2	3½		11.50	14.00	16.50					
	1¼	8.00	11.25	2	4				17.00					
	1½	9.50	13.50	2	6	11.00			18.50					
	2	11.25	16.00	2	8	12.00								
	2½	13.50	19.00											
Round	3	20.00	28.00											
	4	33.50	47.00											

Prices of flanged fittings do not include companion flanges, bolts, or gaskets. Prices of companion flanges do not include bolts or gaskets.

Flanges: 90° Elbows, Tees, and No. 1559 Return Bends require regular No. 1547 Tongue and No. 1545 Groove Flanges (page 398). The No. 1563 Return Bend requires the flanges shown above. Fittings ordered with flanges are furnished with bolts, nuts, and a Cranite gasket.

No. 1563: The No. 1563 Bend is extremely compact and is ideal for close-coupled coil assemblies, such as are used in processing coke oven gas.

Malleable Iron Screwed Fittings For Ammonia

See page 148



No. 260 E
90° Elbow



No. 272 E
Return
Bend

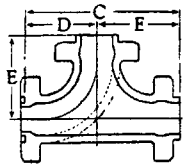
Divided screwed return bend: The No. 1570 Return Bend consists of a gasket, bolts, and two 90° elbows, one with a screwed end and a flanged tongue end, the other with a screwed end and a flanged groove end.

The No. 1570 Bends can be divided and used as combination screwed and flanged elbows.

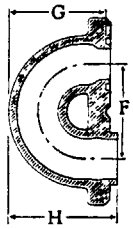
One return bend and a No. 1589 Union (page 186) will make two complete combination elbows with flange, bolts, and gasket.

35

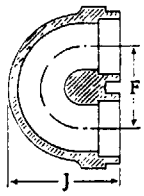
Dimensions, in Inches



No. 1521
or No. 1523



No. 1559



No. 1563

Size	C	D	E
½	5 13/16	2 11/16	3⅛
¾	6 5/16	2 15/16	3⅜
1	6 11/16	3⅛	3 9/16
1¼	7⅜	3⅜	4
1½	8⅛	3¾	4⅜
2	9⅛	4¼	4⅞
2½	10 5/16	4¾	5 9/16
3	12 13/16	6	6 13/16
4	14 9/16	6⅞	7 11/16

Size	F	G	H	J	K
1¼	4	4⅛	4⅝		5⅜
	6	5⅛	5⅝		5⅜
2	3½			4 11/16	7 1/16
	4				7 1/16
	6	5 13/16	6 5/16		7 1/16
	8	6 13/16	7 5/16		



No. 1570

General description ..... ***page 394***
Dimensions of end flanges and facing ... ***page 399***
Other Companion Flanges ..... ***page 398***

Flanges for Ammonia

Screwed Flanges



No. 1547 Tongue



No. 1545 Groove

300 pounds ammonia working pressure

Blind Flanges



No 1555 Tongue



No. 1557 Groove

Unless otherwise ordered, flanges are furnished without bolts or gaskets.

Special Forged Steel Screwed Flanges



No. 1582½ Tongue



No. 1583½ Groove

Flanges 3-inch and smaller are forged steel; the 4-inch size is malleable iron.

Reducing flanges can be made to order by drilling and tapping blind flanges; prices on request.

The No. 1582½ and No. 1583½ Special Screwed Flanges shown at the left have smaller dimensions than regular flanges, and are used on the following:

(See page 186)

No. 1591½ Flange Unions
No. 1529 Combination Elbows

No. 1589 Tongue and Groove Flange Unions recommended for 300 pounds ammonia service are shown on page 186.

For extra charge for bolting on companion flanges, see the Crane Discount Sheet.

List Prices

Catalog Nos.	Style of Flange	Size Inches	Price, Each: With Bolts and Gasket	Price, Each: Without Bolts or Gasket
No. 1545 No. 1547 No. 1555 or No. 1557	Oval	¼	1.20	.95
		⅜	1.45	1.15
		½	1.60	1.30
		¾	1.95	1.50
	Square	1	2.45	1.90
		1¼	2.80	2.25
		1½	3.35	2.50
		2	4.00	3.15
		2½	6.00	4.85
	Round	3	10.25	8.00
		4	13.50	11.25
No. 1582½ or No. 1583½	Oval	1	2.20	1.80
		1¼	2.35	1.95
	Square	2	4.00	3.15

For dimensions of regular screwed and blind flanges, see page 399.

Ferrosteel Double Pipe Fittings

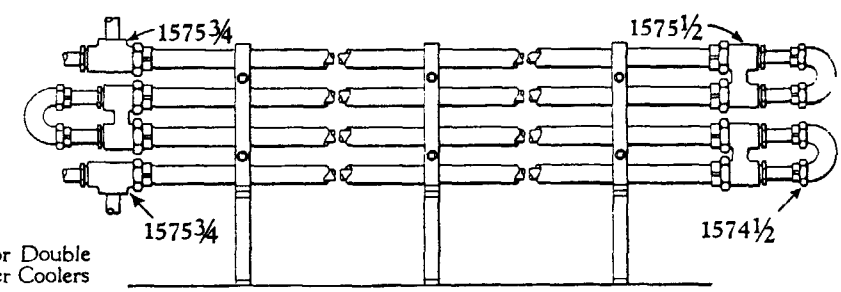
For Water Coolers

35

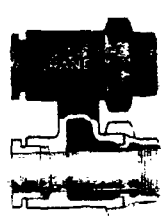


No. 1574½ Return Bend With Union Ends

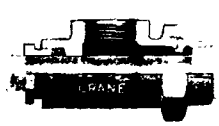
WORKING PRESSURES
125 pounds saturated steam
175 pounds cold water



Fittings for Double Pipe Water Coolers

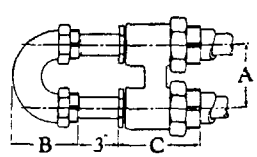


No. 1575½ Double Pipe Return Bend With Union Ends



No. 1575¾ Double Pipe Tee With Union End

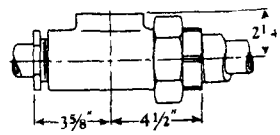
With Crane Double Pipe fittings, the inside and outside pipes are entirely independent of each other, and are free to expand or contract independently without danger of straining the joints. The fittings can be demounted easily and quickly for cleaning or repairs. No. 1574½ Return Bends are cast iron with malleable iron union ends and a rubber gasket. The No. 1575½ Double Pipe Return Bend and No. 1575¾ Tee have a Ferrosteel body and glands with malleable iron union rings and tailpieces. and rubber gaskets.



No. 1574½ and No. 1575½

List Prices and Dimensions

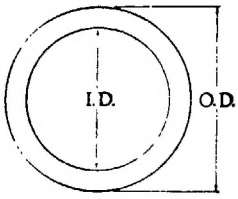
Catalog No.	Size Inches	Price, Each: Black	Price, Each: Galv.	Dimensions, in Inches: A	B	C
No. 1574½	1¼	4.50		4⅝	5¼	
	2	8.00		6	5¼	
No. 1575½	2×1¼	17.00	23.50	4⅝		6⅜
No. 1575¾	2×1¼×2	11.00	15.50	See illustration at right.		



No. 1575¾

Dimensions of valves and other fittings . pages 395 to 397

Gaskets for Ammonia



The tongue and groove dimensions of all Crane Flanged Ammonia Valves, Fittings, and Flanges, including the Flange Unions and Combination Elbows on page 186, are the same for corresponding pipe sizes. Gaskets, therefore, are interchangeable; both the Cranite and lead are 1/16-inch thick.

Gaskets for Boyle joints are rubber, canvas wrapped; they are used in double pipe return bends and tees.



Cranite Gaskets for Tongue and Groove Joints



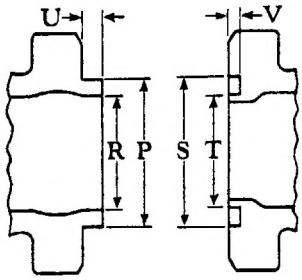
Rubber Gaskets for Boyle Joints

List Prices and Dimensions

Size		Inches	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Tongue and Groove Gaskets	Cranite	Each	.04	.05	.05	.07	.07	.09	.09	.10	.11	.12	.17
	Lead	Each	.06	.07	.07	.10	.13	.18	.18	.21	.24	.26	.34
	I.D.	Inches	19/32	23/32	7/8	1 1/8	1 3/8	1 11/16	1 15/16	2 7/16	2 15/16	3 9/16	4 9/16
	O.D.	Inches	31/32	1 3/32	1 7/32	1 15/32	1 25/32	2 7/32	2 15/32	3 3/32	3 21/32	4 9/32	5 15/32
Canvas Wrapped Boyle Gaskets	Rubber	Each						.20					
	I.D.	Inches						1 11/16					
	O.D.	Inches						2 1/4					
	Thickness	Inches						3/8					

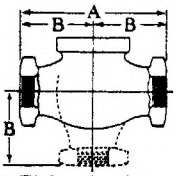
Ammonia Valves, Fittings, Flanges, and Flange Facings

Dimensions, in Inches

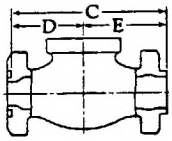


Crane Valves and Fittings for ammonia service are unusually massive and rugged. As can be seen from the dimensions shown here, a wide degree of interchangeability is maintained in the line. Flanged valves, for example, have the same face to face dimensions as flanged tees; screwed globe and angle (except the Union Bonnet Valves on page 395), screwed check valves, and screwed expansion valves have the same end to end or center to end. On flanged valves, the tongue face is on the end next to the upper side of the disc.

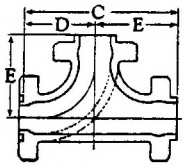
35



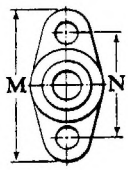
Globe, Angle, or Check Valve Screwed

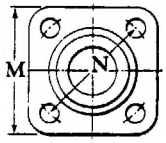


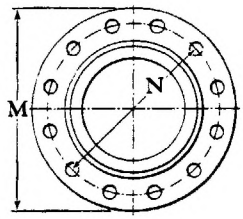
Globe Valve Flanged



90° Elbow or Tee Flanged





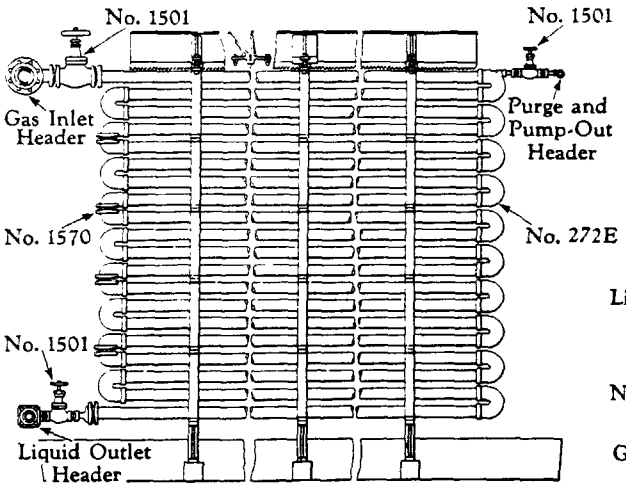


Style of Flanges	Size	A	B	C	D	E	M	N	P	R	S	T	U	V	Bolts No.	Bolts Dia.
Oval	1/4	4 1/2	2 1/4	5 5/16	2 7/16	2 7/8	3 5/8	2 3/8	31/32	19/32	1	9/16	3/16	1/8	2	1/2
	3/8	4 3/4	2 3/8	5 9/16	2 9/16	3	3 13/16	2 9/16	1 3/32	23/32	1 1/8	11/16	3/16	1/8	2	1/2
	1/2	5	2 1/2	5 13/16	2 11/16	3 1/8	4	2 3/4	1 7/32	7/8	1 1/4	27/32	3/16	1/8	2	1/2
	3/4	5 1/2	2 3/4	6 5/16	2 15/16	3 3/8	4 3/4	3 1/4	1 15/32	1 1/8	1 1/2	1 3/32	3/16	1/8	2	5/8
Square	1	6 1/4	3 1/8	6 11/16	3 1/8	3 9/16	3 9/16	3 1/4	1 25/32	1 3/8	1 13/16	1 11/32	3/16	1/8	4	1/2
	1 1/4	6 3/4	3 3/8	7 3/8	3 3/8	4	3 15/16	3 3/4	2 7/32	1 11/16	2 1/4	1 21/32	1/4	3/16	4	1/2
	1 1/2	7 1/2	3 3/4	8 1/8	3 3/4	4 3/8	4 11/16	4 1/2	2 15/32	1 15/16	2 1/2	1 29/32	1/4	3/16	4	5/8
	2	8 1/2	4 1/4	9 1/8	4 1/4	4 7/8	5 1/16	5	3 3/32	2 7/16	3 1/8	2 13/32	1/4	3/16	4	5/8
	2 1/2	9 1/2	4 3/4	10 5/16	4 3/4	5 9/16	5 15/16	5 7/8	3 21/32	2 15/16	3 11/16	2 29/32	5/16	1/4	4	3/4
Round	3	12	6	12 13/16	6	6 13/16	8 1/4	6 5/8	4 9/32	3 9/16	4 5/16	3 17/32	5/16	1/4	8	3/4
	4			14 9/16	6 7/8	7 11/16	10	7 7/8	5 15/32	4 9/16	5 1/2	4 17/32	7/16	1/4	8	3/4

• On flanged valves, the tongue is on the end next to the upper side of the disc.

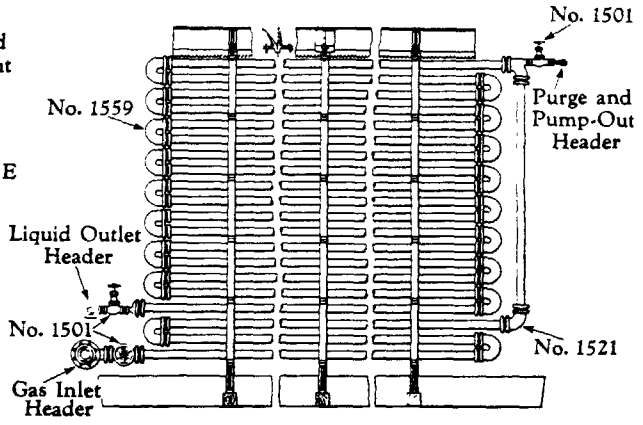
Atmospheric Ammonia Condensers

The illustrations below show two common types of atmospheric condensers, and indicate the application of the return bends and fittings shown on page 397. Either type, or any other type, can be made with flanged, screwed, or divided return bends, or combinations of all three; if welded joints are preferred, welding fittings (see pages 269 to 280) and flanges (see pages 285 to 292) can be used.



Atmospheric Condenser

The atmospheric ammonia condenser above is the simplest type. The hot gas from the compressor enters at the top and the condensed liquid ammonia leaves at the bottom. These condensers are usually made of 2-inch Standard weight pipe, 20 feet long, and 18 or 20 pipes high. However, they can be built of any weight or length of pipe, and any number of pipes high. Each stand of condensers should have a galvanized water trough made in two sections, with adjustable trough supports for leveling.



Atmospheric Condenser With Three Preliminary Pipes

The ammonia condenser illustrated above is of the atmospheric type with a three-pipe preliminary cooler at the lower part of the coil. The hot gas enters at the bottom, where it is partly cooled by the water which has already passed over the main condenser. The partially cooled gas then passes to the top of the coil and meets the coldest condensing surface where the actual process of condensation begins.

35

Cast Iron Pipe Stands

For Condensers, Brine Coolers, Water Coolers, or Heat Exchangers

Made to order only—Prices on application

A complete stand consists of a base, an intermediate section or sections, and a top section. However, an intermediate section may be used at the top: it is always required with water troughs and trough supports.



Top Section



Intermediate Section

Malleable iron or galvanized sections are made to order; prices on application.

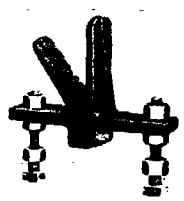
Bases: The 9-inch and 15-inch bases are designed for 2-inch atmospheric and 2-inch double pipe condensers.

List of Sizes, All for Use with 2-inch Pipe		
Top Sections	4 or 6 pipes high	*4⅝"
Intermediate Sections	4, 6, or 8 pipes high	*3½"
	4 or 6 pipes high	*4⅝"
Bases	9 or 15 inches high	
Trough Supports	2 or 6-inch face	

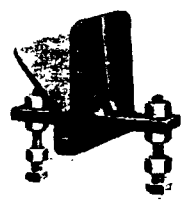
*Indicates center to center dimension for pipes.



Base



Face 2 Inches Wide



Face 6 Inches Wide

Trough Supports

Trough supports: The trough support with a 2-inch wide face is for use on each end of a condenser coil; the support with a 6-inch wide face is for the middle of the coil where two troughs meet.

Each trough support has two long bolts, with three hexagon nuts each, for adjusting and leveling the trough.

Solder-Joint Valves and Fittings

Solder-Joint Valves
- Gate ..... page 402
- Globe ..... page 403
- Angle ..... page 403
- Swing Check ..... page 402

Solder-Joint Fittings
- Straight Sizes ..... pages 404 and 405
- Reducing Sizes ..... pages 406 and 407

Copper Water Tube
- Standard Specifications ..... page 408
- Linear Expansion Table ..... page 407

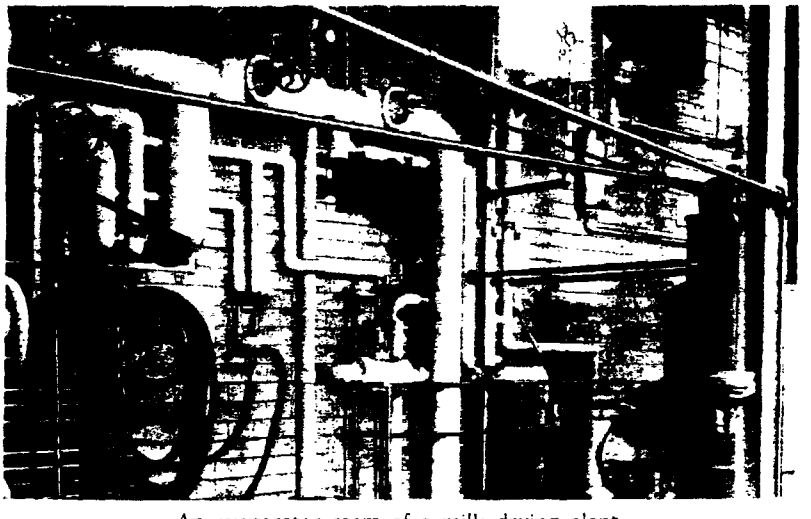
Making a Solder-Joint ..... page 407

Square End Sawing Vise for Copper Tube ***see page 424***

The user of copper tubing for plumbing, heating, and industrial installations will appreciate the complete line of solder-joint material offered by Crane. All of the requirements for a modern, dependable installation—valves, fittings, and tubing —are obtainable from one source—Crane.

The list of Crane Solder-Joint Valves includes globe, angle, gate, and check valves. In addition, a wide selection of Crane screwed end valves, through the use of adaptors, is available for copper tubing piping systems.

The list of Crane Solder-Joint Fittings includes a diversified assortment of all regular and special type fittings, such as elbows, tees, couplings, bushings, caps, plugs, return bends, unions, and many others. The range of sizes, too, is unusually complete.

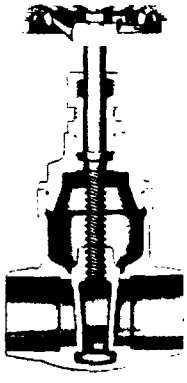


An evaporator room of a milk drying plant utilizes Crane products for top efficiency.

Brass Solder-Joint Gate Valves

Wedge Disc—Non-Rising Stem

WORKING PRESSURES
100 pounds saturated steam
150 pounds water, 200° F.



Cross Section

Service recommendations: Crane No. 1320 Brass Solder-Joint Gate Valves are recommended for general shut-off valve service on low pressure steam lines and on hot and cold water lines.

The valves are well suited for use in plumbing and heating systems, on circulating water lines, on low pressure condensation return lines, and for similar low pressure services.

Important—When Solder-Joint Valves and Fittings are installed on steam lines, the solder used to make the joints must have a melting point high enough to withstand the temperature of the steam.

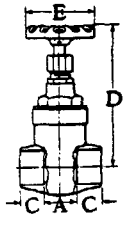
Construction: No. 1320 Gate Valves have a non-rising stem and a one-piece wedge disc. They are sturdily constructed and are amply reinforced at points subject to greatest stress, to withstand piping and operating strains. All parts are made of good quality materials.

Repacking: The valves, when wide open, can be repacked while under pressure.

Larger sizes and higher pressure valves: When larger size or higher pressure valves are wanted, Crane screwed end valves with solder-joint adaptors can be used.

Instruction tag: These valves are furnished with a tag giving special instructions for soldering.





No. 1320, Gate
Wedge Disc, Non-Rising Stem

List Prices and Dimensions

Size		Inches	3/8	1/2	3/4	1	1 1/4	1 1/2	2
No. 1320, Gate		Each	4.30	5.00	5.90	7.00	9.40	12.00	17.00
Dimensions, in Inches	A		13/16	13/16	7/8	1 1/16	1 5/16	1 7/16	1 9/16
	C		13/32	17/32	25/32	29/32	31/32	1 3/32	1 11/32
	D		3 1/4	3 3/4	4 3/8	5 1/8	5 3/4	6 3/8	7 3/8
	E		1 1/2	1 3/4	2 1/16	2 9/16	2 3/4	3 1/16	3 5/8

Brass Solder-Joint Swing Check Valves

WORKING PRESSURES
100 pounds saturated steam
150 pounds water, 200° F.

36

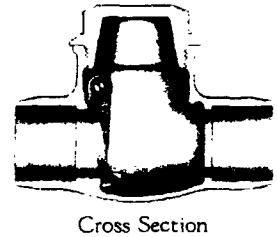
Service recommendations: Crane No. 1303 Brass Solder-Joint Swing Check Valves are recommended for service on steam, hot water, and cold water. They are particularly suited for plumbing and heating systems and for low pressure steam and water lines in industrial and process plants.

Important—When Solder-Joint Valves and Fittings are installed on steam lines, the solder used to make the joints must have a melting point high enough to withstand the temperature of the steam.

Construction: The valves are strong and well proportioned; they will easily withstand normal operating strains. All parts are made of good quality materials.

Larger sizes and higher pressure valves: When larger size valves or valves suitable for higher pressures are wanted, Crane screwed end valves with solder-joint adaptors can be used.

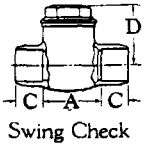
Instruction tag: The valves are furnished with a tag giving special instructions for soldering.



Cross Section



No. 1303
Swing Check



Swing Check

List Prices and Dimensions

Size		Inches	1/2	3/4	1	1 1/4	1 1/2	2
No. 1303, Swing Check		Each	4.30	4.90	6.50	8.00	9.70	14.70
Dimensions, in Inches	A		1 3/8	1 11/16	2 1/16	2 7/16	2 7/8	3 1/2
	C		13/16	1	1 1/16	1 1/8	1 3/16	1 3/8
	D		1 9/16	1 13/16	2 3/16	2 9/16	2 13/16	3 1/4

Swing Check Valves may be used either in a horizontal position, or in a vertical position for upward flow.

Brass Solder-Joint Globe and Angle Valves

Composition Disc

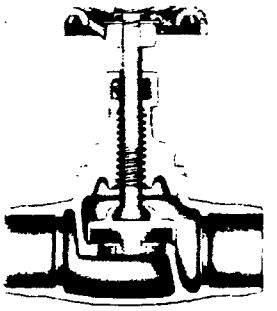
WORKING PRESSURES
100 pounds saturated steam
150 pounds water, 200° F.


No. 1310
Globe


No. 1310½
Globe
With Drain


No. 1311
Angle

No. 1310½ Globe Valves are regularly furnished with a right hand drain unless a left hand drain is specified.


Cross Section
No. 1310, Globe

List Prices

Size	Inches	3/8	1/2	3/4	1	1 1/4	1 1/2	2
No. 1310, Globe	Each	3.20	3.90	5.40	7.40	10.00	13.00	20.00
No. 1310½, Globe with drain	Each		4.30	6.00				
No. 1311, Angle	Each	3.20	3.90	5.40	7.40	10.00	13.00	20.00

For composition discs, see page 140

Service recommendations: Solder-Joint Globe and Angle Valves are recommended for steam or water lines. They are well suited for plumbing and heating systems, for low pressure steam and water piping in industrial plants, and for similar service.

Important—When valves are installed on steam lines, the solder used to make the joints must have a melting point that is high enough to remain unaffected by the temperature of the steam.

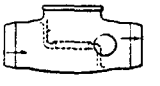
Construction: The valves, although light in weight, are sturdily constructed. They are well proportioned and are amply reinforced to withstand piping and operating strains. All parts are made of good quality materials.

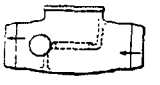
The disc holder is spun onto the end of the stem. The stuffing box is amply deep to prevent leakage around the stem.

Discs: Unless otherwise ordered, these valves are furnished with a No. 12 Low Pressure Disc, suitable for 150 pounds cold water or for hot water, 200° F. maximum temperature.

When so ordered, the valves will be furnished with a No. 10 Low Pressure Disc suitable for 100 pounds steam. For description and dimensions of discs, see page 140.

Drain on No. 1310½ Valve: The No. 1310½ Solder-Joint Globe Valve is regularly furnished with a right hand drain; orders must specify "with left hand drain" if left hand is wanted.


Right Hand

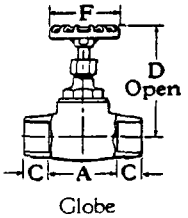

Left Hand

The adjacent illustrations indicate the position of a right hand and a left hand drain.

Repacking: These valves, when wide open, can be repacked while under pressure.

Larger sizes and higher pressure valves: When larger size valves or valves suitable for higher pressures are wanted, Crane screwed end valves with solder-joint adaptors are recommended.

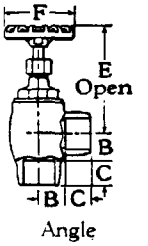
Instruction tag: These valves are furnished with a tag giving special instructions for soldering.



Globe

Dimensions, in Inches

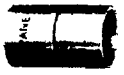
Size	3/8	1/2	3/4	1	1 1/4	1 1/2	2
A	1 1/2	1 3/4	1 15/16	2 3/8	2 3/4	3 3/16	3 7/8
B	9/16	5/8	3/4	7/8	1 1/16	1 1/4	1 9/16
C	7/16	9/16	13/16	15/16	1	1 1/8	1 3/8
D	2 7/8	3 1/2	4	4 1/2	4 7/8	5 1/2	6
E	2 5/8	3 1/8	3 3/4	4 1/4	4 5/8	5 1/4	5 7/8
F	1 1/2	1 3/4	2 1/16	2 9/16	2 3/4	3 1/16	3 5/8



Angle

Wrought Copper Solder-Joint Fittings

Straight Sizes



No. 600
Coupling
With Stop
Copper to
Copper



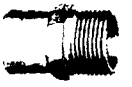
No. 601
Coupling
Without Stop
Copper to
Copper



No. 603
Female
Adapter
Copper to
Female S.P.S.



No. 603-2
Female Fitting
Adapter
Fitting to
Female S.P.S.



No. 604
Male
Adapter
Copper to
Male S.P.S.



No. 604-2
Male Fitting
Adapter
Fitting to
Male S.P.S.



No. 606
45° Elbow
Copper to
Copper



No. 606-2
45° Street
Elbow
Copper to
Fitting



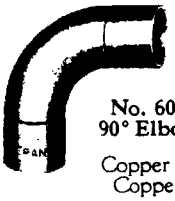
No. 606-2-2
45° Street
Elbow
Fitting to
Fitting



*No. 606-3
45° Elbow
Copper to
Female S.P.S.



*No. 606-4
45° Elbow
Copper to
Male S.P.S.



No. 607
90° Elbow
Copper to
Copper



No. 607-2
90° Street
Elbow
Copper to
Fitting



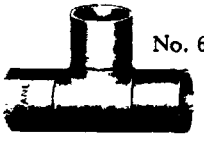
No. 607-2-2
90° Street
Elbow
Fitting to
Fitting



*No. 607-3
90° Elbow
Copper to
Female S.P.S.



*No. 607-4
90° Elbow
Copper to
Male S.P.S.



No. 611, Tee
Copper to Copper
to Copper

Manufactured under
U. S. Patent No. 2,111,695.



No. 616
Fitting End Plug



No. 617
Tube Cap

*For the time being, the Nos. 606-3, 606-4, 607-3, and 607-4 Elbows are made Cast Brass only; when they become available in Wrought Copper, higher list prices may apply.



No. 633
Union
Copper to Copper

36

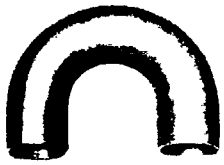
List Prices, Each

Nominal Size Inches	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4
No. 600, Coupling with Stop	.08	.09	.09	.12	.18	.24	.30	.38	.68	1.00	1.65	2.35	2.95
No. 601, Coupling without Stop	.08	.09	.09	.12	.18	.24	.30	.38	.68	1.00	1.65	2.35	2.95
No. 603, Female Adapter	.09	.15	.15	.18	.27	.46	.76	1.05	1.50				
No. 603-2, Female Fitting Adapter	.09	.15	.15	.18	.27	.46	.76	1.05	1.50				
No. 604, Male Adapter	.09	.15	.15	.18	.27	.46	.76	1.05	1.50				
No. 604-2, Male Fitting Adapter	.09	.15	.15	.18	.27	.46	.76	1.05	1.50				
No. 606, 45 Elbow	.15	.15	.15	.18	.30	.55	.84	1.15	1.65	3.05	4.60	6.65	8.70
No. 606-2, 45° Street Elbow	.15	.15	.15	.18	.30	.55	.84	1.15	1.65				
No. 606-2-2, 45° Street Elbow		.15	.15	.18	.30	.55							
*No. 606-3, 45° Elbow			.15	.18	.30								
*No. 606-4, 45° Elbow			.15	.18	.30								
No. 607, 90° Elbow	.15	.15	.15	.18	.30	.55	.84	1.15	1.65	3.05	4.60	6.65	8.70
No. 607-2, 90° Street Elbow	.15	.15	.15	.18	.30	.55	.84	1.15	1.65	3.05	4.60	6.65	8.70
No. 607-2-2, 90° Street Elbow	.15	.15	.15	.18	.30	.55	.84	1.15	1.65	3.05	4.60	6.65	8.70
*No. 607-3, 90° Elbow			.15	.18	.30								
*No. 607-4, 90° Elbow			.15	.18	.30								
No. 611, Tee	.23	.23	.23	.27	.49	.76	1.15	1.65	2.30	4.85	6.90	8.00	10.65
No. 616, Fitting End Plug			.09	.12	.18	.24							
No. 617, Tube Cap	.08	.09	.09	.12	.18	.24	.30	.38	.68	1.00	1.65	2.35	2.95
No. 633, Union	.76	.76	.76	.91	1.30	1.65	2.30	3.35	4.20				

Wrought Copper Solder-Joint Fittings

Straight Sizes

Return Bends

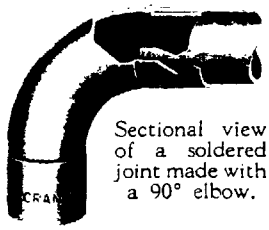


No. 638
Return Bend

Copper
to
Copper

No. 638, Return Bends		
Nominal Size Inches	Center to Center Inches	List Price Each
1/8	1	.24
1/4	1 1/4	.24
3/8	1 1/2	.30
1/2	2	.38
3/4	2 1/2	.53
	3 3/8	.53
1	3	.76
1 1/4	4	1.20
1 1/2	4 1/2	1.65
2	5 1/2	2.65

The Crane line of Wrought Copper Solder-Joint Fittings includes the straight sizes shown on this and the preceding page and the reducing sizes shown on the two pages following. At the right is a sectional view of a joint formed by a 90° elbow soldered to a portion of copper tubing.



Sectional view of a soldered joint made with a 90° elbow.

Wrought Copper Solder-Joint Fittings for refrigeration, and Cast Brass Solder-Joint Fittings, including a complete line for drainage service, are available. Prices and other information will be furnished on application.

Rough-in Dimensions, in Inches



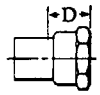
No. 600



No. 601



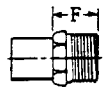
No. 603



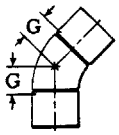
No. 603-2



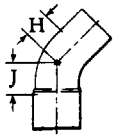
No. 604



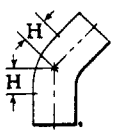
No. 604-2



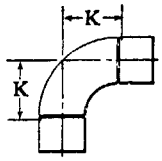
No. 606



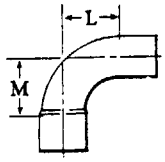
No. 606-2



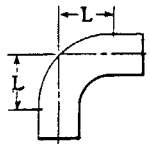
No. 606-2-2



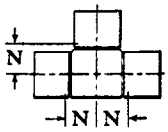
No. 607



No. 607-2



No. 607-2-2



No. 611

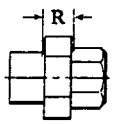


No. 616

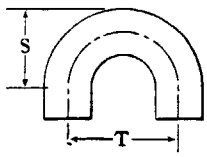


No. 617

Dimensions of Nos. 606-3 and 606-4 45° Elbows and Nos. 607-3 and 607-4 90° Elbows furnished on application.



No. 633



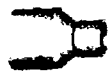
No. 638

Nominal Size	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T
1/8	1/16	11/16	7/16	7/16	1/2	3/4	9/32	1/4	5/16	9/16	1/2	9/16	5/16		9/32	5/8	33/64	1
1/4	1/16	13/16	3/4	5/8	27/32	13/16	11/32	9/32	11/32	11/16	1/2	5/8	3/8		11/32	5/8	27/32	1 1/4
3/8	1/16	1 1/16	27/32	23/32	29/32	7/8	3/8	5/16	3/8	13/16	3/4	13/16	29/64	9/16	27/64	15/32	1 1/16	1 1/2
1/2	1/16	1 3/16	31/32	7/8	1 1/16	1 1/8	1/2	7/16	1/2	1 1/16	1	1 1/16	35/64	5/8	35/64	23/32	1 23/64	2
3/4	1/16	1 11/16	31/32	7/8	1 1/8	1 3/16	19/32	17/32	19/32	1 5/16	1 1/4	1 5/16	45/64	29/32	1 3/16	25/32	1 3/4	2 1/2
1	1/16	2 1/16	1 1/8	1 1/8	1 3/8	1 9/32	1 1/16	1 1/16	1 1/16	1 9/16	1 1/2	1 9/16	27/32	1 13/32	1	27/32	2 1/8	3
1 1/4	3/32	2 3/16	1 5/16	1 1/16	1 5/8	1 15/32	7/8	1 5/16	3/4	2 1/16	2 1/8	2 1/16	1 3/32		1 1/16	29/32	2 3/4	4
1 1/2	3/32	2 11/32	1 11/32	1 1/8	1 13/16	1 5/8	1	1 1/32	1 5/16	2 11/32	2 13/32	2 3/4	1 9/32		1 13/64	1 1/32	3 5/64	4 3/8
2	3/32	2 15/32	1 15/32	1 3/16	1 15/16	1 3/4	1 1/4	1 1/16	1 1/8	2 27/32	2 9/16	2 7/8	1 9/16		1 15/32	1 1/8	3 45/64	5 1/8
2 1/2	3/32	2 31/32					1 23/32			3 15/16	3 29/32	3 15/16	1 27/32		1 19/32			
3	3/32	3 11/32					2			4 5/8	4 5/8	4 5/8	2 5/32		1 51/64			
3 1/2	3/16	3 11/16					2 3/8			5 7/16	5 7/16	5 7/16	2 19/32		2 1/16			
4	3/16	3 29/32					2 21/32			6 1/8	6 1/8	6 1/8	2 29/32		2 11/32			

For reducing fittings, see the two pages following.

Wrought Copper Solder-Joint Fittings

Reducing Sizes



No. 600-R
Reducing Coupling
Copper to Copper



No. 600-2
Fitting Reducer
Fitting to Copper

List Prices, Each

Nominal Size Inches	No. 600-R Reducing Coupling	No. 600-2 Fitting Reducer
1/4 ×1/8	.09	.09
3/8 ×1/4	.09	.09
×1/8		
1/2 ×3/8	.12	.12
×1/4		
3/4 ×1/2	.18	.18
×3/8		
×1/4		
1 ×3/4	.24	.24
×1/2		
×3/8		
1 1/4×1	.30	.30
×3/4		
×1/2		
1 1/2×1 1/4	.38	.38
×1		
×3/4		
×1/2		
2 ×1 1/2	.68	.68
×1 1/4		
×1		
×3/4		
×1/2		
2 1/2×2	1.00	1.00
×1 1/2		
×1 1/4		
×1		
3 ×2 1/2	1.65	1.65
×2		
×1 1/2		
×1 1/4		
×1	.....	
3 1/2×3	2.35	2.35
4 ×3 1/2	2.95	2.95
×3		
×2 1/2		
×2		
×1 1/2		
×1 1/4		
×1	.....	

Dimensions on request.

For reducing tees, see page 407.

For straight size fittings, see pages 404 and 405.



No. 606-R
Reducing
45° Elbow
Copper to
Copper



No. 607-R
Reducing
90° Elbow
Copper to
Copper



No. 607-2-R
Reducing
90° Street Elbow
Copper to
Fitting



No. 618
Flush
Bushing
Fitting to
Copper



No. 603-R
Reducing
Female Adapter
Copper to
Female S.P.S.



No. 603-2-R
Reducing Female
Fitting Adapter
Fitting to
Female S.P.S.



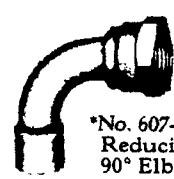
No. 604-R
Reducing
Male Adapter
Copper to
Male S.P.S.



No. 604-2-R
Reducing Male
Fitting Adapter
Fitting to
Male S.P.S.

List Prices, Each

Nominal Size Inches	No. 606-R 45° Elbow	No. 607-R 90° Elbow	No. 618 Flush Bushing	Nominal Size Inches	No. 607-2-R 90° Street Elbow
1/4 ×1/8		.15	.09	1/4×1/2	.18
3/8 ×1/4	.15	.15	.09	3/8×1/2	.18
1/2 ×3/8	.18	.18	.12	1/2×3/8	.18
×1/4		.18		3/4×1	.55
3/4 ×1/2	.30	.30	.18	1 ×3/4	.55
×3/8		.30			
1 ×3/4	.55	.55	.24		
×1/2		.55			
1 1/4×1	.84	.84	.30		
×3/4		.84			
1 1/2×1 1/4		1.15	.38		
×1		1.15			
2 ×1 1/2		1.65			
×1 1/4		1.65			



*No. 607-3-R
Reducing
90° Elbow
Copper to
Female S.P.S.



*No. 607-4-R
Reducing
90° Elbow
Copper to Male S.P.S

Fittings with Threaded S.P.S. Ends

Nominal Size Inches	Adapters				90° Elbows	
	No. 603-R	No. 603-2-R	No. 604-R	No. 604-2-R	*No. 607-3-R	*No. 607-4-R
1/4 ×3/8 S.P.S.	.15		.15			
3/8 ×3/4 S.P.S.	.27		.27			
×1/2 S.P.S.	.18	.18	.18	.18	.18	.18
1/2 ×1 S.P.S.			.46			
×3/4 S.P.S.	.27	.27	.27	.27	.30	.30
×3/8 S.P.S.	.18	.18	.18	.18	.18	.18
×1/4 S.P.S.	.18					
3/4 ×1 S.P.S.	.46		.46		.55	.55
×1/2 S.P.S.	.27	.27	.27	.27	.30	.30
1 ×1 1/4 S.P.S.	.76		.76			
×3/4 S.P.S.	.46		.46		.55	.55
1 1/4×1 1/2 S.P.S.	1.05		1.05			
×1 S.P.S.	.76		.76	.76		
1 1/2×2 S.P.S.	1.50		1.50			
×1 1/4 S.P.S.	1.05		1.05			
2 ×1 1/2 S.P.S.	1.50		1.50			

*For the time being, No 607-3-R and No. 607-4-R 90° Elbows are made Cast Brass only: when they become available in Wrought Copper, higher list prices may apply

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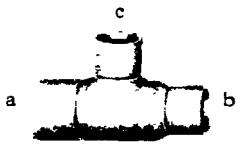
Wrought Copper Solder-Joint Fittings

Reducing Tees



No. 611-R, Reducing Tee
Copper to Copper to Copper
Reduction on Run or on Run and Outlet

Manufactured under
U S Patent No 2,111,695

List Prices

Nominal Size Inches a b c	No. 611-R Price Each	Nominal Size Inches a b c	No. 611-R Price Each
1/4×1/4×1/8	.23	1 1/4×1 1/4×1	1.15
×1/8×1/4		×3/4	
×1/8×1/8		×1/2	
1/8×1/8×1/4		1 1/4×1 ×1 1/4	
3/8×3/8×1/4	.23	×1	
×1/8		×3/4	
3/8×1/4×3/8		×1/2	
×1/4		1 1/4×3/4 ×1 1/4	
×1/8		×1	
3/8×1/8×3/8		×3/4	
×1/4		1 ×1 ×1 1/4	
×1/8		1 1/2×1 1/2×1 1/4	1.65
1/4×1/4×3/8		×1	
1/2×1/2×3/8	.27	×3/4	
×1/4		×1/2	
1/2×3/8×1/2		1 1/2×1 1/4×1 1/2	
×3/8		×1 1/4	
×1/4		×1	
1/2×1/4×1/2		×3/4	
×3/8		1 1/2×1 ×1 1/2	
×1/4		×1 1/4	
3/8×3/8×1/2		×1	
3/4×3/4×1/2	.49	1 1/2×3/4 ×1 1/2	
×3/8		1 1/4×1 1/4×1 1/2	
3/4×1/2×3/4		1 ×1 ×1 1/2	
×1/2		2 ×2 ×1 1/2	2.30
×3/8		×1 1/4	
3/4×3/8×3/4		×1	
×1/2		×3/4	
×3/8		×1/2	
1/2×1/2×3/4		2 ×1 1/2×2	
1 ×1 ×3/4	.76	×1 1/2	
×1/2		×1 1/4	
×3/8		×1	
1 ×3/4×1		×3/4	
×3/4		2 ×1 1/4×2	
×1/2		×1 1/2	
×3/8		×1 1/4	
1 ×1/2×1		1 1/2×1 1/2×2	
×3/4		1 1/4×1 1/4×2	
×1/2		***Dimensions on application.***	
3/4×3/4×1			
1/2×1/2×1			

When specifying reducing tees, always name the size of openings in the sequence of the lower case letters shown on the illustration above.

Making a Solder Joint

The mechanics of making a solder joint are comparatively easy. A few simple instructions should be adhered to:

1. Cut tube end square; ream; burr, size.
2. Use steel wool, sand cloth, or steel wire brush to clean both tube and cup to a bright metal.
3. Carefully apply proper solder flux to the end of the tube and to the inside cup of the fitting.
4. Use solder wire according to nature of the job, bending over an end as long as the diameter of the fitting—1/2" solder for 1/2" fittings, etc.
5. Apply flame at end of fitting to heat tube and fitting until solder melts; then pass flame toward center of fitting until solder is absorbed and joint completed.
6. Remove excess solder with a small brush while plastic, leaving a fillet at cup of fitting as it cools

Expansion of Copper Tubing

To plan a solder-joint piping installation successfully, it is necessary, as in any other piping assembly, to make suitable provisions for the expansion of the pipe lines under actual service conditions. Expansion bends can be designed only when the amount of expansion is known.

To find the expansion in inches of any length of copper tubing, proceed as follows:

First, obtain from the adjacent table the expansion at the minimum line temperature and at the maximum line temperature.

Second, subtract the value for the minimum temperature from the value for the maximum temperature to find the expansion per foot through that temperature range.

Third, multiply the expansion per foot by the number of feet of tubing for total expansion.

Temperature Deg. F.	Linear Expansion in Inches Per foot of Copper Tubing
0	.0000
20	.0025
40	.0045
60	.0065
80	.0087
100	.0110
120	.0135
140	.0157
160	.0177
180	.0200
200	.0225
220	.0252
240	.0274
260	.0295
280	.0317
300	.0342
320	.0370
340	.0395
360	.0415
380	.0440
400	.0464
420	.0489
440	.0515
460	.0537
480	.0564
500	.0588

Other Solder-Joint Fittings

In addition to the Solder-Joint Fittings shown on this and the preceding three pages, Wrought Copper Solder-Joint Fittings for refrigeration, and Cast Brass Solder-Joint Fittings, including a complete line for drainage service, are available. Prices and other information will be furnished on application.

Copper Water Tube

Standard Specifications

These seamless copper tubes are especially designed for plumbing purposes, underground water services, etc., but are also suitable for copper coil water heaters, fuel oil lines, gas lines, certain industrial piping, etc. They are furnished in three weights: Types K and L, in hard and soft temper, and Type M, in hard temper only.

Dimensions and Weights

Nominal Size of Tube	Actual Outside Diameter of Tube	Type K Tube		Type L Tube		Type M Tube	
		Wall Thickness	Weight per Foot	Wall Thickness	Weight per Foot	Wall Thickness	Weight per Foot
Inches	Inches	Inches	Pounds	Inches	Pounds	Inches	Pounds
¼	⅜			.030	.126		
⅜	½	.049	.269	.035	.198		
½	⅝	.049	.344	.040	.285		
⅝	¾	.049	.418	.042	.362		
¾	⅞	.065	.641	.045	.455		
1	1⅛	.065	.839	.050	.655		
1¼	1⅜	.065	1.04	.055	.884	.042	.682
1½	1⅝	.072	1.36	.060	1.14	.049	.940
2	2⅛	.083	2.06	.070	1.75	.058	1.46
2½	2⅝	.095	2.93	.080	2.48	.065	2.03
3	3⅛	.109	4.00	.090	3.33	.072	2.68
3½	3⅝	.120	5.12	.100	4.29	.083	3.58
4	4⅛	.134	6.51	.110	5.38	.095	4.66
5	5⅛	.160	9.67	.125	7.61	.109	6.66
6	6⅛	.192	13.9	.140	10.2	.122	8.92
8	8⅛	.271	25.9	.200	19.3	.170	16.5
10	10⅛	.338	40.3	.250	30.1	.212	25.6
12	12⅛	.405	57.8	.280	40.4	.254	36.7

Service recommendations: Copper water tube is used for many services, such as for steam, water, air, oil, gas, or similar fluids.

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Type K Tube is recommended for general plumbing and heating systems, and especially for underground use and where conditions are severe; the tube is also used for gas, oil, and steam.

Type L Tube is recommended for interior use in general plumbing and heating work.

Type M Tube is for use with soldered fittings only, for waste, vent, interior drainage, and other non-pressure applications.

On steam installations, the successful application of copper tubes depends not only upon the weight of the tube but also upon the solder used when making joints. The solder must have a melting point high enough to remain unaffected by the temperature of the steam.

Hard Copper Tube: Hard copper tube is intended primarily for use in straight lengths. It is not recommended for field bending except when proper bending equipment is used.

Soft Copper Tube: Soft copper tube can be bent without special bending equipment; it is recommended for service where bends must be made in the field, as on concealed replacement work.

Soft copper tube while in transit or when being handled may become flattened or distorted. Before being used, the ends of the tube should be sized to assure a tight soldered joint.

Standard lengths: 20-foot straight lengths for both hard and soft copper tube and 60-foot coiled lengths for soft copper tube are generally considered standard. Other lengths can be furnished.

Tinning: Copper tube can be furnished tinned on the outside, on the inside, or on both the outside and the inside.

American Standard: Type K (hard and soft) and Type L (hard and soft) in sizes ⅜ to 12-inch, and Type M (hard) in sizes 2½ to 12-inch conform to the American Standard for Copper Water Tube. A.S.A. No. H23.1-1947 (A.S.T.M. B88-47).

Prices on application

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No piping system is better than the means provided for its suspension and support.

The support, suspension, and regulation of motion are important factors to be considered when installing a piping system since the stresses and thrusts occasioned by dead weight and expansive movement may exceed safe working values for the piping materials, the connected equipment, or the building structure.

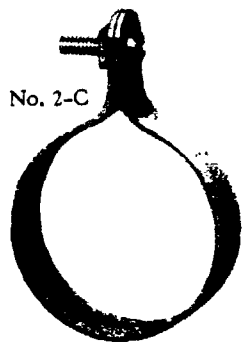
The purpose of pipe hangers and supports is to carry the weight of the piping safely. Safety requires that supporting equipment, except springs, should be designed to include the weight of the pipe, valves, fittings, fluid transported or that used in testing (whichever is the heavier), and insulation, if used.

Each pipe hanger or support should carry its portion of the load. Hangers, in particular, should be adjustable so that proper pitch and support of the pipe line can be maintained. The basic difference between pipe hangers and pipe supports is that with hangers, the piping load is supported from above; with supports, the piping load is supported from below.

The following pages illustrate many of the various pipe hangers, pipe supports and accessories, furnished by Crane to meet the needs of nearly every piping installation.

For deflection of horizontal pipe lines and spacing of pipe supports, see pages 532 and 533.

Pipe Hangers



Standard Ring and Bolt Hangers

The No. 2-C Hangers are made of light weight, good quality soft steel. They can also be furnished galvanized.

The hangers can be used with perforated extension bars, or with malleable iron sockets for use with pipe or rod extensions.

Sizes and Dimensions

Pipe size		Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
Stock	Size	Inches	¾	¾	⅞	⅞	1	1	1⅛	1⅛	1⅛	1¼	1¼	1¼
	No. of Gauge		16	16	16	16	15	15	12	12	12	12	12	12
Size of bolt		Inches	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	5/16	5/16

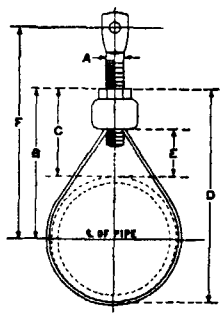
Adjustable Ring Hangers



No. 95-G, Steel
No. 95 CP-G, Copper Plated

For ¾ to 1½-inch copper tubing, use rings one size smaller than for steel pipe.

For extra heavy cast iron soil pipe, use same size rings as for steel pipe.



These hangers consist of a steel ring supported by a malleable adjusting nut threaded for hanger rod. They may be used directly with an I-Beam Clamp or with a perforated extension bar.

Dimensions, in Inches

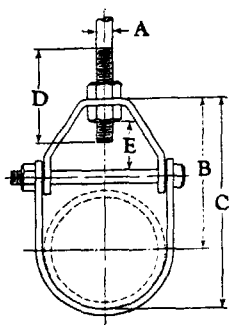
Pipe Size	A	B	C	D	E (Max.)	F (Max.)	Max. Load Lbs.
½	⅜	2½	2 1/16	2⅞	1⅛	4 7/16	75
¾	⅜	2⅝	2 1/16	3⅛	1⅛	4 9/16	80
1	⅜	2 11/16	2 1/16	3⅜	1⅛	4 11/16	85
1¼	⅜	2 15/16	2 1/16	3¾	1⅛	4⅞	95
1½	⅜	3	2⅛	4	1 3/16	5 1/16	105
2	⅜	3¼	2 1/16	4 7/16	1⅛	5 3/16	150
2½	½	3 13/16	2⅜	5¼	1¼	6 1/16	225
3	½	4 3/16	2 7/16	5 15/16	1 5/16	6 7/16	310
3½	½	4 7/16	2 7/16	6 7/16	1 5/16	6 11/16	390
4	⅝	5⅜	3⅛	7⅝	1 11/16	8 3/16	475
5	⅝	5 15/16	3⅛	8 11/16	1 11/16	8¾	685
6	¾	7⅛	3 13/16	10 7/16	2 3/16	10½	950
8	⅞	8 13/16	4½	13⅛	2⅝	12 15/16	1510

Adjustable Clevis and Band Hangers

These wrought steel Adjustable Band and Clevis Hangers provide for vertical adjustment either before or after pipe is in place.

Hanger rods and supporting nuts may be locked into position after adjustment by use of the upper load nut. Hanger rods and nuts must be ordered separately.



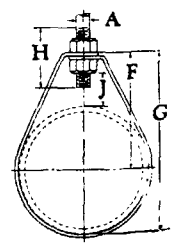


No. 260-G
Clevis Hanger

Dimensions, in Inches

Pipe Size	No. 260-G						No. 269-G					
	A	B	C	D	E (Max.)	Max. Load Lbs.	A	F	G	H	J (Max.)	Max. Load Lbs.
¾	⅜	3 1/16	3 13/16	2½	1½	80	⅜	2 1/16	2⅝	2½	1	80
1	⅜	3⅜	4 1/16	2½	1½	85	⅜	2⅛	2 11/16	2½	1	85
1¼	⅜	3⅝	4 7/16	2½	1½	95	⅜	2 9/16	3 7/16	2½	1¼	95
1½	⅜	3 13/16	4¾	2½	1½	105	⅜	2¾	3 11/16	2½	1¼	105
2	⅜	4	5 3/16	2½	1½	150	⅜	3	4 3/16	2½	1¼	150
2½	½	4⅝	6 1/16	3	1¾	225	½	3 15/16	5⅜	3½	1¾	225
3	½	4 15/16	6 11/16	3	1¾	310	½	4¼	6	3½	1¾	310
3½	½	5¼	7¼	3	1¾	390	½	4½	6½	3½	1¾	390
4	⅝	5¾	8	3½	1¾	410	⅝	4⅞	7⅛	3½	1¾	475
5	⅝	6 9/16	9⅜	3½	2	590	⅝	5 11/16	8 7/16	4	2	685
6	¾	7 5/16	10⅝	4	2	815	¾	6⅜	9 11/16	4½	2	950
8	⅞	8 9/16	12⅞	4¼	2	1300	⅞	7 9/16	11⅞	4½	2	1510
10	⅞	10 3/16	15 9/16	4¼	2⅛	2100						
12	⅞	11 9/16	17 15/16	4¾	2⅜	2300						
14	1	13	20	5¼	2⅝	3075						
16	1	14 9/16	22 9/16	6	3¼	3075						





No. 269-G
Band Hanger

Prices on application

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Pipe Hangers

Adjustable Clips



No. 116-G
Clip Base

The No. 106-G Adjustable Clip is made of malleable iron and consists of the No. 105-G Clip Ring, No. 116-G Clip Base, and a hanger rod.



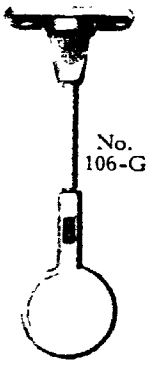
No. 105-G
Clip Ring

Dimensions, in Inches

Pipe Size	Square Head Hanger Rod		Ceiling to Center of Pipe		Inside Diameter of Ring
Inches	Length	Diam.	Min.	Max.	
3/4	6 1/4	3/8	8	9 5/8	1 3/16
1	6 3/4	3/8	8 1/2	10 1/8	1 7/16
1 1/4	6 3/4	3/8	8 3/4	10 3/8	1 13/16
1 1/2	7	3/8	9	10 5/8	2 1/16
2	7 1/4	3/8	9 1/2	11 1/8	2 9/16

No. 106-G Clips allow a 1 1/2-inch adjustment which can be made easily after the pipe is installed. The adjustment is made by raising the pipe until the head of the rod is close to the ceiling and turning rod.

This Clip is regularly furnished in black. Galvanized on order.



No. 106-G

Split Pipe Ring Hangers



No. 110-G
No. 110 R-G
Socket

Dimensions, in Inches

No. 110-G, Pipe Threaded				No. 110 R-G, Rod Threaded			
Pipe Size Inches	A	B	Max. Load Lbs.	Pipe Size Inches	A	B	Max. Load Lbs.
1/2-1	1/8	1 1/4	150	1/2-2	3/8	1 1/4	150
1 1/4-3	1/4	1 5/8	390	2 1/2-3 1/2	1/2	1 5/8	390
3 1/2-4	3/8	1 5/8	685	4-5	5/8	1 15/16	685
5-6	1/2	1 15/16	950	6	3/4	2 1/8	950
8	3/4	2 1/8	1510	8	7/8	2 15/16	1510

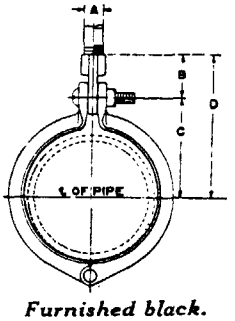


No. 108-G
Pipe Ring



No. 107-G
No. 107 R-G
Ring and Socket

Pipe Size Inches	Ring Only C	Ring and Socket							Maximum Load Pounds
		Pipe Threaded			Rod Threaded				
		A	B	D	A	B	C	D	
1/2	1 5/16	1/8	1 1/8	2 1/8	3/8	1 1/8	1 5/16	2 1/8	75
3/4	1 1/8	1/8	1 1/8	2 5/16	3/8	1 1/8	1 1/8	2 5/16	80
1	1 1/4	1/8	1 1/8	2 7/16	3/8	1 1/8	1 1/4	2 7/16	85
1 1/4	1 9/16	1/4	1 5/16	2 15/16	3/8	1 1/8	1 9/16	2 3/4	95
1 1/2	1 11/16	1/4	1 5/16	3 1/16	3/8	1 1/8	1 11/16	2 7/8	105
2	2 1/16	1/4	1 5/16	3 7/16	3/8	1 1/8	2 1/16	3 1/4	150
2 1/2	2 1/4	1/4	1 5/16	3 5/8	1/2	1 5/16	2 1/4	3 5/8	225
3	2 3/4	1/4	1 5/16	4 1/8	1/2	1 5/16	2 3/4	4 1/8	310
3 1/2	3 1/8	3/8	1 9/16	4 3/4	1/2	1 5/16	3 1/8	4 1/2	390
4	3 5/8	3/8	1 9/16	5 1/4	5/8	1 9/16	3 5/8	5 1/4	475
5	4 1/2	1/2	1 7/8	6 7/16	5/8	1 9/16	4 1/2	6 1/8	865
6	5 7/16	1/2	1 7/8	7 3/8	3/4	1 13/16	5 7/16	7 5/16	950
8	6 3/8	3/4	2 1/8	8 9/16	7/8	2 1/16	6 3/8	8 1/2	1510



Furnished black. Galvanized on order.

Adjustable Split Swivel Hangers

Dimensions, in Inches

Pipe Size Inches	Ring to Bolt Hole (Centers)	Center of Bolt Hole to Top	Adjustment	Adjuster No.	Pipe Thread	Bolt Thread
3/8	7/8	3 3/8	1 5/8	1	1/8	3/8
1/2	1	3 3/8	1 5/8	1	1/8	3/8
3/4	1 1/8	3 3/8	1 5/8	1	1/8	3/8
1	1 1/8	3 3/8	1 5/8	1	1/8	3/8
1 1/4	1 5/8	3 3/8	1 5/8	1	1/4	1/2
1 1/2	1 3/4	3 3/8	1 5/8	1	1/4	1/2
2	2 1/4	3 3/8	1 5/8	1	1/4	1/2
2 1/2	2 1/2	3 3/8	1 5/8	1	1/4	1/2
3	3	3 3/8	1 5/8	1	1/4	1/2
3 1/2	3 3/8	4 1/8	2 1/8	2	3/8	5/8
4	3 5/8	4 1/8	2 1/8	2	3/8	5/8
4 1/2	5 1/4	4 1/8	2 1/8	2	3/8	5/8
5	4 1/8	4 1/8	2 1/8	2	1/2	3/4
6	4 3/4	4 1/8	2 1/8	2	1/2	3/4
8	7 1/4	5 5/8	2 5/8	3	1/2	3/4
10	9 1/8	5 5/8	2 5/8	3	1/2	7/8

Prices on application

The No. 215-F Adjustable Hanger is made of malleable iron. By its use, the supporting rod or pipe may be cut approximately to size and placed in position; the unit may then be adjusted to the proper position without removing the hanger from the pipe.

The lower portion of the adjuster is cast within the top section, forming an integral swivel which allows the top section to rotate, thus raising or lowering the entire unit to the desired position. The top section is formed in the shape of a hexagon nut to allow the use of a wrench when needed.

This hanger is regularly furnished black. Galvanized finish can be furnished, when so specified.



No. 215-F

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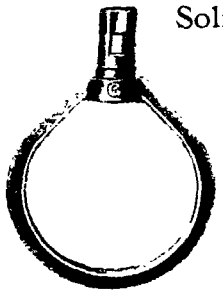
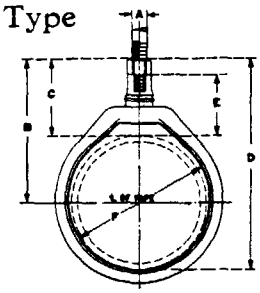
Pipe Hangers

Adjustable Swivel Ring Hangers

Solid Ring Type



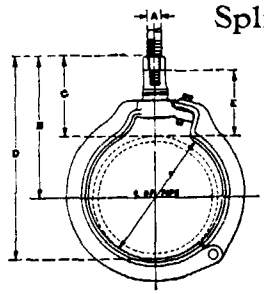


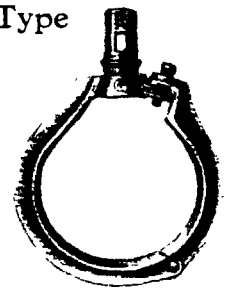
No. 101-G

The No. 101-G Solid Ring Type Swivel Ring is made of malleable iron and is Underwriters' approved. The swivel shank allows adjustment by turning the shank nut to left or right. No temporary support of the pipe line is necessary while making adjustments. The swivel shank automatically locks when the pipe is in the desired position.

This ring is regularly furnished black. Cadmium plated finish is available on order.

Split Ring Type





No. 104-G

The No. 104-G Split Ring Type Swivel Ring has the same swivel shank with adjustable and automatic locking features as the No. 101-G Solid Ring Type.

The hinging of the ring is off center, providing sufficient seating to hold the pipe before closing the ring.

A wedge type pin is loosely but inseparably cast into the hinged section for fastening this section after the pipe is in place.

Dimensions, in Inches

Pipe Size	No. 101-G, Solid Ring Type						No. 104-G, Split Ring Type						Max. Load Lbs.
	A	B	C	D	E	F	A	B	C	D	E	F	
¾	⅜	2 15/16	2 7/16	3½	2	1 3/16	⅜	2 7/8	2 3/8	3 7/16	1 15/16	1 3/16	80
1	⅜	2¾	2⅛	3 7/16	1 11/16	1 7/16	⅜	2 7/8	2¼	3 9/16	1¾	1 7/16	85
1¼	⅜	3 1/16	2 3/16	3⅞	1¾	1 13/16	⅜	3	2 3/16	3⅞	1 11/16	1 13/16	95
1½	⅜	3 1/16	2⅛	4	1 11/16	2	⅜	3 1/8	2 3/16	4⅛	1 11/16	2 1/16	105
2	⅜	3 7/16	2¼	4⅝	1 13/16	2 9/16	⅜	3½	2 5/16	4 11/16	1 13/16	2½	150
2½	½	4	2 9/16	5 7/16	2 1/16	3 1/16	½	3 15/16	2½	5⅜	1⅞	3	225
3	½	4 3/8	2⅝	6⅛	2⅛	3 11/16	½	4 3/8	2⅝	6⅛	2	3¾	310
3½	½	4 9/16	2 9/16	6 9/16	2 1/16	4 3/16	½	4¾	2¾	6¾	2⅛	4 5/16	390
4	⅝	5 7/16	3 3/16	7 11/16	2 9/16	4¾	⅝	5 13/16	3 9/16	8 1/16	2⅞	4 13/16	475
5	⅝	6	3¼	8 13/16	2⅝	5 13/16	⅝	6⅜	3⅝	9 3/16	2 15/16	5 15/16	685
6	¾	7⅛	3 13/16	10 7/16	3 1/16	6⅞	¾	7⅝	4 5/16	10 15/16	3½	7 1/16	950
8	⅞	8 13/16	4½	13⅛	3⅜	8 15/16	⅞	9⅛	4⅞	13½	3⅞	9 1/16	1510

Adjustable Swivel Pipe Rolls

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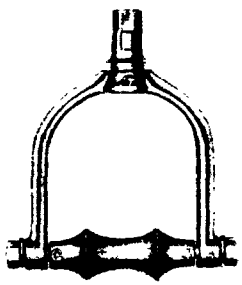
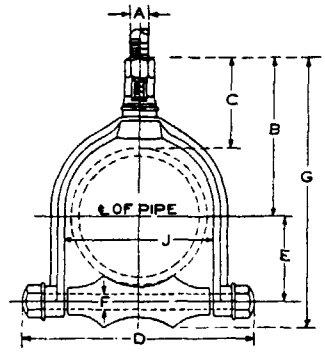


No. 174-G
Adjustable Swivel
Pipe Roll



These Adjustable Swivel Pipe Rolls have a malleable iron yoke and a cast iron roll. Vertical adjustment is made by use of the swivel shank which automatically locks, preventing loosening due to vibration.

Dimensions, in Inches

Pipe Size	A	B	C	D	E	F	G	J	Max. Load Lbs.
2½	½	4	2 9/16	5½	1 15/16	7/16	6⅝	3¼	225
3	½	4 5/16	2 9/16	6⅛	2¼	7/16	7⅝	3⅞	310
3½	½	4⅝	2⅝	6⅞	2 9/16	½	8	4⅜	390
4	⅝	5⅜	3⅛	7 7/16	2 13/16	½	9 1/16	4 15/16	475
5	⅝	5 15/16	3⅛	8¾	3 7/16	⅝	10⅜	6	685
6	¾	7 1/16	3¾	10⅞	4	¾	12¼	7⅛	950
8	⅞	8 13/16	4½	13¼	5⅛	⅞	15⅜	9¼	1510
10	⅞	10	4⅝	15½	6⅜	⅞	18 1/16	11¼	2100
12	⅞	11⅛	4¾	17¾	7 7/16	1	20½	13¼	2300

This type of hanger is primarily designed for use with uncovered pipe; but, covered pipe with Pipe Covering Protection Saddles can be used when the proper size pipe rolls are installed.

Prices on application

Grinnell Constant-Support Hangers

For High Temperature Piping Installations

Grinnell Constant-Support Hangers are designed to reduce the total stresses of high temperature piping. The total supporting effort of these hangers is equal, in all positions, to the constant weight of the vertically shifting pipe line.

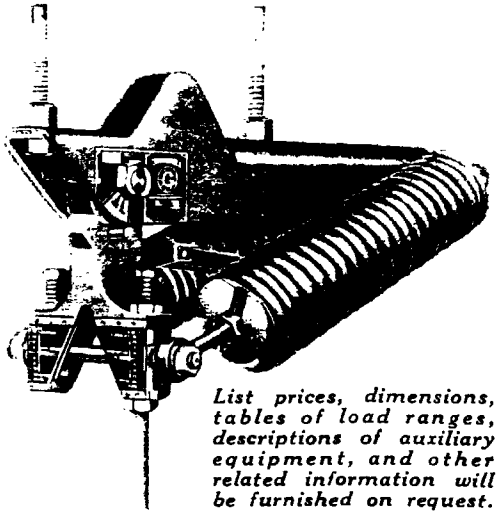
These hangers are recommended for high temperature piping in power plant, oil refinery, and marine installations.

No. 286, Model H11: This Constant-Support Hanger is made in eleven sizes for an over-all load range of 250 to 8500 pounds, and a total travel range of 2 to 4 inches.

No. 283, Model H12: The No. 283 Hanger is an intermediate size unit with a load range of 800 to 5000 pounds, and a total travel range of 1¾ to 3¼ inches.

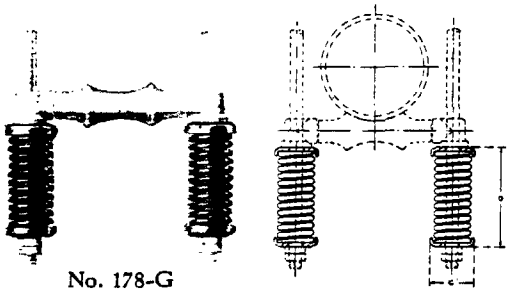
No. 288, Model H14: The No. 288 Constant-Support Hanger has a load range of 150 to 2400 pounds and a total travel range of 1¼ to 2½ inches.

Each Constant-Support Hanger is individually adjusted to support the exact load, in pounds, that may be specified.



List prices, dimensions, tables of load ranges, descriptions of auxiliary equipment, and other related information will be furnished on request.

Spring Cushion Hangers

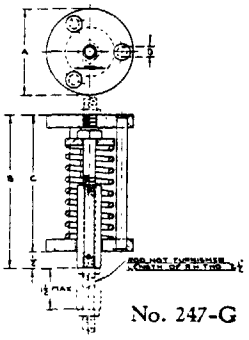


No. 178-G

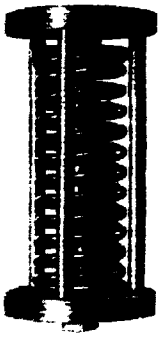
(Illustrations show complete assembly of No. 178-G Spring Cushion and a Single Pipe Roll.)

Spring Cushion Hangers are recommended for service where constant support is required and compensation must be made for movement of the piping.

The use of springs is an efficient means of absorbing vibration.



No. 247-G



No. 178-G: The No. 178-G Spring Cushion Hanger is usually used with a single pipe roll hanger as illustrated above.

The Spring Cushion consists of a set of two springs and four retainers. Size No. 1 retainer is cored with a 7/16-inch hole suitable for a 3/8-inch hanger rod. Retainer sizes No. 2 and No. 3 are cored with a 1-inch hole suitable for a 7/8-inch hanger rod. These holes may be drilled or reamed larger to satisfy the hanger roll rod diameter.

No. 247-G: The No. 247-G Light Duty Spring Hanger is a flexible support with a relatively small variation in supporting force.

It is used on small sized piping where the piping weight is in its range of load carrying capacity.

This hanger is recommended to the plumbing and heating trade for use on steam mains in municipal and commercial buildings and also for small piping in power and industrial plants.

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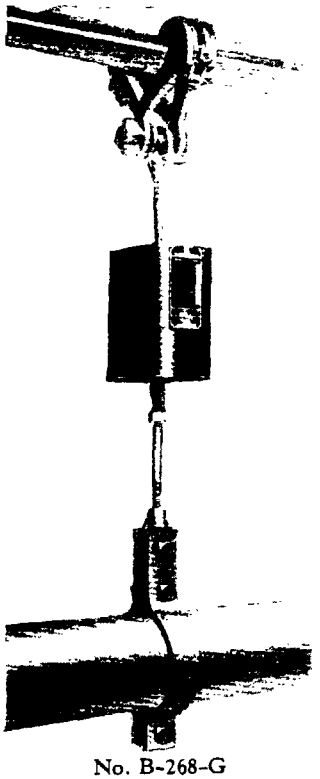
Dimensions, in Inches

Size No.	No. 247-G							No. 178-G			
	A	B	C	D	*Maximum Deflection Inches	Load Pounds at Maximum Deflection	Rod Size Inches	C	D	†Capacity of Hanger Pounds	Deflection Rate per Spring Pounds per Inch
1	2 5/8	4 5/8	4 1/8	5/16	1 1/4	47.5	3/8	2 21/32	6 1/8	535	214
2	2 5/8	5 19/32	5 3/32	5/16	1 1/4	85.0	3/8	4 1/8	6 1/16	1500	600
3	3 3/8	5 11/16	5 3/16	3/8	1 1/4	150.0	1/2	4 1/8	9 1/16	3000	1200
4	3 1/2	7 3/4	7 1/4	3/8	1 1/4	267.5	1/2				

*At maximum deflection, spring can be compressed an additional ¼-inch before becoming solid.
†Maximum capacity of double spring assembly.

Prices on application

Grinnell Pre-Engineered Spring Hangers



No. B-268-G

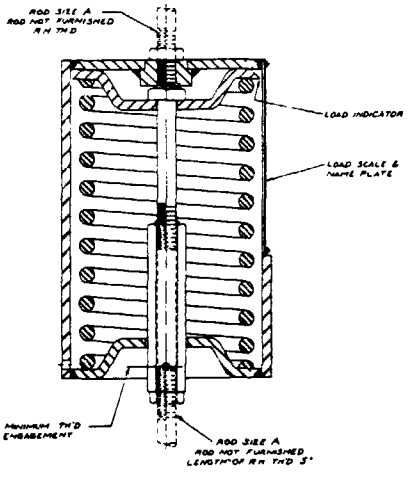
The Grinnell Pre-Engineered Spring Hanger was developed after years of experience in analyzing the problems of flexible pipe suspension systems. Spring design for the expanded line of No. B-268 Spring Hangers has been carefully calculated in all sizes and types to minimize the inherent changes in the supporting force with deflection of the spring. The feature of pre-compression assures operation of the spring within its proper working range, where variation in supporting force is at a minimum. Maximum variation in supporting force per ½-inch deflection of the spring is 10½ per cent of the rated capacity.

The design embodies pre-compressing the spring into the casing, within ½-inch of the working range, thereby reducing the over-all height of the hanger assembly.

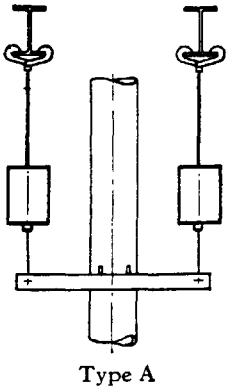
Erection of the hanger system has been simplified by incorporating a scale plate on the side of each hanger.

A unique load coupling eliminates the necessity for a turnbuckle to adjust the hanger load. Shortening or lengthening the rod until the scale pointer indicates the correct load assures proper installation of the equipment.

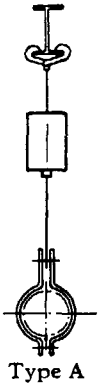
This Spring Hanger is offered in seven types and makes available a wide choice of carefully engineered spring hangers. It is made in fourteen sizes with load ranges from 74 to 4800 pounds capacity.



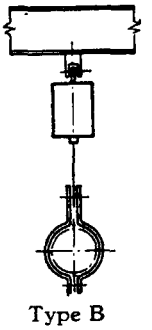
Type A Cross Section



Type A



Type A



Type B

Specifications: Grinnell Pre-Engineered Spring Hangers are designed to meet the requirements of the American Standard Code for Pressure Piping. Standard weight steel piping is used for the casing and serves to protect the spring from damage as well as weather conditions. The top and bottom spring cap serves as a centering device or guide and prevents the spring from coming in contact with the sides of the casing. All welding is done in strict accordance with the American Standard Code.

When ordering: When ordering, specify catalog number, type, and hanger size. These hangers provide a space for die-stamping the hanger mark number, the operating load per spring unit in pounds, and also for indicating the actual hot and cold position when the necessary data is furnished on the order. The desired supporting force should be specified in the hot or operating position. The direction of movement, up or down from the cold to the hot position. may also be specified.

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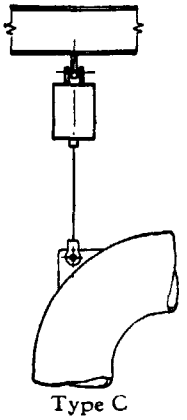
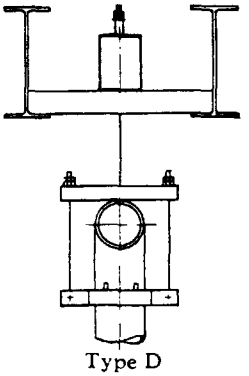
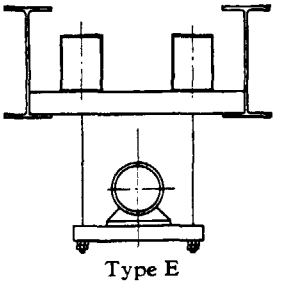


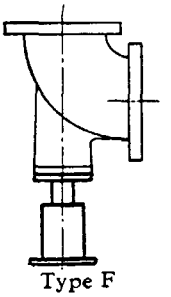
Type C



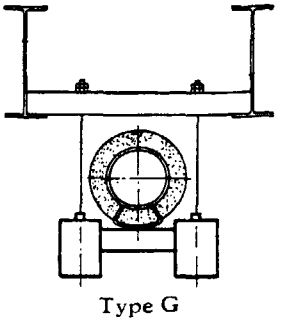
Type D



Type E



Type F



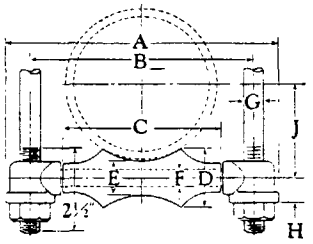
Type G

Prices on application

Single Pipe Rolls and Sockets

The No. 171-G Cast Iron Pipe Roll and Sockets is designed to take care of expansion and contraction. The adjustable sockets permit vertical adjustment at the roll.

Hanger rods and nuts are to be ordered separately. Rolls of special lengths can be furnished, and special sockets are available to permit the use of larger rolls for covered pipe with Pipe Covering Protection Saddles.





No. 171-G, Complete
No. 173-G, Pipe Roll Only
No. 171 A-G, Adjustable Socket Only

Dimensions, in Inches

Pipe Size Inches	Socket No.	Max. Socket Adjust.	A (Max.)	B	C	D	E	F	G (Max.)	H	J (Max.)	Max. Load Pounds
1	1	3/8	4 1/8	3	1 1/2	1	3/4	3/8	3/8	1 1/16	9/16	85
1 1/4	1	3/8	4 1/2	3 3/8	1 7/8	1 1/16	3/4	3/8	3/8	1 1/4	9/16	95
1 1/2	1	3/8	4 3/4	3 5/8	2 1/8	1 1/8	3/4	3/8	3/8	1 3/8	9/16	105
2	1	3/8	5 1/4	4 1/8	2 5/8	1 3/16	3/4	3/8	3/8	1 5/8	9/16	150
2 1/2	2	7/16	6 1/4	4 7/8	3 1/8	1 3/8	7/8	7/16	1/2	1 15/16	11/16	225
3	2	7/16	6 7/8	5 1/2	3 3/4	1 7/16	7/8	7/16	1/2	2 1/4	11/16	310
3 1/2	2, 3	1/2	7 3/4	6 1/4	4 1/4	1 5/8	1	1/2	5/8	2 9/16	3/4	390
4	2, 3	1/2	8 1/4	6 3/4	4 3/4	1 3/4	1	1/2	5/8	2 13/16	3/4	475
5	2, 3	5/8	9 11/16	8 1/16	5 13/16	2	1 1/8	5/8	5/8	3 7/16	7/8	685
6	2, 3, 4	3/4	11 7/16	9 9/16	6 7/8	2 5/16	1 1/4	3/4	3/4	4	1	950
8	2, 3, 4, 5	7/8	14 1/16	11 15/16	8 7/8	2 13/16	1 1/2	7/8	7/8	5 1/8	1 1/8	1510
10	2, 3, 4, 5	7/8	16 3/16	14 1/16	11	3 3/8	1 3/4	7/8	7/8	6 3/8	1 1/8	2100
12	3, 4, 5	1	18 7/16	16 5/16	13	3 7/8	2	1	7/8	7 7/16	1 1/4	2300
14	5, 6	1 1/8	20 1/8	17 3/4	14 1/4	4 5/8	2 1/2	1 1/8	1	8 3/8	1 3/8	3075
16	5, 6, 7	1 1/4	22 3/8	19 3/4	16 1/4	5	2 5/8	1 1/4	1 1/8	9 7/16	1 1/2	3075
18	5, 6, 7	1 1/4	24 1/2	21 7/8	18 1/4	5 7/16	2 3/4	1 1/4	1 1/8	10 1/2	1 1/2	3875
20	8	1 3/8	27 1/4	24 1/4	20 1/4	6	3	1 3/8	1 1/4	11 5/8	1 5/8	4980
24	6, 7, 8, 9	1 1/2	32 1/8	28 5/8	24 1/4	7 3/16	3 5/8	1 1/2	1 1/2	14	1 3/4	4980
30	8, 9, 10	1 7/8	39 7/8	35 1/2	30 1/4	8 15/16	4 1/2	1 7/8	1 7/8	17 7/16	2 1/8	4980

Hanger Couplings and Toggle Bolts



No. 134-G Adjustable Swivel Coupling



No. 136-G Rod Coupling

Dimensions, in Inches

Size No.		1	2	3	4	5
No. 134-G	Rod tappings	3/8	1/2	5/8	3/4	7/8
	Length	3 1/16	3 5/8	4 5/8	5 3/16	6 3/8
No. 136-G	Rod tappings	3/8	1/2	5/8	3/4	7/8
	Length	1 15/16	2 1/4	2 1/2	2 13/16	3 1/8

No. 134-G: The No. 134-G has a swivel nut to raise or lower the pipe. It is self-locking.

No. 136-G: The No. 136-G is furnished with right hand threads unless otherwise specified.

Nos. 209-G, 208-G: Nos. 209-G and 208-G are used under tile and cinder concrete construction.

No. 209-G → Toggle Bolt

No. 208-G → Hanger Rod Coupling



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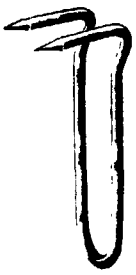
Pipe Straps



These Galvanized Tin Pipe Straps are furnished for pipe sizes 1/4 to 3 inches, inclusive.

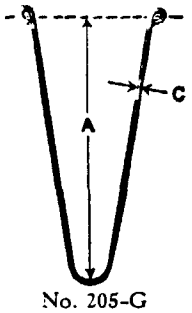
Wire Hooks



These Wire Pipe Hooks have long diamond points and are humped for easy driving. They are made in lengths of 4 to 10 inches for pipe sizes, 3/8 to 2 inches; coppered finish at additional cost.

Prices on application

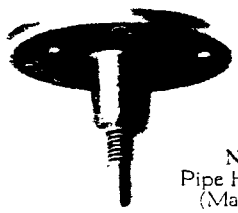
U-Hooks

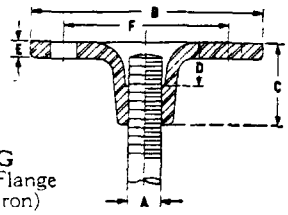


No. 205-G

U-Hooks are available in lengths of 6 to 36-inch for pipe sizes, 3/4 to 8 inches. Rod sizes (C dimension) are 5/16, 3/8, 7/16, 9/16, 5/8, and 3/4 inches.

Hanger Flanges





No. 153-G
Pipe Hanger Flange
(Malleable Iron)

The No. 153-G Hanger Flange size No. 1 has two holes for wood screws; size Nos. 2, 3, 4, and 5 have three holes for coach screws. Underwriters' approved for pipe sizes up to 8-inch, the Flange is used primarily on level ceilings. A 1-inch adjustment is provided where the rod enters the flange.

Dimensions, in Inches

Size No.	Pipe Size	A	B	C	D	E	F	Size Screw
1	3/4–2	3/8	2 7/8	1 3/8	7/8	3/16	2	1 1/2 No. 18
2	2 1/2–3 1/2	1/2	4	1 1/2	1 15/16	1/4	2 7/8	3/8×2
3	4–5	5/8	4 3/4	1 5/8	1	5/16	3 3/8	1/2×2
4	6	3/4	5 1/4	1 7/8	1 1/16	3/8	3 5/8	9/16×2
5	8–12	7/8	6	2 1/8	1 1/8	7/16	4 1/4	5/8×2

Adjustable Swinging Hanger Flanges

Malleable Iron — Underwriters' Approved



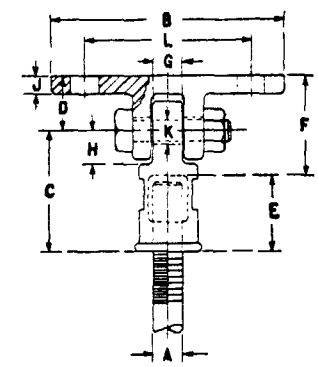
No. 155-G
Adjustable Swinging
Hanger Flange
(Complete)



No. 156-G
Flange with
Bolt, Nut, and
Spring Washer



No. 157-G
Extension
Piece
Rod
Threaded



The No. 155-G Hanger Flanges provide a means of hanging pipe where a swing through a radius of 180° is required.

No. 155-G is a combination of No. 156-G and No. 157-G. Size No. 1 has two holes for wood screws; Nos. 2, 3, 4, and 5 have three holes for coach screws. Extension Piece No. 157-G has an adjustment of 1 inch, and can also be used with Universal Side I-Beam Clamps or Universal Channel Clamps.

Dimensions, in Inches

Size No.	Pipe Size	A	B	C	D	E	F	G	H	J	K	L	Size Screws	Size Bolt
1	3/4–2	3/8	3 1/4	2 1/8	3/4	1 1/4	1 5/8	1/2	9/16	3/16	1/2	2 1/2	1 1/2 No. 18	3/8×1 1/2
2	2 1/2–3 1/2	1/2	4	2 3/8	15/16	1 3/8	1 15/16	5/8	11/16	1/4	1/2	2 7/8	3/8×2	3/8×1 3/4
3	4–5	5/8	4 3/4	2 9/16	1 1/8	1 9/16	2 1/8	5/8	11/16	3/8	1/2	3 3/8	1/2×2	7/16×2
4	6	3/4	5 1/4	2 7/8	1 5/16	1 3/4	2 7/16	5/8	13/16	7/16	1/2	3 5/8	9/16×2	7/16×2 1/8
5	8–12	7/8	6	3 1/16	1 7/16	1 7/8	2 5/8	3/4	7/8	1/2	9/16	4 1/4	5/8×2	1/2×2 3/8

Hanger Rods

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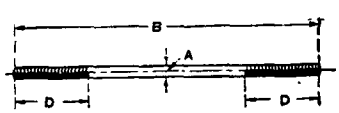
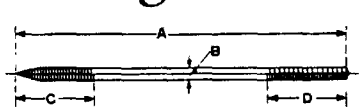
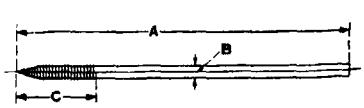


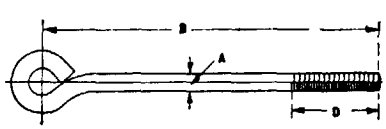
No. 140-G
Hanger Rod
Both Ends Machine Threaded
with Right Hand Threads



No. 142-G
Coach Screw Rod
Machine Threaded
on Opposite End



No. 143-G
Coach Screw Rod
Not Threaded
on Opposite End



No. 248-G
Eye Rod
Machine Threaded

Other rods can be furnished. Information and prices on request.

Dimensions, in Inches

Length Inches		No. 142-G and No. 143-G Rod Size B, Inches				No. 140-G and No. 248-G Rod Size A, Inches								
		3/8	1/2	5/8	3/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
Available in lengths of 8, 10, 12, 14, 18, 24, 30, 36, 42, 48, 54, 60, 66, and 72-inch		Specify length on orders Prices on application.				Specify length on orders. Prices on application.								
Thread Length	C	2	2 7/16	2 9/16	2 9/16									
	D	2 1/2	2 1/2	2 1/2	3	2 1/2	2 1/2	2 1/2	3	3 1/2	4	4 1/2	5	b

Extension Eye Bolts

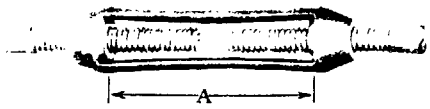


No. 220-G Eye Bolt Forged Steel

Dimensions, in Inches

Dia. of Eye Bolt	Length	Length of Thread	Dia. of Hole	Thickness of Metal at Eye
3/8	2 1/2	2	13/32	1/2
	4	2 1/4	13/32	1/2
	5 1/2	2 1/4	13/32	1/2
1/2	2 3/4	2	15/32	5/8
	4 1/4	2 1/2	15/32	5/8
	5 3/4	2 1/2	15/32	5/8
5/8	3	2 1/8	15/32	5/8
	4 1/2	3 1/4	15/32	5/8
	6	3 1/4	15/32	5/8
3/4	3	2 1/8	15/32	5/8
	4 1/2	3 1/2	15/32	5/8
	6	3 3/4	15/32	5/8
7/8	3 1/4	2 1/4	17/32	3/4
	4 3/4	3 3/4	17/32	3/4
	6 1/4	4 1/2	17/32	3/4

Turnbuckles



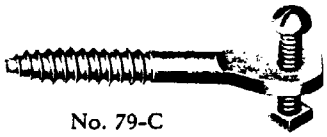
No. 230-G

The No. 230-G Turnbuckle is made of drop forged steel, and can be furnished galvanized at additional cost. It is available in screw diameters 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 2, 2 1/4, and 2 1/2 inches. When ordering, specify whether turnbuckles are wanted with or without stub ends.

Standard length Turnbuckles have a 6-inch opening (dimension "A" on illustration). Opening lengths of 9, 12, 18, and 24 inches are also available.

Flattened Lag Screws

With Bolt



No. 79-C

Dimensions, in Inches

Number of Screw	1	2	3
Size	5/16	3/8	1/2
Length	3 1/2	3 1/2	5

Flattened End Bolts

The No. 96-G End Bolt is forged steel. It is also available heavily copper plated for use with copper pipe and fittings, and is designated No. 96 CP-G.

Dimensions, in Inches

Bolt No.	Pipe Size	Bolt Size	Thread Length	Length Center of Hole to End	Size Hole
1	1/2 to 2	3/8	2	2 7/8	9/32
2	2 1/2 to 3 1/2	1/2	2 1/2	3 3/8	11/32
3	4 to 5	5/8	3	4 1/4	13/32
4	6	3/4	3 3/4	5	13/32
5	8	7/8	4 1/2	6	17/32

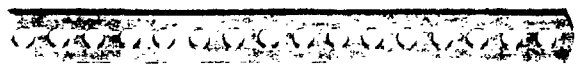


No. 96-G

Extension Bars

Dimensions, in Inches

Size Number	Width	Thickness	Std. Length Feet	Size Holes	Ctr. to Ctr. of Holes
00	3/4	18 ga.	10	9/32	1/2
0	3/4	16 ga.	10	9/32	1/2
1	7/8	16 ga.	10	9/32	1/2
2	1	15 ga.	10	9/32	1/2
3	1 1/8	12 ga.	10	3/8	3/4
4	1 1/4	12 ga.	10	3/8	3/4
5	1 1/4	3/16	8	7/16	1
6	1 1/4	1/4	8	7/16	1



No. 1-C

The No. 1-C Perforated Extension Bar is made of soft steel and can be cut with a cold chisel. It can be furnished galvanized at additional cost.

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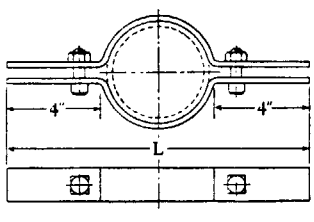
Extension Pipe or Riser Clamps

Dimensions, in Inches

Pipe Size	Length L	Size Stock	Pipe Size	Length L	Size Stock
3/4	9 3/8	3/16×1 1/4	5	14 1/2	1/4×2
1	9 5/8	3/16×1 1/4	6	15 1/2	1/4×2
1 1/4	10	1/4×1 1/4	8	18 1/2	3/8×2
1 1/2	10 3/8	1/4×1 1/4	10	20 3/4	3/8×2
2	10 3/4	1/4×1 1/4	12	22 3/4	1/2×2
2 1/2	11 1/4	1/4×1 1/4	14 OD	24	1/2×2
3	12	1/4×1 1/4	16 OD	26	5/8×2 1/2
3 1/2	13	1/4×1 1/2	18 OD	28	5/8×2 1/2
4	13 1/2	1/4×1 1/2	20 OD	30	5/8×2 1/2



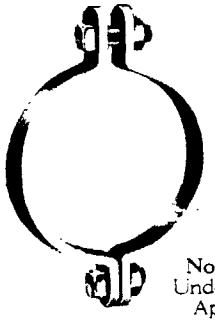


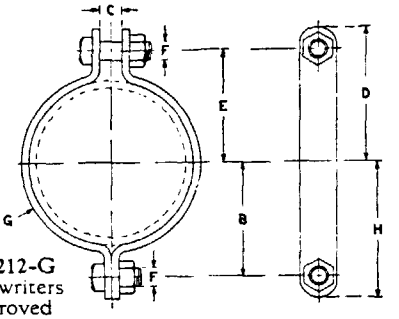
No. 261-G

The No. 261-G Clamp is made of wrought steel and is used as a riser clamp for supporting steel or cast iron pipe risers; also asbestos and other types of pipe covering.

Prices on application

Wrought Pipe Clamps





No. 212-G
Underwriters
Approved

This clamp is made of wrought steel and is used for hanging power piping and for anchoring pipe on steam and hot water mains. For heavier load ratings the No. 216-G Clamp is available; specifications and prices will be furnished upon request.

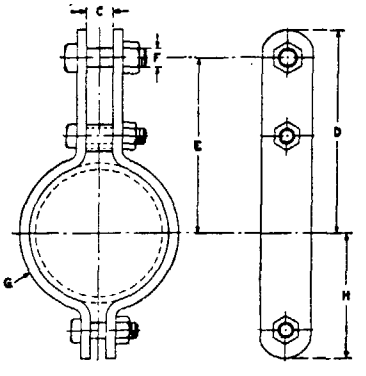
Dimensions, in Inches

Pipe Size Inches	B	C	D	E	F	G	H	Max. Load Pounds 450° F.	Max. Load Pounds 750° F.
1½	1 13/16	½	2½	1 7/8	3/8	¼×1	2 7/16	850	650
2	2 1/8	½	2 3/4	2 1/8	½	¼×1	2 3/4	850	650
2½	2½	5/8	3 1/4	2 5/8	½	¼×1	3 1/8	850	650
3	2 13/16	5/8	3 9/16	2 15/16	½	¼×1	3 7/16	850	650
3½	3 1/8	5/8	3 13/16	3 3/16	½	¼×1	3 3/4	850	650
4	3 7/16	¾	4 3/8	3 5/8	5/8	¼×1¼	4 3/16	865	660
5	4	¾	4 15/16	4 3/16	5/8	¼×1¼	4 3/4	865	660
6	4 7/8	7/8	5 7/8	5	¾	3/8×1½	5 3/4	1550	1200
8	6	1	7	6 1/8	¾	3/8×1½	6 7/8	1550	1200
10	7 5/16	1	8 9/16	7 7/16	7/8	½×2	8 7/16	2200	1700
12	8¼	1	9 9/16	8 7/16	7/8	½×2	9 3/8	2200	1700
14 OD	9	1⅛	10 5/8	9¼	7/8	½×2½	10 3/8	2380	1820
16 OD	10	1⅛	11 5/8	10¼	7/8	½×2½	11 3/8	2380	1820
18 OD	11½	1¼	13	11 5/8	1	5/8×2½	12 7/8	2380	1820
20 OD	12½	1 3/8	14 1/8	12 3/4	1⅛	5/8×2½	13 7/8	3120	2400
24 OD	15	1 5/8	16 7/8	15¼	1¼	5/8×3	16 5/8	3120	2400

Double Bolt Wrought Pipe Clamps



No.
295-G



A clamp for power station and industrial service for use where the top bolt is outside a 4-inch pipe covering; a heavy material is available for above normal loads.

Dimensions, in Inches

Pipe Size Inches	C	D	E	F	G	H	Max. Load Pounds 750° F.
1½	1 1/16	4 7/8	4 1/8	5/8	¼×1¼	2 3/8	725
2	1 1/16	5 7/8	5 1/8	5/8	¼×1¼	2 11/16	725
2½	1 1/16	6 1/8	5 3/8	5/8	¼×1¼	2 15/16	725
3	1 1/16	6 11/16	5 15/16	5/8	¼×1¼	3½	725
3½	1 1/16	6 15/16	6 3/16	5/8	¼×1¼	3¾	725
4	1 1/16	7 5/8	6½	¾	3/8×2	4½	1300
5	1 1/16	8 1/8	7	¾	3/8×2	5	1300
6	1 7/16	9 15/16	8 9/16	1	3/8×2½	6 1/8	1900
8	1 7/16	10 15/16	9 9/16	1	3/8×2½	7 1/8	1900
10	1 7/16	12	10 5/8	1	½×2½	8¼	2200
12	1 7/16	13	11 5/8	1	½×2½	9¼	2200
14 OD	2	14 5/16	12 11/16	1¼	5/8×3	10 11/16	3200
16 OD	2	15 5/16	13 11/16	1¼	5/8×3	11 11/16	3200
18 OD	2	16 5/16	14 11/16	1¼	5/8×3	12 11/16	3200
20 OD	2	17½	17 7/8	1 3/8	¾×3	14	4200
24 OD	2	19½	17 7/8	1½	¾×3	16	3500

I-Beam and Channel Clamps

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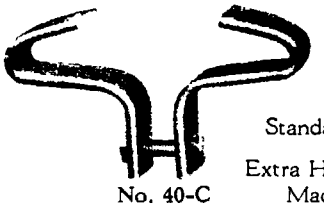
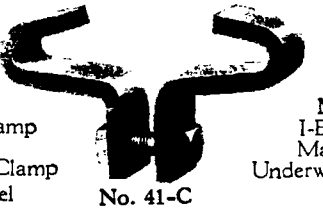


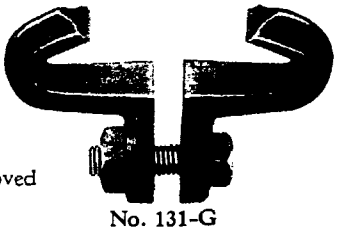
No. 40-C

No. 40-C
Standard I-Beam Clamp
No. 41-C
Extra Heavy I-Beam Clamp
Made of Strap Steel



No. 41-C

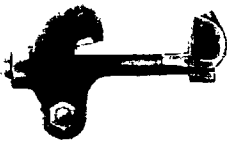
No. 131-G
I-Beam Clamp
Malleable Iron
Underwriters' Approved



No. 131-G



No. 225-G
Universal Side
I-Beam Clamp
Malleable Iron
Underwriters' Approved

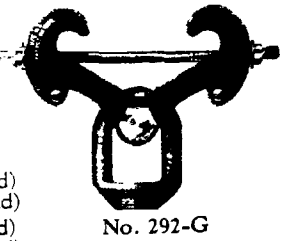


No. 226-G
Universal
Channel Clamp
Malleable Iron
Underwriters' Approved



No. 228-G

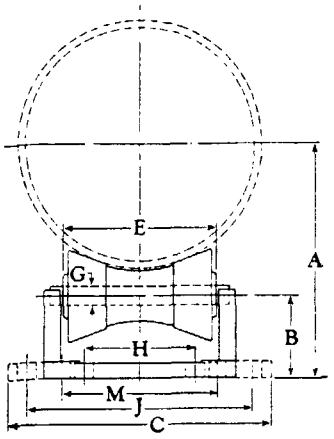
No. 228-G (Right Hand Thread)
No. 228 L-G (Left Hand Thread)
No. 292-G (Right Hand Thread)
No. 292 L-G (Left Hand Thread)
I-Beam Clamps — Forged Steel



No. 292-G

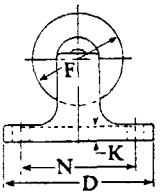
Prices on application

Pipe Roll Stands



These Cast Iron Pipe Roll Stands are designed for supporting piping in cases where vertical adjustment is not necessary, but where provision must be made for expansion and contraction of the pipe line.

There are two 1-inch cored holes located on the outside of the stands for 2 to 6-inch pipe, see dimension "J"; the stands for 8-inch pipe and larger have two 1-inch cored holes located inside of the uprights, see dimension "H".





No. 271-G
Pipe Roll Stand, Complete
No. 272-G
Pipe Roll and Rod Only
No. 273-G
Pipe Roll Only

There are four cored holes located at the four corners of the stand to provide additional anchorage. Dimensions "M" and "N" show the location of these holes.

Dimensions, in Inches

Pipe Size	A	B	C	D	E	F	G	H	J	K	M	N	Max. Load Pounds
2	3 1/2	1 3/4	8 3/8	5 3/8	2 3/4	1 7/8	1/2		6 3/8	9/16	3 7/16	4	390
2 1/2	3 7/8	1 3/4	8 3/8	5 3/8	2 3/4	1 7/8	1/2		6 3/8	9/16	3 7/16	4	390
3	4 1/8	1 3/4	8 3/8	5 3/8	2 3/4	1 7/8	1/2		6 3/8	9/16	3 7/16	4	390
3 1/2	4 3/8	1 3/4	8 3/8	5 3/8	2 3/4	1 7/8	1/2		6 3/8	9/16	3 7/16	4	390
4	4 13/16	2 1/16	9 7/8	5 5/8	3 3/4	2 1/16	1/2		7 7/8	3/4	4 11/16	4 1/4	950
5	5 7/16	2 1/16	9 7/8	5 5/8	3 3/4	2 1/16	1/2		7 7/8	3/4	4 11/16	4 1/4	950
6	6 1/16	2 1/16	9 7/8	5 5/8	3 3/4	2 1/16	1/2		7 7/8	3/4	4 11/16	4 1/4	950
8	8 11/16	3 7/16	8 5/8	6 5/8	6	3 1/4	3/4	4		3/4	7	5	2100
10	9 13/16	3 7/16	8 5/8	6 5/8	6	3 1/4	3/4	4		3/4	7	5	2100
12	11 3/8	3 7/8	10 15/16	7 7/8	8	4	7/8	5 3/4		3/4	9 1/16	6	3075
14 OD	12	3 7/8	10 15/16	7 7/8	8	4	7/8	5 3/4		3/4	9 1/16	6	3075
16 OD	13 5/8	4 1/4	12 3/8	8 5/8	9	4 1/2	1 1/8	6 3/4		7/8	10 1/4	6 1/2	4980
18 OD	14 5/8	4 1/4	12 3/8	8 5/8	9	4 1/2	1 1/8	6 3/4		7/8	10 1/4	6 1/2	4980
20 OD	15 5/8	4 1/4	12 3/8	8 5/8	9	4 1/2	1 1/8	6 3/4		7/8	10 1/4	6 1/2	4980
24 OD	17 3/4	4 3/8	13 1/2	8 5/8	10	4 7/16	1 3/8	7 1/2		1	11 3/8	6 1/2	7940
30 OD	21 7/8	5 1/8	17	10 3/4	12 1/2	5 1/2	1 3/4	10		1 1/4	14 1/4	8	7500

Pipe Roll and Plate



No. 277-G
Pipe Roll and Plate
No. 277 P-G
Base Plate Only

This Cast Iron Pipe Roll and Plate is used to support piping where vertical adjustment is not necessary, but where provision must be made for expansion and contraction. The supports can be raised or lowered by blocking or shimming up the base plate. They use pipe roll No. 273-G.

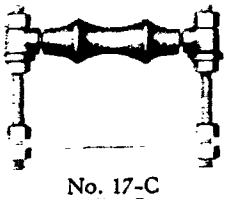
Pipe Roller Supports

No. 17-C Cast Iron Adjustable Roller is used on welded steel brackets or almost any type of steel construction. It is adjustable while the pipe is in place; the nuts lock the roller in position. All sizes provide a vertical adjustment of 6 inches, and include a roll with sockets, roll rod, two vertical threaded rods, and eight nuts.

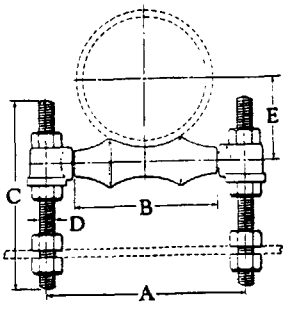
Dimensions, in Inches

Pipe Size	A	B	C	D	E
1	3	1 1/2	9 1/2	1/2	1 1/16
1 1/4	3 3/8	1 7/8	9 1/2	1/2	1 1/4
1 1/2	3 5/8	2 1/8	9 1/2	1/2	1 3/8
2	4 1/8	2 5/8	9 1/2	1/2	1 5/8
2 1/2	4 7/8	3 1/8	9 1/2	1/2	1 15/16
3	5 1/2	3 3/4	9 1/2	1/2	2 1/4
3 1/2	6 1/8	4 1/4	10	5/8	2 9/16
4	6 3/4	4 3/4	10	5/8	2 13/16
5	8 1/16	5 13/16	10	5/8	3 7/16
6	9 9/16	6 7/8	11	3/4	4
8	11 15/16	8 7/8	11 3/4	7/8	5 1/8
10	14 1/16	11	11 3/4	7/8	6 3/8
12	16 5/16	13	11 3/4	7/8	7 7/16
14 OD	17 3/4	14 1/4	11 3/4	7/8	8 3/8
16 OD	19 3/4	16 1/4	18	1 1/4	9 7/16
18 OD	21 7/8	18 1/4	18	1 1/4	10 1/2
20 OD	24 1/4	20 1/4	18	1 1/4	11 5/8
24 OD	28 5/8	24 1/4	24	1 1/2	14
30 OD	35 1/2	30 1/4	24	1 7/8	17 7/16

Prices on application



No. 17-C
Pipe Roller Support



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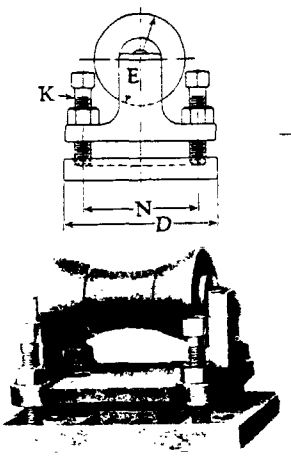
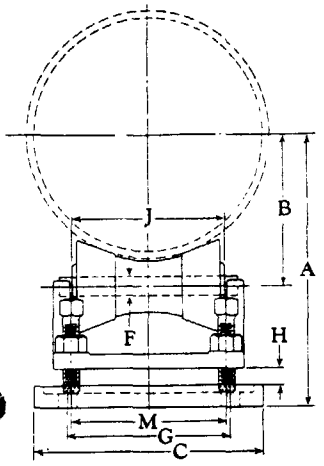
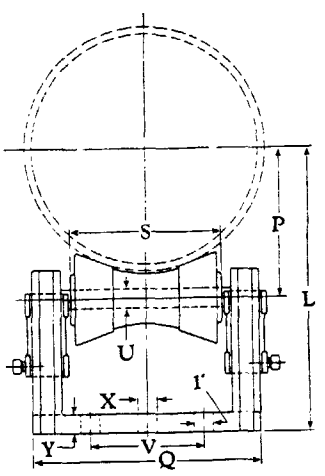
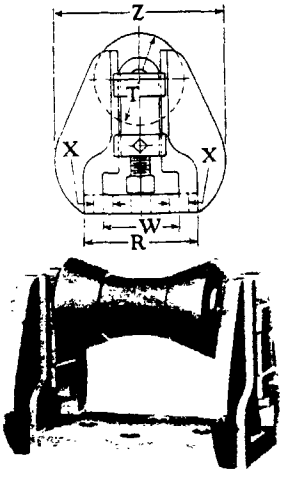
Adjustable Pipe Roll Stands





No. 274-G, Adjustable Pipe Roll Stand with Base Plate
No. 275-G, Adjustable Pipe Roll Stand Only
No. 274 P-G, Base Plate Only





No. 276-G
Adjustable Pipe Roll Stand

No. 274-G: These Cast Iron Stands are designed to support piping where there must be provision for vertical adjustment and lateral movement, as well as for expansion and contraction. Vertical adjustment is obtained by the four adjusting screws. Lateral movement of 1 inch on smaller sizes, and up to 1 3/8 inches on larger sizes, is accomplished by sliding the stand on the ends of the adjusting screws.

No. 276-G: These Cast Iron Stands are for supporting piping where vertical adjustment is needed as well as allowance for expansion and contraction Vertical adjustment is accomplished by turning the two adjustment screws which raise and lower adjusting slides located at either end of the stand. When proper alignment is obtained, the adjusting screws may be locked by tightening the small set screws.

Dimensions, in Inches, for No. 274-G, No. 275-G, and No. 274 P-G

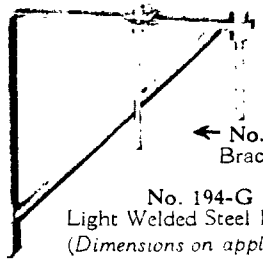
Pipe Size Inches	A Min.	A Max.	B	C	D	E	F	G	H (Max.)	J	K	M	N	Max. Load Pounds
2	5 1/8	5 3/8	1 3/4	6 7/8	5 1/2	1 7/8	1/2	3 7/8	7/8	2 3/4	5/8	3 7/16	4	390
2 1/2	5 3/8	5 5/8	2 1/8	6 7/8	5 1/2	1 7/8	1/2	3 7/8	7/8	2 3/4	5/8	3 7/16	4	390
3	5 3/4	6	2 3/8	6 7/8	5 1/2	1 7/8	1/2	3 7/8	7/8	2 3/4	5/8	3 7/16	4	390
3 1/2	6	6 1/4	2 5/8	6 7/8	5 1/2	1 7/8	1/2	3 7/8	7/8	2 3/4	5/8	3 7/16	4	390
4	6 1/2	7	2 3/4	8 1/8	5 3/4	2 1/16	1/2	5 1/8	1 1/8	3 3/4	5/8	4 11/16	4 1/4	950
5	7	7 1/2	3 3/8	8 1/8	5 3/4	2 1/16	1/2	5 1/8	1 1/8	3 3/4	5/8	4 11/16	4 1/4	950
6	7 5/8	8 1/8	4	8 1/8	5 3/4	2 1/16	1/2	5 1/8	1 1/8	3 3/4	5/8	4 11/16	4 1/4	950
8	10 3/8	11 5/8	5 1/4	10 5/8	6 3/4	3 1/4	3/4	7 3/8	1 3/4	6	3/4	7	5	2100
10	11 1/2	12 3/4	6 3/8	10 5/8	6 3/4	3 1/4	3/4	7 3/8	1 3/4	6	3/4	7	5	2100
12	13	14 1/4	7 1/2	13	8	4	7/8	9 1/2	1 3/4	8	7/8	9 1/16	6	3075
14 OD	13 5/8	14 7/8	8 1/8	13	8	4	7/8	9 1/2	1 3/4	8	7/8	9 1/16	6	3075
16 OD	15 1/4	16 5/8	9 3/8	14 5/8	8 5/8	4 1/2	1 1/8	11 1/8	1 7/8	9	1	10 1/4	6 1/2	4980
18 OD	16 3/8	17 3/4	10 3/8	14 5/8	8 5/8	4 1/2	1 1/8	11 1/8	1 7/8	9	1	10 1/4	6 1/2	4980
20 OD	17 3/8	18 3/4	11 3/8	14 5/8	8 5/8	4 1/2	1 1/8	11 1/8	1 7/8	9	1	10 1/4	6 1/2	4980
24 OD	19 5/8	21	13 3/8	15 3/4	8 5/8	4 7/16	1 3/8	12 1/4	1 7/8	10	1	11 3/8	6 1/2	6100
30 OD	24	26 3/4	16 3/4	19 1/4	10 1/2	5 1/2	1 3/4	15 3/4	3 1/4	12 1/2	1 1/4	14 1/4	8	7500

Dimensions, in Inches, for No. 276-G

Pipe Size Inches	L Min.	L Max.	P	Q	R	S	T	U	V	W	X	Y	Z	Max. Load Pounds
4	7 1/8	8 3/8	2 3/4	7	6	3 3/4	2 1/8	1/2	2 1/2	4	7/8	3/4	7 1/8	950
5	7 3/4	9	3 3/8	7	6	3 3/4	2 1/8	1/2	2 1/2	4	7/8	3/4	7 1/8	950
6	8 3/8	9 5/8	4	7	6	3 3/4	2 1/8	1/2	2 1/2	4	7/8	3/4	7 1/8	950
8	10 7/8	12 3/8	5 1/4	9 1/2	6	6	3 1/4	3/4	4 1/2	4	1	7/8	8 1/2	2100
10	12	13 1/2	6 3/8	9 1/2	6	6	3 1/4	3/4	4 1/2	4	1	7/8	8 1/2	2100
12	13 1/2	15 1/4	7 1/2	12	6	8	4	7/8	6	4	1	1	9	3075
14 OD	14 1/8	15 7/8	8 1/8	12	6	8	4	7/8	6	4	1	1	9	3075
16 OD	15 1/2	17 1/8	9 3/8	13	6 1/2	9	4 1/2	1 1/8	7	4 1/2	1	1	9 1/8	4980
18 OD	16 1/2	18 1/8	10 3/8	13	6 1/2	9	4 1/2	1 1/8	7	4 1/2	1	1	9 1/8	4980
20 OD	17 1/2	19 1/8	11 3/8	13	6 1/2	9	4 1/2	1 1/8	7	4 1/2	1	1	9 1/8	4980
24 OD	19 5/8	21 1/2	13 3/8	14 1/8	6 1/2	10	4 1/2	1 3/8	8	4 1/2	1	1	9 1/8	6100
30 OD	24 3/4	27	16 3/4	17 1/4	8	12 1/2	5 1/2	1 3/4	10 1/4	6	1	1 1/4	11 1/2	7500

Prices on application

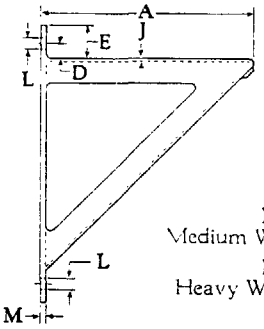
Welded Steel Brackets

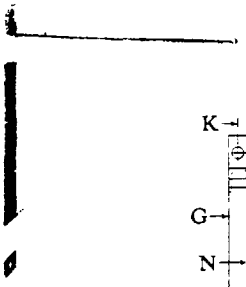


No. 194-G
Light Welded Steel Bracket
(Dimensions on application)

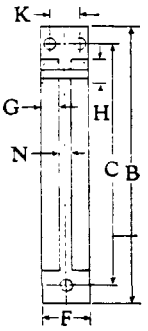
MAXIMUM LOADS
Light Weight Brackets — 750 pounds
Medium Weight Brackets—1500 pounds
Heavy Weight Brackets —3000 pounds

No. 193-G Bracket Clips will support 3½-inch pipe and smaller from any position along the arm of the bracket.





No. 195-G
Medium Welded Steel Bracket
No. 199-G
Heavy Welded Steel Bracket



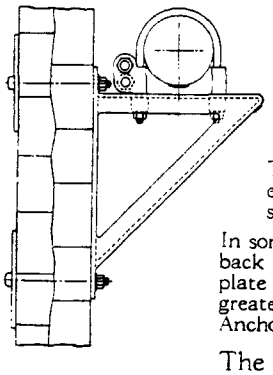
Welded steel brackets in all of the weights shown can be furnished in practically any size or type. The brackets are coated with a protective paint to prevent rusting during shipment.

Dimensions of Medium and Heavy Brackets, in Inches

Figure No.	Bracket No.	A	B	C	D	E	F	G	H	J	*K	L	M	N
No. 195-G	0	12	18	15½	1¼	2½	4	1½	1½	3/16		13/16	3/8	1
	1	18	24	21½	1¼	2½	4½	1¾	1¾	3/16		13/16	3/8	1
	2	24	30	27½	1¼	2½	5	2	2	¼		13/16	3/8	1
No. 199-G	0	12	18	15¼	1¼	2¾	4	1½	2	¼		13/16	½	1
	1	18	24	21⅜	1⅜	2¾	5	2	2	⅜	2¾	15/16	½	1
	2	24	30	27½	1½	2¾	5	2	2½	5/16	2½	1 1/16	½	1
	3	30	36	33¼	1½	3	5	2	2½	5/16	2½	1 1/16	½	1
	4	36	42	39	1½	3	6	2½	3½	⅜	3½	1 1/16	½	1
	5	42	50	46	1½	3½	6	2½	3½	⅜	3½	1 1/16	½	1

*Medium Weight Brackets and No. 0 Heavy Weight Brackets have only one bolt hole at the top.

Application of Welded Steel Brackets



Used with Pipe Rolls and Supports

Left: When a bracket is bolted to a wall, back plates must be ordered of such size and thickness to properly distribute the weight over the wall section.

The size and thickness of the plate will be governed by the load to be carried and the construction and condition of the wall.

In some installations, it is advisable to reinforce the back plates with additional steel in the form of a plate or angle to distribute the load over an even greater wall area. This is especially desirable when Anchor Chairs are mounted on a bracket.

The illustrations at the right show various types of pipe supports mounted on welded steel brackets. Pipe supports and welded steel brackets must be ordered separately.



No. 197-G
Anchor Chair



No. 271-G
Pipe Roll Stand



No. 274-G
Pipe Roll Stand
with Base Plate



No. 276-G
Adjustable Pipe
Roll Stand

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Single Hooks



No. 168-G
Single Hook

Dimensions

Pipe Size	Inches	½	¾	1	1¼	1½	2	2½	3
Center to center of holes	Inches	1 27/32	2⅛	2 7/16	3	3 5/16	3⅞	4 13/16	5½
Size of screws		No. 14			No. 18			⅜-inch	

Application: No. 168-G Single Hooks are used mainly from sides of beams where no adjustment is necessary, and in cases where there is no movement due to expansion and contraction. Single hooks are often used in conjunction with hook plates to carry wall coil.

Prices on application

Cast Iron Pipe Supports



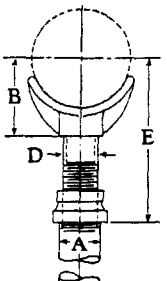
*No. 264-G
Adjustable Pipe

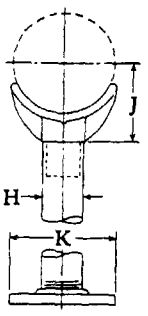


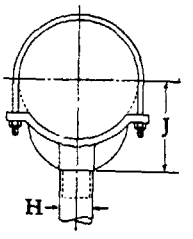
No. 258-G
Pipe Saddle
Support



No. 259-G
Pipe Stanchion
Saddle





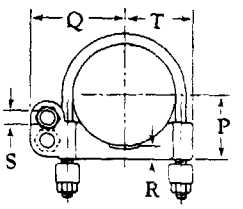


*Retaining spots are welded to the lower end of the nipple after assembly to prevent separation of the nipple and reducer during adjustment.

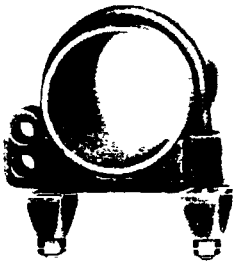
Dimensions, in Inches

Pipe Size Inches	No. 264-G A	B	C	D	E Min.	E Max.	No. 258-G and No. 259-G H	J	K
2½	2½	3½	9	1½	8	13			
3	2½	3¾	9	1½	8¼	13¼			
3½	2½	4	9	1½	8½	13½			
4	3	4¼	9	2½	9¼	14	3	4¼	9
5	3	4⅞	9	2½	10	14¾	3	4⅞	9
6	3	5½	9	2½	10½	15¼	3	5½	9
8	3	6⅞	9	2½	11¾	16½	3	6⅞	9
10	3	8½	9	2½	13½	18¼	3	8½	9
12	3	10	9	2½	15	19¾	3	10	9
14 OD	4	11	11	3	16¼	20¾	4	11	11
16 OD	4	12½	11	3	17¾	22¼	4	12½	11
18 OD	6	14	13½	3½	19½	24	4	14	11
20 OD	6	15½	13½	3½	21	25½	6	15½	13½
24 OD	6	18	13½	4	23¾	28¼	6	18	13½
30 OD	6	21½	13½	4	27	31½	6	21½	13½
36 OD	6	24¾	13½	4	30¼	34¾	8	24¾	16

Anchor Chairs



No. 197-G Anchor Chair



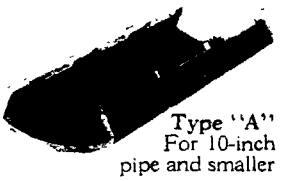
Dimensions, in Inches

Pipe Size	P	Q	R	S	T
4	3	4⅛	¾	⅝	3 3/16
5	3 9/16	5	¾	¾	3⅞
6	4 1/16	5¾	¾	⅞	4 9/16
8	5 5/16	7⅛	1	1	5¾
10	6½	8⅜	1⅛	1⅛	6 13/16
12	7⅝	9½	1¼	1¼	7 13/16
14 OD	8½	10⅛	1½	1¼	8 7/16
16 OD	9⅝	11½	1⅝	1½	9 7/16
18 OD	10⅞	12½	1⅞	1½	10 7/16
20 OD	12	13½	2	1½	11 7/16
24 OD	14	15½	2	1½	13 7/16

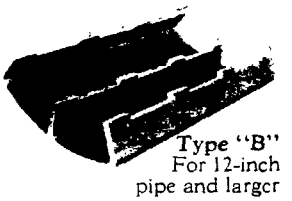
These supports consist of a cast iron chair, a round iron yoke, two special cast iron washers, and two hexagonal nuts.

These anchor chairs are well adapted for use with welded steel brackets.

Protection Saddles



Type "A"
For 10-inch
pipe and smaller



Type "B"
For 12-inch
pipe and larger

The No. 186-G, for Standard covering, the No. 186A-G for 2-inch covering, and the No. 187-G for Double Standard covering are available in the ¾, 1, 1¼, 1½, 2, 2½, 3, 3½, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, and 24-inch sizes.

The No. 188-G for Double 1½-inch covering is made in sizes 2, 2½, 3, 3½, 4, 5, 6, 8, and 10-inch.

All saddles are 12 inches long and are made of curved steel plates with the edges turned up.

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B & C Floor and Ceiling Plates



B & C No. 3



B & C No. 4 or 5

When ordering, specify the catalog number, the size, and the type of finish desired.



B & C No. 10



B & C No. 20

Nos. 3, 4, and 5 Plates are made of cast brass and are available in sizes ¼ to 12-inch. They can be furnished chromed or nickel-plated. Nos. 3 and 5 have a set screw for ceiling use. The No. 4 does not have a set screw.

Nos. 10 and 20 Plates, made of pressed steel in sizes ¼ to 6-inch, have a spring to hold position on the pipe. They are similar except the No. 10 is heavier and has a concealed hinge. They are available chromed; the No. 20 is furnished nickel-plated also.

Prices on application

Pipe Tools and Insulating Materials

Pipe and Square-End Sawing Vises . . . . page 424
Pipe Wrenches and Pipe Tongs . . . . page 425
Pipe Cutters and Cutter Wheels . . . . page 426
Pipe End Reamers . . . . page 427
Pipe Taps . . . . page 427
Tubing Cutters . . . . page 426

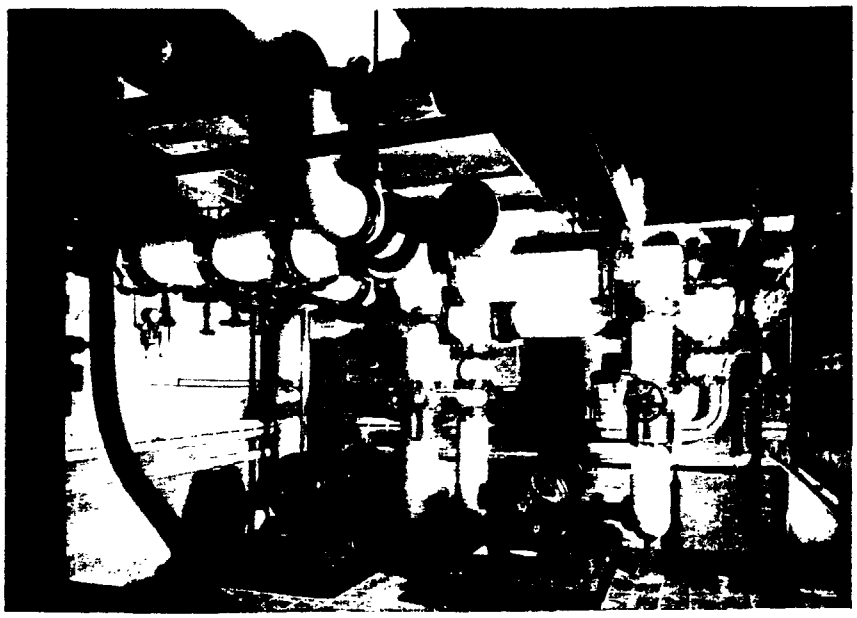
Pipe and Bolt Threading Devices . . . . pages 427 to 430
Pipe Threading Machines . . . . page 430
Thread Cutting Oil . . . . page 432

Valve Reseating Equipment . . . . page 433
Grade Scales . . . . page 432
Flue Brushes and Scrapers . . . . page 432
Flange Jacks . . . . page 425
Torches, Fire Pots, and Gas Guns . . . . page 431

Insulating Materials and Cements . . . . pages 434 and 435
Plastic Cork Coating . . . . page 432
Air Filters . . . . page 436

In addition to the tools and supplies shown on pages 424 to 436, the following are shown in other sections of this catalog, in order to group them with allied products:

Body Seat Ring Wrenches . . . . page 139
Machine Bolts . . . . page 445
Gaskets . . . . pages 452 to 456, and 399
Sheet Packings . . . . page 453
Thread Lubricants . . . . page 444

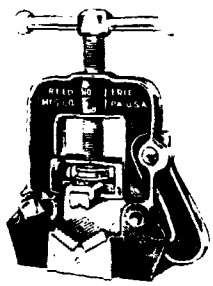


A portion of the basement piping in a large office building—Crane products were used throughout.

Crane Valves and Fittings can be found in all industries, on all services, wherever fluids are conveyed in pipe lines.

Pipe Vises

Reed Long Jaw and Extra Heavy Pipe Vises



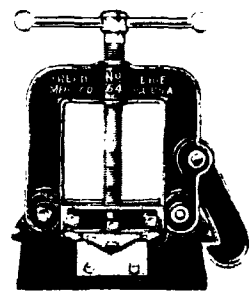
Long Jaw Vise
For ⅛ to 4½-Inch Pipe

Reed Long Jaw Pipe Vises: These vises have long bearing alloy tool steel jaws which grip firmly without crushing, marring, or bending the pipe. The lower jaw is reversible, and an automatic take-up keeps the vise tight.

Reed Extra Heavy Pipe Vises: These vises are ruggedly built and have interlocking pipe jaws with heat-treated high carbon steel screws. The base has a flat bottom, without apron, and can be mounted on any flat surface.

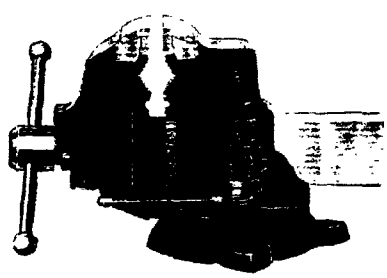
Sizes and Capacities

No. of Vise		Long Jaw					Extra Heavy		
		No. 00	No. 0	No. 1	No. 2	No. 3	No. 64	No. 65	No. 66
For Pipe	Inches	⅛ to 1½	⅛ to 2	⅛ to 2½	⅛ to 3½	⅛ to 4½	⅛ to 6	1 to 8	1½ to 12



Extra Heavy Vise
For ⅛ to 12-Inch Pipe

Parker Combination Pipe Vises



The Parker Combination Pipe Vises have pipe jaws of highest grade steel, milled and tempered in oil. These vises are furnished with a reversible front jaw which can be turned from end to end when worn, making the vise suitable for general use.

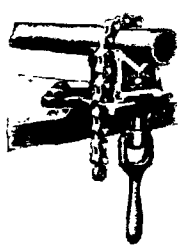
The Parker Vise bolts to a bench, and the split swivel base construction assures ample gripping power. A tension spring holds the handle wherever it is placed.

Sizes and Capacities

Number of Vise		No. 433½	No. 434½	No. 435	No. 436
Size of jaw	Inches	3½	4½	5	6
Maximum pipe size	Inches	2	3	4	6

Williams Drop-Forged Chain Pipe Vises

Vulcan: The Williams Vulcan wrought steel chain pipe vises can be used on bench or post. The jaws are tempered for file sharpening.



Vulcan
For ⅛ to 8-Inch Pipe

Vulcan Superior: The Williams Vulcan Superior chain vises are made from wrought steel. These vises are quickly set up. The overhead adjustment feature simplifies operation. Reversible jaws provide long life.

Sizes and Capacities

Number of Vise		Vulcan				Vulcan Superior	
		No. 1	No. 2	No. 3	No. 4	No. 11	No. 12
For Pipe	Inches	*⅛ to 2	¼ to 4	½ to 6	½ to 8	⅛ to 2½	¼ to 4½

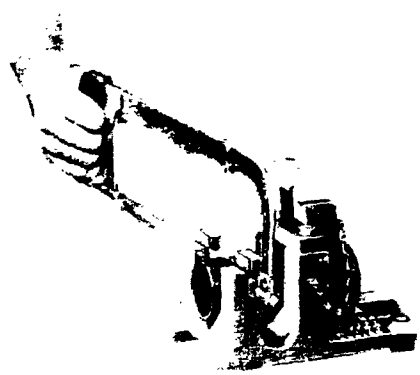
*Will grip pipe fittings not larger in diameter than Standard 2½-inch pipe (2⅞ inches O.D.).



Vulcan Superior
For ⅛ to 4½-Inch Pipe

38

Beaver Square-End Sawing Vises



These vises are particularly well suited for copper tubing, on which a square-cut end is desirable in making a good joint. The hacksaw illustrated is not furnished with the vise.

No. 2: The No. 2 Square-End Vise is for pipe sizes ⅛ to 2 inches, and is made of aluminum, with renewable hardened steel inserts in the saw guides. It is self-contained, light in weight, and can be used with any kind of a hacksaw. A strip of cotton webbing and a piece of rosin are included for use when cutting polished nickel tubing. The vise is equipped with a long "V" trough, to assure accurate centering of the tubing.

No. 4: The No. 4 is similar to the No. 2 except that it is for tube sizes 1½ to 4 inches, and is made of air-furnace malleable iron and uses a different type clamping device.

Prices on application

Pipe Wrenches and Pipe Tongs



Straight Pattern
(Available in sizes 6 to 60 inches)

Ridgid Pipe Wrenches

Handles are made of steel.



End Pattern (Style E)
(Available in sizes 6 to 36 inches)

Sizes and Capacities

Size Inches	6	8	*10	12	*14	18	24	36	48	60
Capacity Inches	¾	1	1½	2	2	2½	3	4½	6	8

*Wrenches in the 10 and 14-inch sizes can be furnished with rubber grips.

"Stillson" Pipe Wrenches

These pipe wrenches have steel handles.

Sizes and Capacities

Length open Inches	6	8	10	14	18	24	36	48
For pipe sizes Inches	⅛-½	⅛-¾	⅛-1	¼-1½	¼-2	¼-2½	¼-3½	1-5



Trimo-Alloy Pipe Wrenches



All sizes have steel handles.

These wrenches are made of drop-forged, heat-treated alloy steels.

Sizes and Capacities

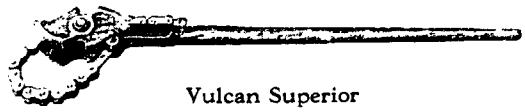
Length open Inches	6	8	10	14	18	24	36	48
For pipe sizes Inches	⅛-½	⅛-¾	⅛-1	¼-1½	¼-2	¼-2½	½-3½	1-5

Williams Drop-Forged Chain Pipe Tongs



Vulcan

These Vulcan Pipe Tongs are furnished with either flat link or cable chain. (Flat link chain illustrated.) Each flat chain is individually tested to two-thirds of the breaking strain listed in the table below.



Vulcan Superior

Vulcan Superior Pipe Tongs have reversible jaws. The chain locks easily and positively. A greater number of grips or bites on pipe and fittings is attained by a "V" recess in the jaws.

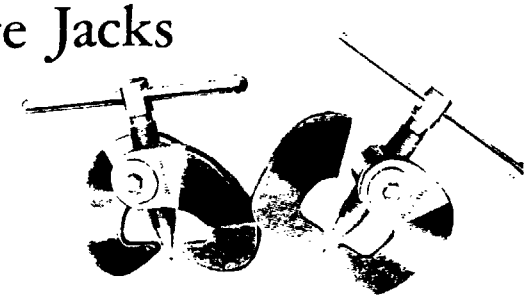
Capacities and Dimensions

For pipe sizes		Inches	⅛ to ¾	⅛ to 1½	¼ to 2½	¾ to 4	1 to 6	1½ to 8	2 to 12	4 to 18
Vulcan	Number		10	11	12	13	13½	14	15	16
	Length	Inches	13¾	20	27	37	44½	50½	64½	87
Vulcan Superior	Number		0	1	2	3	3½	4	5	
	Length	Inches	13¾	20	27	37	44½	50½	64½	
Flat chain length		Inches	9½	13½	17½	22½	32	40½	55½	74½
Flat chain breaking strain		Pounds	3600	6700	9800	12500	14300	15700	21800	40000
Cable chain length		Inches	9¾	14½	18	27	33½	42	57	76
Cable chain breaking strain		Pounds	1800	6000	9000	12500	14300	15700	21800	40000

38

Williams Flange Jacks

Williams Flange-Jacks are exceptionally well suited for flange gasket replacement work. Available in pairs only.



Capacities, in Inches
(Standard Raised Face Flanges)

No.	125-Pound Cast Iron	150-Pound Steel	250-Pound Cast Iron	300-Pound Steel
20	2 to 20	2 to 20	1 to 12	¾ to 12
30	16 to 48	18 to 24	12 to 30	12 to 24

Prices on application

Pipe Cutters and Cutter Wheels



Nye No. 2N Pipe Cutter

For ⅛ to 2-Inch Pipe

The No. 2N Nye Pipe Cutter is of welded steel construction with an unbreakable plastic handle.

Nye Barnes Type Pipe Cutters

Furnished with plain edge unless knurled wheels are specified.

No.		2	4	5	6
For pipe sizes	Inches	½ to 2	2½ to 4	4 to 6	6 to 8

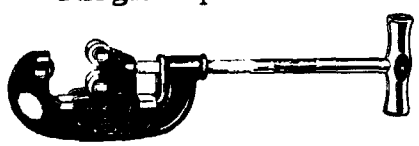




Trimo Pipe Cutters

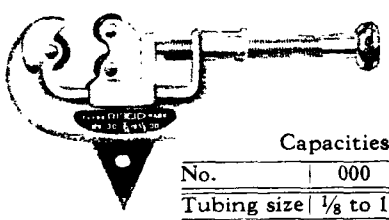
No.		1	2	3	4
For pipe sizes	Inches	⅛ to 1¼	⅛ to 2	1 to 3	2 to 4

Ridgid Pipe Cutters



No.		1	2	3	4	6
For pipe sizes	Inches	⅛ to 1¼	⅛ to 2	1 to 3	2 to 4	4 to 6

Ridgid Tubing Cutters

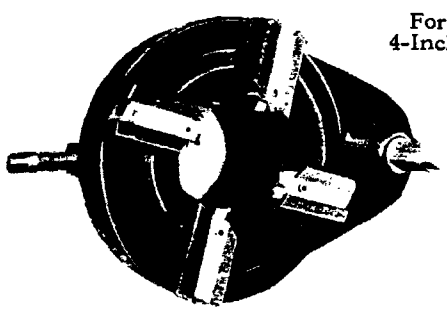


Capacities, in Inches

No.	000	00	0
Tubing size	⅛ to 1	3/16 to 1⅛	½ to 2⅛

Toledo No. 40 Pipe Cutter

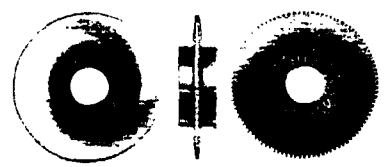
For 2 to 4-Inch Pipe



The No. 40 Pipe Cutter has the cutter knives fed automatically, cuts rapidly, gives a square-end cut, and can be converted into a power cutter.

Prices on application

Nye Cutter Wheels



These Cutter Wheels are alloy steel with knurled or smooth edge. Specify type when ordering.

Make of Cutters Wheels Will Fit

Wheel No.	Type	Cutter Size Number
1 & 2-R	Ridgid	No. 1 or No. 2
	Nye	No. 2N
	Oster	[1]No. 502 Power Machine
3 & 4-R	Ridgid	[1]No. 3 or No. 4
1 & 2-T	Trimo	No. 1 or No. 2
	Nye	Nos. 1T or 2T (Former Nos. 1A, 2A)
	Reed	Nos. 1R or 2R, Roller Block only
	Beaver	No. 102, Models A or B Machines
3-T	Trimo	No. 3
	Nye	No. 3T (Former No. 3A)
	Reed	No. 3R Roller Block only
4-T	Trimo	No. 4
	Beaver	No. 204
1-U	Universal	Nye No. 1
2-U	Universal	Nye No. 2
4-U	Universal	Nye No. 4
1-B[2]	Barnes	No. 1, all makes
	Reed	No. 1W, hook end only on No. 1R
2-B[2]	Barnes	No. 2, all makes
	Reed	Nos. 2W, 2F, hook end only on No. 2R
3-B[2]	Barnes	No. 3, all makes
	Reed	No. 3W, hook end only on No. 3R
4-B	Barnes	No. 4, all makes
5-7B	Barnes	Nos. 5, 6, 6½, or 7, all makes
1-S	Saunders	[3]No. 1, all makes
2-S	Saunders	[3]No. 2, all makes
3 & 4-S	Saunders	[3]Nos. 3 or 4, all makes
5-S	Saunders	[3]No. 5, all makes
N10CW	Nye	[3]No. 10 Tube Cutter
N20CW	Nye	[3]Nos. 20 or 30 Tube Cutters

[1]Heavy duty wheels are available at extra cost; specify when ordering. [2]When ordering pins for Reed cutters, add "H" to number. [3]For pins, specify whether for wheel or roller.

Pipe Taps and Reamers

Nye Taper Pipe Taps

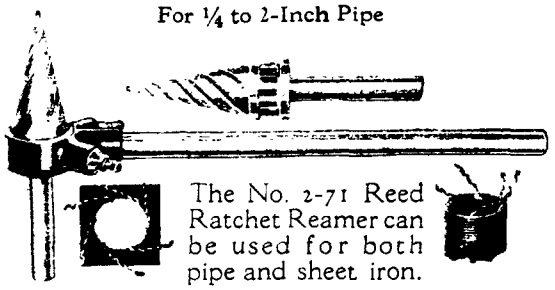
For ⅛ to 2-Inch Pipe



Nye Taper Pipe Taps are made of carbon steel for pipe sizes ⅛ to 2 inches.

Reed Self-Feeding Ratchet Reamer

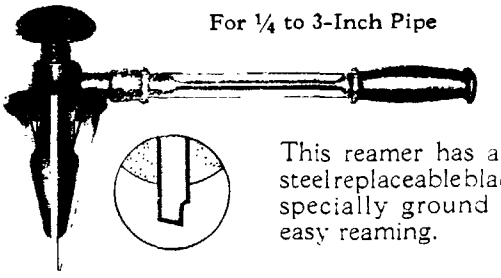
For ¼ to 2-Inch Pipe



The No. 2-71 Reed Ratchet Reamer can be used for both pipe and sheet iron.

Nye Ratchet Reamer

For ¼ to 3-Inch Pipe



This reamer has alloy steel replaceable blades, specially ground for easy reaming.

Nye Bit Brace Reamers

Spiral Flute

Made with taper shank to fit any standard bit brace.



No.		42	42½	44
For pipe sizes	Inches	⅛ to 1	⅛ to 1¼	¼ to 2

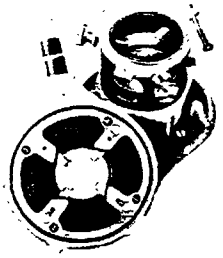
Ridgid Threading Devices



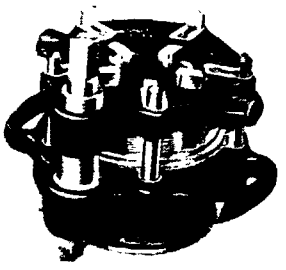
Nos. 65 and 85 Series Chaser Dies

These Chaser Dies are made of high speed steel.

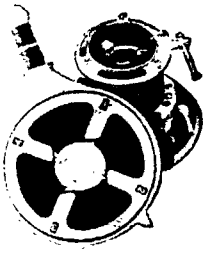
Chaser Dies (Nos. 1 and 1-R Series) are available for any Ridgid Poster Threaders.



No. 1 R-C
Poster Threader
For 1, 1¼, 1½, and 2-Inch Pipe



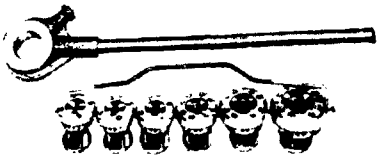
No. 4-P
Ratchet Threader
For 2½ to 4-Inch Pipe



No. 65 R-C
Ratchet Threader
For 1, 1¼, 1½, and 2-Inch Pipe

Beaver Threading Devices

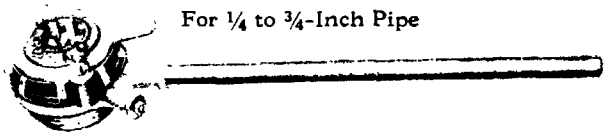
No. 3 Ratchet Pipe and Bolt Threader



For ⅛ to 1-inch pipe, with fully enclosed ratchet. Dies can be inverted for close work.

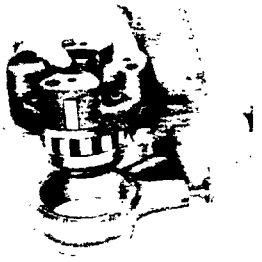
No. 6-R Beaverette Ratchet Threader

For ¼ to ¾-Inch Pipe



The No. 6-R Threader consists of two sets of dies (¼, ⅜-inch and ½, ¾-inch) in tool, being moved in and out of working position by a simple cam arrangement. The ⅛-inch die is extra.

This threader is furnished with a smooth working chuck, right or left dies, and will cut standard, oversize, or undersize threads.



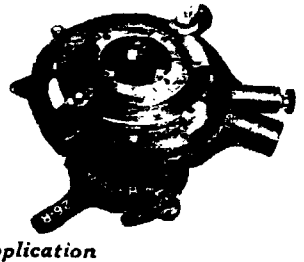
No. 17 Ratchet Pipe Threader

For ⅛ to 2-Inch Pipe

This threader has square removable die segments which can be resharpened. Non-adjustable.

No. 26-R Adjustable Ratchet Threader

For 1 to 2-Inch Pipe



The No. 26-R Threader is fully adjustable and has the ratchet drive ring located in the head, providing straight line pull.

This threader is self-contained and well balanced.

Prices on application

38

Nye Threading Devices

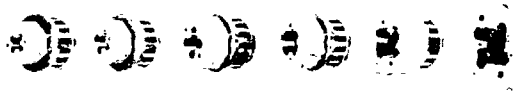
No. 50 Triad Ratchet Stock





Die sizes: ⅛, ¼, ⅜, ½, and ¾-inch

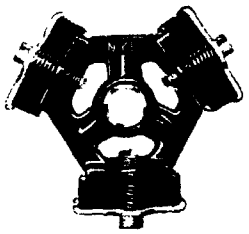
No. 60 Triad Ratchet Stock





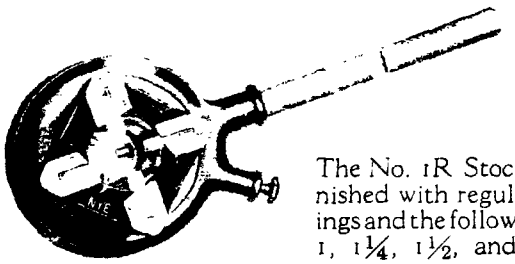
Die sizes: ⅛, ¼, ⅜, ½, ¾, 1, and 1¼-inch

Triplex Solid Die Stock



This stock is a one-piece combination stock with three dies and permanently fixed steel guides. To thread short nipples, the dies can be reversed and a nipple bushing or guide inserted between die and tap plate. Furnished in two combinations. ⅜ to ¾-inch and ½ to 1-inch.

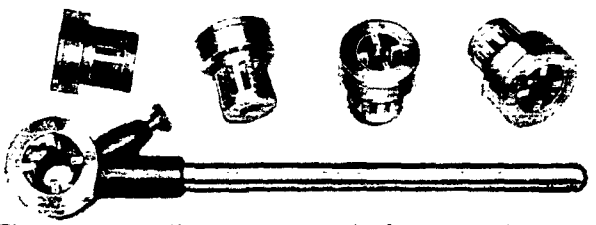
No. 1R Ratchet Stock



The No. 1R Stock is furnished with regular bushings and the following dies: 1, 1¼, 1½, and 2-inch.

Toledo Threading Devices

Ratchet Threaders



These are small, compact tools for general use or where space is restricted. A separate die head and set of dies are furnished for each pipe size.

No. 00: Capacity, ⅛ to ¾-inch pipe.

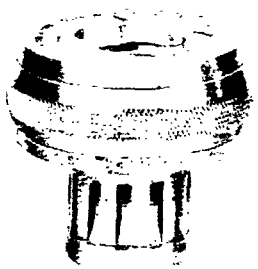
No. 11: Capacity, ⅛ to 1¼-inch pipe.

No. 12: Capacity, ⅛ to 2-inch pipe.

Adjustable Die Heads
For Bolts and Pipe

38

These adjustable die heads may be used in the No. 00 ratchet handle die stock. They have standard bolt threads with an over or under adjustment of 1/64-inch. The die heads have ample chip clearance.



No. 101R: Capacity, ¼ to ⅝-inch bolts.

No. 102R: Capacity, ¾ ⅞, and 1-inch bolts.

Adjustable Bolt Stocks and Dies



Segmental dies move in and out by a turn of the knurled sizing ring, allowing quick setting for deep, shallow, or standard threads. Each die takes a proportional share of the work; may be reground.

No. 101: Available as a single unit consisting of a stock, one size die, and guide, or as a set consisting of seven full-mounted stocks and dies (¼, 5/16, ⅜, 7/16, ½, 9/16 and ⅝-inch) in a metal box.

No. 102: Similar to the No. 101 except it is larger (¾, ⅞, and 1-inch). Can be furnished either full mounted for instant use or with one stock and necessary dies and guides in sizes desired.

Three-Way Threaders



Toledo Three-Way Threaders are small and compact, with dies that can be reground when dull.

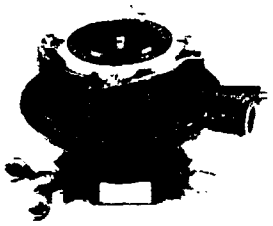
No. 30: This threader is used on ⅜ to ¾-inch pipe

No. 31: This threader is used on ½ to 1-inch pipe

Prices on application

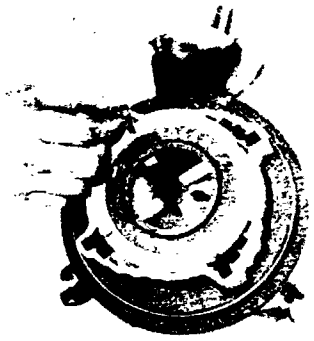
Toledo Threading Devices

Simpact Threaders
For 1 to 2-Inch Pipe



Simpact
Ratchet Threader

The Simpact Threader is a compact all-in-one tool. This self-contained threading tool is operated with ease. One set of Simpact Dies threads all sizes, 1 to 2 inches.



Dies changed easily, quickly. Just push in the dies and then slip them in the proper steps.

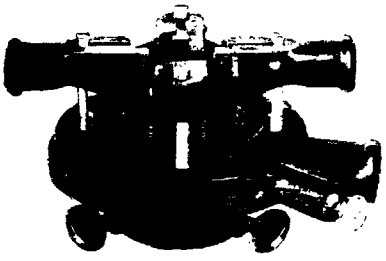


Oil collects in the pockets and drips on the dies as the tool revolves. No waste.

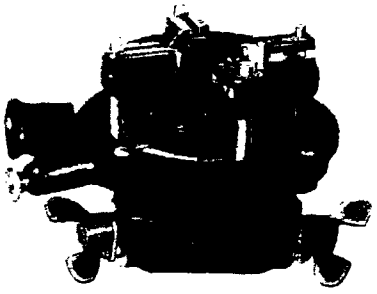
The high speed dies cut quickly on all sizes, can be reground when dull, and are changed instantly.

The Toledo Simpact Threader is adjustable for over, under, or standard size pipe threads.

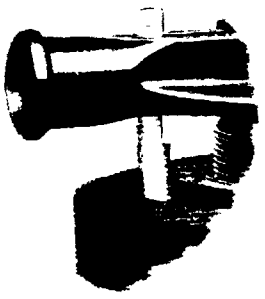
Adjustable Threaders
For 1 to 2-Inch Pipe



No. 1 A Ratchet Tool
(No. 1 same except no ratchet)



No. 1 BR Ratchet Tool
With 3-Jaw Pipe Holder and Bushings



Toledo Taper-Pin principle assures smooth, perfectly tapered threads.

These tools use a separate set of dies for each size pipe, and the Toledo taper pin principle of operation. Adjustments are made easily and quickly.

Dies cut with extreme ease and always assure smooth, perfectly tapered threads.

Both the No. 1 A and No. 1 use bushings to center the tools on the pipe.

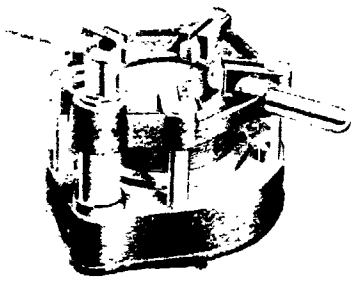
No. 1 A: This tool is equipped with ratchet and may be used with two handles or with a ratchet.

No. 1: This tool is the same as No. 1 A except that it does not have a ratchet and uses two handles.

No. 1 BR: The No. 1 BR is a ratchet tool only and uses three broad-face chuck jaws and graduated guide posts to center the tool.

38

Geared Adjustable Threaders
For 2½ to 4-Inch Pipe



These Geared Adjustable Threaders are sturdy and strong, yet easily handled by one man, to provide smooth, perfectly tapered threads.

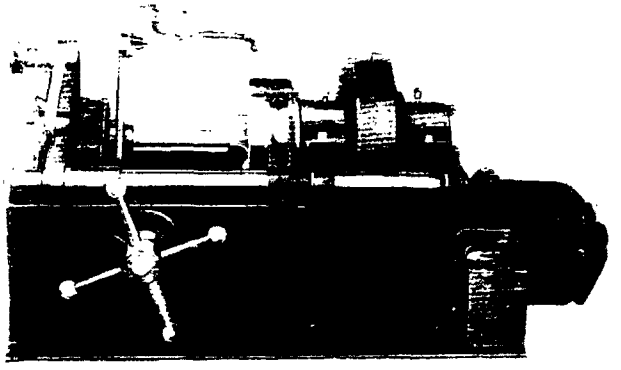
These tools can be converted into power threaders with installation of a Toledo Power Drive.

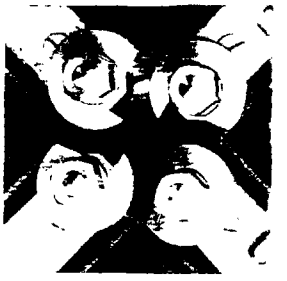
No. 2: The No. 2 Threader uses bushings to center the pipe and threads 2½ to 4-inch pipe.

No. 2 BR: This threader is of the same design as No. 2 except that it has three broad face chuck jaws and graduated guide parts in place of bushings. Both the No. 2 and No. 2 BR use a separate set of dies for each size pipe.

Prices on application

Toledo Power Pipe Machines





Four cutting knives all cut simultaneously, smoothly, quickly.



Quick acting, all steel, hinged type die heads.

No. 999 Super Model: This machine cuts, threads, and reams pipe from ½ to 2-inch, and threads ⅜ to 1½-inch bolts.

The die heads are quick-opening hinged type.

The motor automatically adjusts its speed to the load and is reversible. All the controls are in the forward and reversing switch.

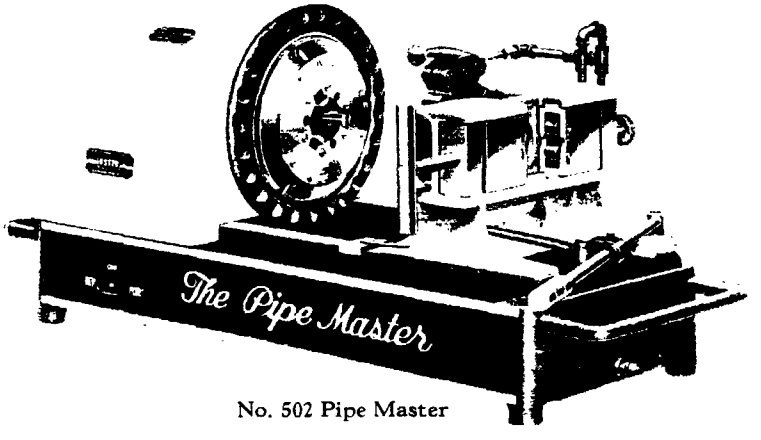
No. 999 Standard Model: The Standard Model is the same as the Super Model except that it has non-opening die heads.

Used for cutting, threading, and reaming ½ to 2-inch pipe, and for threading ⅜ to 1½-inch bolts.



Prices on application

Oster Portable Power Pipe Machine



No. 502 Pipe Master

The Oster No. 502 Pipe Master can be easily and quickly handled by two men.

This machine will handle a regular range of ¼ to 2-inch pipe and an extra range of ⅛-inch pipe. Its range with drive shaft accommodates 2½ to 6-inch pipe. Bolt range is ¼ to 1½-inch.

Equipment consists of a reversible motor with variable speed; quick-opening adjustable die head or solid die adaptor; die set ¼ to 2 inches; pipe reamer; pipe cutter; front chuck-universal, gripping (no chuck wrench needed); rear chuck-universal, centering; oil pump; thread length gauge; 10 feet of 14 gauge cable; and 5 gallons of oil.

Oster Power Vise Stand

38

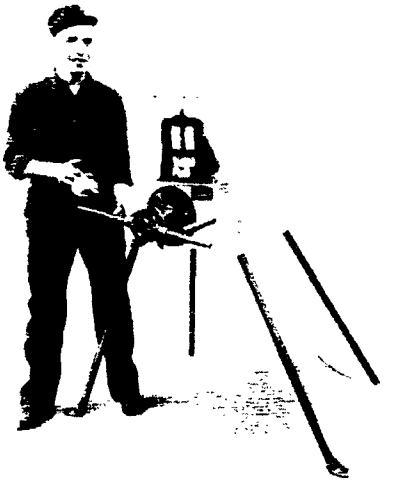
The Oster No. 422 Power Vise Stand will thread ⅛ to 2-inch pipe. Drive shaft permits additional handling capacity of from 2½ to 6-inch pipe.

Construction is rugged, yet light weight for easy portability. Motor gears are ball bearing mounted. Spindle gear is made of hardened steel, and the spindle of semi-steel. The case is all-welded with two convenient carrying arms.

Universal motor is ½-h.p., reversible, with variable speed. Two chucks, one front and one rear, are furnished for positive gripping and centering.

Regular equipment includes motor; gripping chuck; centering chuck; two carrying arms; feet for front legs; pipe bending fixture; and universal vise mount plate.

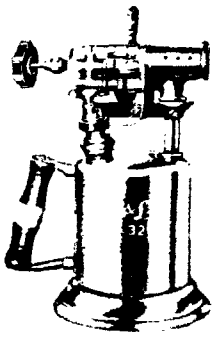
Prices on application



Clayton & Lambert Torches and Fire Pots

For Gasoline and Kerosene

No. 32 A Mechanic's Standard Torch



This torch gives dependable service indoors or outdoors. The burner is protected by a full skirted wind-shield, and generates a large steady blue flame, 7 inches long, which can be reduced for light work.

A blunt control needle makes it impossible to enlarge the gas orifice. The No. 32 A has a removable jet block and replaceable cleaner tip. The tank is heavy gauge polished brass with concave bottom which acts as a funnel in filling. Capacity, 1 quart. Will burn kerosene if jet block and cleaner pin are changed.

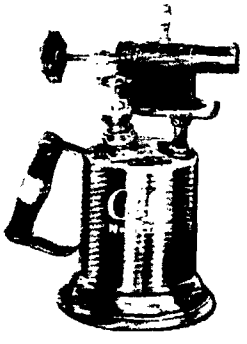
No. 327 Heavy Duty Torch



The No. 327 Torch is used for extra heavy work under the most severe weather conditions. It is designed for soldering fittings on copper water and drain pipe, sizes 1 to 6 inches. The powerful burner produces a strong blue blast over 10 inches long of great heat intensity. The flame can be regulated for ordinary work.

The tank is made of heavy gauge polished brass with a bottom filler plug. An automatic pump produces ample air pressure. Capacity, 1 quart. Will burn kerosene if jet block and cleaner pin are changed.

No. 158 A Torch



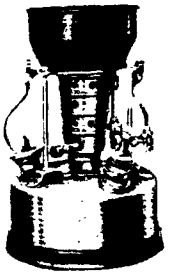
For Gasoline Only

The bronze burner of the No. 158 A is made with a backflow super-heating vein which generates an intense blue flame, 6½ inches long. Fitted with a windshield.

The tank is made of heavy gauge polished brass and has a concave bottom which acts as a funnel when filling.

Equipped with a quick acting automatic pump. Capacity, 1 quart.

No. 44 A Coiltral Fire Pot



The No. 44 A Fire Pot is easy to start and simple to operate.

The detachable coil unit has a flame control device which allows the powerful flame to be varied in size and volume.

A pot of metal can be rapidly melted and then, by adjusting the flame control valve, be held at the desired temperature.

This fire pot is designed to handle a full 6-inch metal pot. Capacity, 1 gallon. The No. 44-A can be used to burn kerosene if the burner jet is changed.

Prices on application; if No. 32A, 327, or 44A are wanted for kerosene, orders should specify.

Century Gas Guns

No. 8200A is furnished with ⅛-inch combustion tube and nozzle, and all parts illustrated.

No. 8200B is furnished with 3/16-inch combustion tube and nozzle, and all parts illustrated.

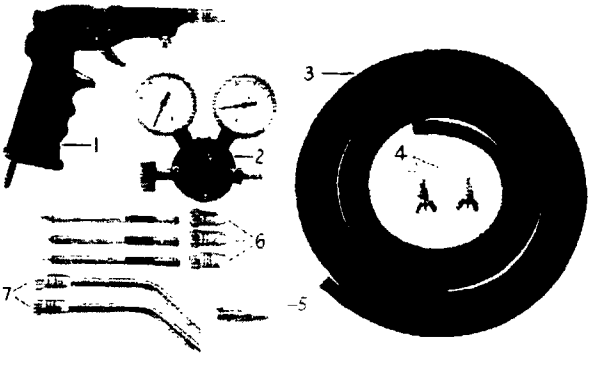
No. 8200C is furnished with ¼-inch combustion tube and nozzle, and all parts illustrated.

The Century Regulator has the approval of the Board of Fire Underwriters.

The Century Gas Gun is an automatic acetylene torch widely used by plumbers for sweating in of copper fittings, brazing of elbows, thawing of frozen pipes, pre-heating of metal fittings, lead burning, and general soldering.

The automatic lighting feature of the Gas Gun operates on the same principle as a cigarette lighter. When the trigger is pulled, the gas ignites. When the trigger is released, the flame goes out. A trigger lock is provided in case a continuous flame is desired.

The temperature of the flame is adjusted by the knob on the regulator, and the size of the flame is governed by combustion tubes and nozzles in ⅛, 3/16 and ¼-inch sizes. Tubes and nozzles are easily interchanged. Temperature range is from 1000° to 2680° F.



1. Gas Gun. 2. Gas Gun Regulator with Gauge and Tank Coupling. 3. 10-Foot Heavy Duty Hose. 4. Two Hose Clamps. 5. Industrial Type Flints (100). 6. Combustion Tubes and Nozzles. 7. Extension Tips (45° Angle—3/16 and ¼-Inch Diameter).

Prices on application

Stuart's Thred-Kut Oil



Highly recommended for thread cutting because it makes dies last longer.

Also:

Stuart's Plumbers' Lard Oil Compound
Stuart's Extra Winter Strain Lard Oil Compound

Available in cans, pails, and drums.

Mortell NoDrip Plastic Cork Coating



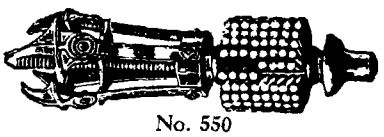
Mortell NoDrip is an easy-flowing plastic cork coating that can be applied by brush, trowel, or spray to any clean, painted or unpainted surface to prevent condensation dripping and corrosion. May be used on any metal, concrete, brick, wood, plaster or composition surface.

Mortell NoDrip Primer is required only when metal is severely rusted or pitted or on concrete, masonry, wood, or absorbent material, to stop suction and eliminate drying too rapidly.

NoDrip Coating is widely used in industrial plants, warehouses, stores, and railroads wherever condensation drip may cause damage to equipment or materials. It eliminates sweating on industrial equipment, blower pipes, air conditioning ducts, cyclones, as well as pipes and tanks. It has sound deadening characteristics which aid in eliminating noise, caused by vibration of metal on blower ducts, air conditioning ducts, etc.

Available in 1, 5, and 55-gallon containers.

Pilley Flue Brushes and Scrapers



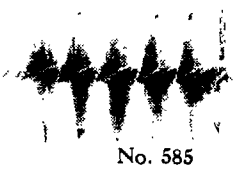
No. 550

No. 550 has adjustable claws and brush for use on 2 to 6-inch flues.



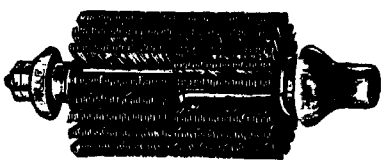
No. 570

No. 570 is made with malleable iron claws mounted on spring steel arms. The adjustable scraper cleans the entire flue. Made for 2, 2½, 3, 3½ and 4-inch flues.



No. 585

No. 585 is made of flat steel wire, single spiral. This brush will fit all sizes of flues from 1 to 6 inches.



No. 555

No. 555 Brush is used to remove hard deposits. It is made of flat steel wire for 1½ to 9-inch flues.



No. 589

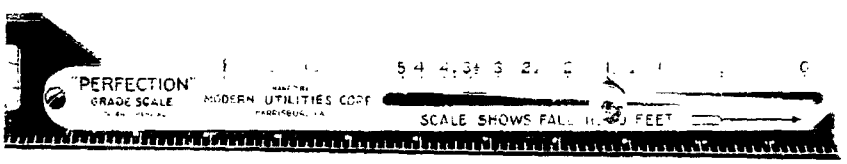
No. 589 is made of round steel wire, single spiral. This brush will fit all sizes of flues from 1 to 6 inches.



No. 590

No. 590 is made of round steel wire, double spiral. This brush will fit all sizes of flues from 1 to 6 inches.

Modern Perfection Grade Scales



The Perfection Grade Scale is designed for all craftsmen and classes of skilled mechanics who erect or construct work to a grade, pitch, or fall. It eliminates guess-work in piping to assure accurate grading of mains, branches, run-outs, and laterals of variable degrees of pitch.

Sliding and moving parts are protected from dust, dirt, grease, tallow drippings, dope, red-lead, etc.

This grade scale is well-made, accurate, rust-proof and convenient to handle. The two clear-glass spirit vials have a full 1-inch long three-way vision for easy reading.

Brass snap-on clip guards are furnished to protect either glass not in use. The letters and figures are recessed and painted with durable yellow enamel for easy reading. The scale bar is nickel-plated.

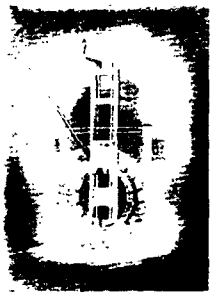
Prices on application

Dexter Valve Reseating Equipment

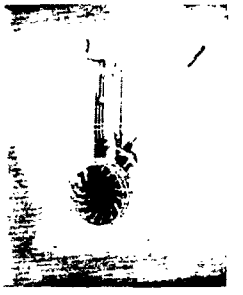
For Gate Valves



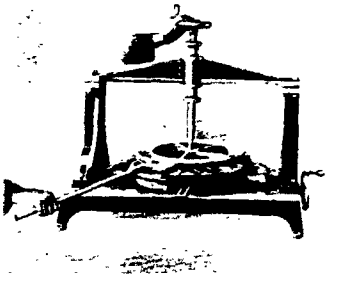
Simple operation of reseating machine refacing valve seat.



Phantom view of reseating machine showing cutter support.



Phantom view of gate valve reseating machine showing cutter.



Gate valve disc being refaced in the Dexter Gate Valve Disc cutting Machine.

Dexter Valve Reseating equipment reseats valves right on the line in a few minutes, ending expensive leakage at extremely low cost. They are easily operated, reliable, efficient, and durable.

Equipment includes cutter supports, disc cutting machines for refacing discs, risers, wrenches, and screw drivers. Rotary cutters are furnished with cutter blades, to meet individual requirements.

Sets and Capacities

No.		2-3-C	2-4-C	2-6-C	2-8-C	2-10-C	2-12-C	2-14-C	2-16-C
For Valve Sizes	Inches	1½-3	1½-4	1½-6	1½-8	1½-10	1½-12	1½-14	1½-16

For Globe Valves

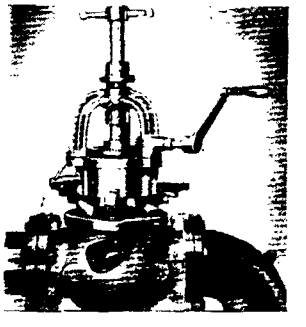
Dexter Globe Valve Reseating Equipment is designed especially for this type of valve, and includes improved valve reseating machines, a patent valve disc cutting machine, a disc holding chuck, an extension spindle, and other necessary equipment.

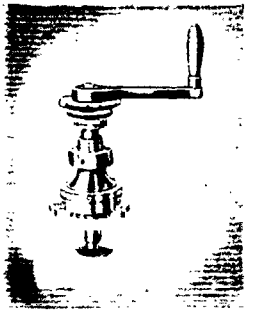
Dexter Cutters in flat, 45°, 55°, and 75° angles are available in two materials: carbon tool steel cutters for low pressure valves, and Universal cutters for all types of valves, including high pressure valves with seats of the toughest metals.

The choice of type and angle of cutters is optional, dependent on individual requirements. Globe equipment can be furnished in variable valve range capacities.

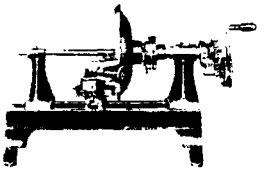
Sets and Capacities

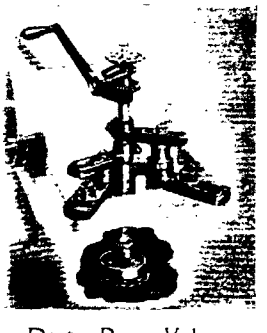
No.		4-04D	7-04D	12-04D
For Valve Sizes	Inches	¼-4	¼-7	¼-12





Top left: Reseating machine, **No. 12MO**, in operating position.
Top right: Reseating machine, **No. 4MO**, in operating position.
Lower right: Lathe Disc Cutting Machine, **No. 7LDC.**





Dexter Pump Valve Reseating Outfit **No. DPC7½**

For Pump Valves

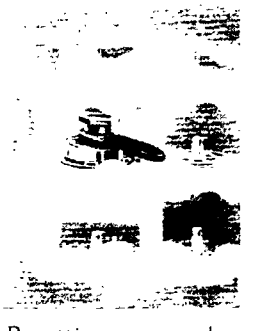
When pumps become defective and inefficient due to worn or badly scored valve seats, Dexter Pump Valve Reseating equipment will reseat them with little expense or trouble.

Equipment for Pump Valve Reseating consists of reseating machine, brackets, ratchet wrench, and pump valve cutters.

Types and capacities: The No. DPC7½ consists of improved No. D60 Pump Machine and a complete set of pump cutters, 2, 2½, 3, 3½, 4, 4½, 5, 5½, 6, 6½, 7 and 7½-inch.

Available in any cutter range to meet requirements.

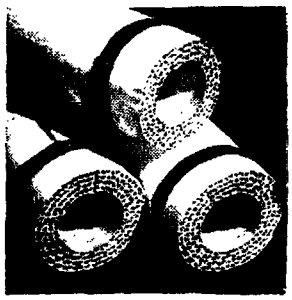
Prices on application



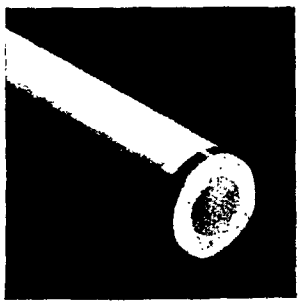
Recutting pump valve seats in water chest, using ratchet handle.

38

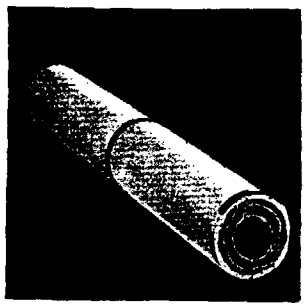
Johns-Manville Insulating Materials



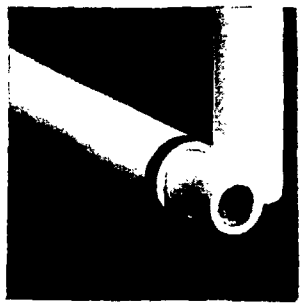
Asbestocel
For Temperatures
Up to 300° F.



85% Magnesia
For Temperatures
Up to 600° F.



Wool Felt
For Hot and Cold Water
Service Lines



Zero
To Prevent Cold Water
Pipes from Freezing

Pre-Shrunk Asbestocel

Johns-Manville Pre-Shrunk Asbestocel is a cellular type of insulation, made of alternate layers of plain and corrugated asbestos felts. Used on pipe lines carrying low pressure steam and hot water.

This material affords positive assurance against shrinkage troubles. It will not absorb moisture while in stock or during handling and consequently expand. Pre-Shrunk Asbestocel is made of specially-treated, moisture-resistant asbestos paper which prevents "breathing" and thus removes the cause of objectionable shrinkage cracks. It is also fabricated with an improved type of corrugation which affords greater strength and a more uniform appearance.

It is furnished to fit standard pipe sizes, in 3-foot long sections in standard thicknesses of 2 to 8 plies, each ply approximately ¼-inch thick. Greater thicknesses can be furnished on order. Available in three finishes: regular canvas-covered, asbestos-covered high-speed finish, and aluminum high-speed finish.

Zero Pipe Insulation

Zero Pipe Insulation is designed for insulating cold water pipes that are exposed to moderate (ordinary) rather than extremely low temperatures, or where the time that the surrounding atmosphere would be below the freezing point is of short duration.

It is constructed of layers of hair felt surrounded by several layers of wool felt, with a layer of saturated wool felt inside the hair felt to keep the hair from direct contact with the pipe. Hair felt greatly retards the flow of heat from the water in the pipe to the colder surrounding air and is protected by a wool felt jacket and an inner layer of saturated felt.

For extremely low temperatures or for temperatures below the freezing point that are of long duration, built-up hair felt is recommended. It is applied in various thicknesses depending upon the temperature.

Zero Pipe Insulation is furnished in 3-foot lengths, split for ready application, covered with canvas and equipped with brass lacquered bands. Made for all pipe sizes from ½-inch up, and in one thickness, approximately 1¼ inches.

85% Magnesia

Johns-Manville 85% Magnesia insulation combines the high insulating qualities of basic carbonate of magnesia and asbestos, affording a light weight and efficient insulation. It contains a maximum number of dead-air cells which increases its natural resistance to heat transmission and reduces its weight.

Johns-Manville 85% Magnesia Pipe Insulation is moulded in 3-foot lengths in standard 1½-inch, 2½-inch, Double Standard, and 3-inch thicknesses (double layer), to fit standard pipe sizes.

For smaller pipe, 85% Magnesia Pipe Insulation is furnished in sectional form, packed in crates or cartons with canvas jacket and metal bands. For larger pipe sizes it is supplied in segmental form, without canvas or bands.

Pre-Shrunk Wool Felt

Johns-Manville Pre-Shrunk Wool Felt Pipe Insulation is an effective and economical material for keeping hot water hot, for keeping cold water cold, and to prevent sweating of cold water lines.

Like Pre-Shrunk Asbestocel, Johns-Manville Pre-Shrunk Wool Felt is made of moisture-resisting felts which prevent the objectionable absorption of moisture in storage, thus minimizing drying shrinkage and pulling apart at the joints after application.

The sheets of wool felt of which this material is composed are indented, which reduces the conductivity of the finished material approximately 25 per cent as compared with ordinary wool felt. It is also 16 to 25 per cent lighter in weight.

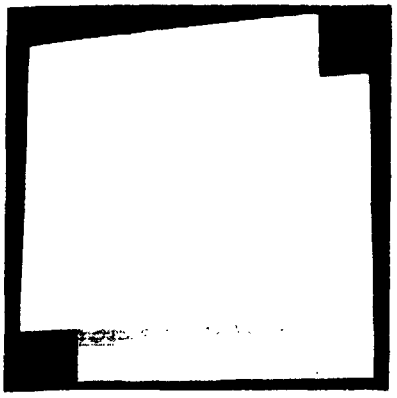
This wool felt has a dual-service, asphalt-saturated felt liner which is waterproof, making it perfectly suited to cold water lines. Since the liner will withstand temperatures as high as 225° F., the material is equally satisfactory for hot water lines.

Available in sections 3 feet long, in thicknesses of ½-inch, ¾-inch, 1-inch, double ½-inch, and double ¾-inch for pipe sizes of ½-inch and larger. It is supplied in two finishes, the regular canvas and a smooth, dull-coated aluminum

Prices on application

Johns-Manville Insulating Materials

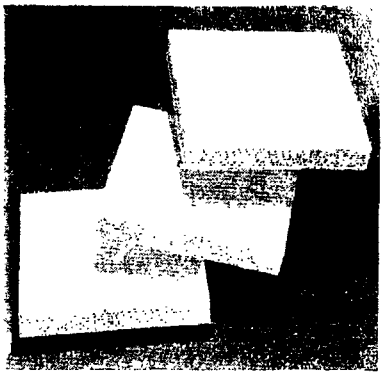
Asbestos Sheet Millboard



Asbestos Sheet Millboard is recommended for general uses requiring sheet or board for protection against fire, heat, acid fumes, etc. It is frequently used as a fireproof lining for floors, partitions, ceilings, elevator shafts, ranges, stoves, grates, etc.

Millboard can be cut with shears to any size desired and fastened with nails or screws. Standard sheet size is 42 x 48 inches. It is also furnished in cut pieces. Thickness is 1/16 to 3/4 inches.

Asbestocel Blocks



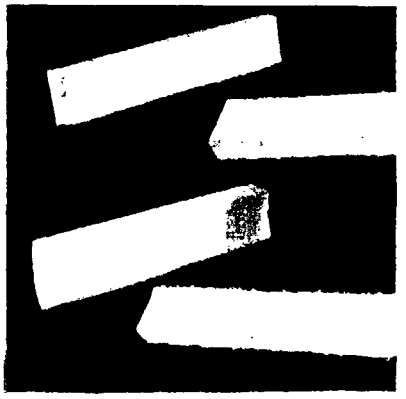
These blocks are available in sizes 6, 12, 18, or 36x36 inches.

Asbestocel Blocks weigh about 1-pound per square foot per 1-inch of thickness.

Furnished in 3/4-inch and 1-inch thicknesses. Greater thicknesses are available.

Prices and additional information on application

85% Magnesia Blocks



These blocks are used to insulate flat, curved, or irregular surfaces where temperatures do not exceed 600° F.

This material is adapted to conditions where high insulating value and light weight are needed, and where surfaces are so irregular that an easily cut insulation is required for proper fitting.

Available in standard sizes 3 x 18 inches and 6 x 36 inches. Greater thickness on application.

Johns-Manville Asbestos Cements



Johns-Manville Asbestos Cements provide excellent coverage, good finish, and insulating properties, and are used as a surface finish over black or sheet forms of insulations to seal joints between the blocks. They also provide a smooth, attractive surface to which canvas may be applied, and are used for irregular surfaces where it is impractical to apply sectional insulation, sheets, or blocks.

No. 302 produces a hard, durable surface which does not crack, break, or peel off.

No. 400 is not quite as hard as No. 302.

No. 352 is used in large quantities for insulating boilers and pipe fittings.

Temperatures and Covering Capacities

No.	Max. Temp. Degrees F.	Covering Capacity, Applied and Dried, 1-Inch Thick: Sq. Ft. per 100 Lbs.	Covering Capacity, Applied and Dried, 1-Inch Thick: Sq. Ft. per Bag	Approx. Lbs. of Water to Mix 100 Lbs. Cement	Weight Per Bag Pounds
302	1000	25	25	175	100
400	700	25	25	150	100
352	1000	19	9½ or 19	100	50 or 100
0352	1000	19	19	100	100

No. 0352 is an inexpensive asbestos cement widely used for plumbing and steamfitting purposes.

Prices on application

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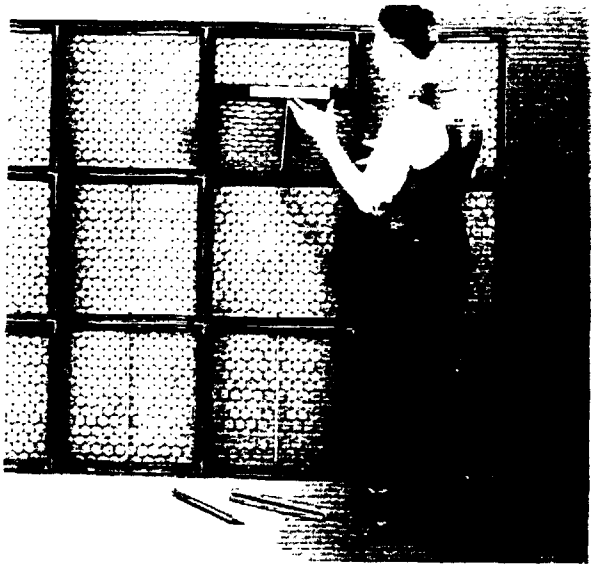
Fiberglas Dust-Stop Air Filters

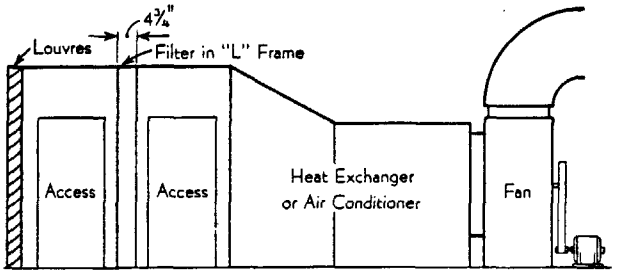
"V" and "L" Frames

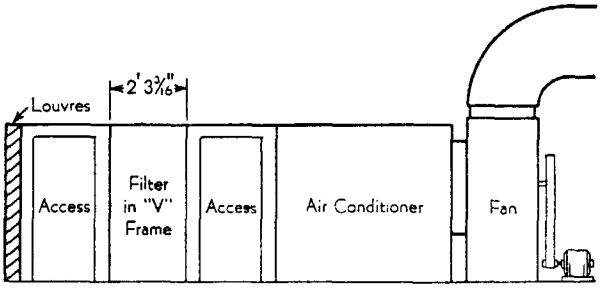


"L" Type frames take only 20"x20"x1" Dust-Stop Filters.



"V" Type frames take only 20"x25"x1" Dust-Stop Filters





Fiberglas Dust-Stop Filters are replaceable, impingement-type air filters. They provide clean air at extremely low cost.

These filters will efficiently rid circulated air of dust, dirt, lint, soot, paint spray, etc. in manufacturing and assembly plants, laboratories, paint shops, distilleries, canneries, packing and processing plants, breweries, chemical plants, public buildings, theatres, hotels, and institutions.

Dust-Stop Filters may be incorporated in self-contained units or installed in duct work or plenum chambers, depending upon the requirements. The filters are composed of numerous glass fibers coated with a viscous adhesive, to catch the dust particles as the air moves through them. This adhesive is non-evaporating and retains its viscosity over a wide range of temperatures from below zero F. to maximum temperatures encountered in normal heating and ventilating applications.

The glass fibers cannot burn; they will withstand temperatures of 1,000° F. before they begin to soften enough to weaken the resistance of the pack to the air pressure encountered in the plenum chamber.

Fiberglas Dust-Stop Filters may be installed in banks of either "L" Type or "V" Type filter frames, which are designed for convenience and correct handling of Dust-Stop filters. They are made of heavy metal.

The "L" Type frame takes less depth within the duct or plenum chamber but requires a larger face area than the "V" frame for the same Cfm. capacity.

The "V" frame is designed for use where a space measured across the area of the duct is limited. Because the "V" arrangement shortens the flat frontal face dimension, it takes up 40 per cent less frontal area than the "L" frame.

The "V" frame requires a face area approximately the same as the cross-sectional area of a duct handling the volume of air for which the filters are rated.

Space Requirements for Equal Capacities

Depth (in plan) All Frames	"L" Frames	"V" Frames
Capacity C.F.M.	Face Area Square Feet	Face Area Square Feet
4000	13.9	8.3
8000	27.8	16.6
12000	41.7	25.0
24000	83.3	50.0
36000	125.0	75.0
48000	166.6	100.0

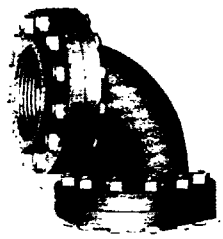
Prices on application

Drilling Templates; Thread Lubricants; Bolts; Flange Facings; Gaskets; Galvanizing

Templates for Drilling, Brass, Iron, and Steel ..... pages 438 to 443
Thread Lubricants ..... page 444
Machine Bolts ..... page 445
Triplex and Templex Steel Bolt-Studs ..... pages 446 and 447
Bolting on Companion Flanges ..... page 437
Wooden Flange Protectors ..... page 437
Special Facings for Flanges, Valves, and Fittings ..... pages 448 to 451
Gaskets for Iron, Brass, and Steel Flanged Joints ..... pages 452 to 456
Ring Gaskets for Unions ..... page 456
Sheet Packing, Cranite and C. C. Rubber ..... page 453
Galvanizing Steel Flanged Fittings and Flanges ..... page 456

Pages 437 to 456 are devoted to a variety of subjects, not wholly related, but having in common the fact that they apply to nearly all Crane products and are referred to frequently. In addition, other sections of this catalog include data on subjects of a somewhat similar nature, but more specialized or technical in character. Among these are found the following:

Normal Engagement Between Male and Female Threads ..... page 474
Threaded Pipe Joints ..... page 475
Flange Finishes ..... pages 492 and 493
Assembly and Maintenance of Flanged Joints ..... page 508
Crane Bolting, Engineering Data on ..... pages 506 and 507
Taps and Drains for Flanged Fittings ..... page 534
Taps and Drains for Flanged Valves ..... page 535
Pipe and Fabricated Piping ..... pages 457 to 504
Engineering Data ..... pages 505 to 563
Gaskets for valves, fittings, and flanges for ammonia ..... page 399



Bolting On Companion Flanges

Orders for valves, fittings, or other products with companion flanges bolted on should indicate clearly what is wanted: catalog number of flange; style of facing on flanges, if necessary, as in the case of high pressure steel material; kind of bolts or bolt-studs; and kind of gasket, if gaskets are required. An additional charge is made for the labor involved in bolting on the flanges; see the Crane Discount Sheet for prices.

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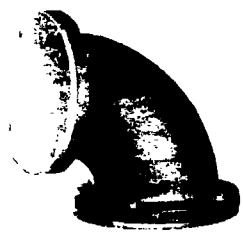
Wooden Flange Protectors

Damaged flange faces may make it difficult or impossible to make up tight joints. Wooden protectors are a worthwhile investment, offering ample protection to flange faces while in transit and prior to installation. In addition, in the case of valves, they keep out foreign matter that might otherwise injure the seating surfaces. For complete information on protectors for the ends of valves and fittings, refer to the Crane Discount Sheet.



Templates for Drilling
Brass Flanged Valves and Flanges

150-Pound MSS Standard

Size	Dimensions, in Inches						
Inches	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Diameter of Bolts	Length of Bolts	Length of Bolt-Studs with 2 Nuts
1/2	3 1/2	5/16	2 3/8	4	1/2	1 1/4	1 7/8
3/4	3 7/8	11/32	2 3/4	4	1/2	1 1/2	1 7/8
1	4 1/4	3/8	3 1/8	4	1/2	1 1/2	2
1 1/4	4 5/8	13/32	3 1/2	4	1/2	1 1/2	2
1 1/2	5	7/16	3 7/8	4	1/2	1 1/2	2 1/8
2	6	1/2	4 3/4	4	5/8	1 3/4	2 1/2
2 1/2	7	9/16	5 1/2	4	5/8	2	2 5/8
3	7 1/2	5/8	6	4	5/8	2	2 3/4
3 1/2	8 1/2	11/16	7	8	5/8	2 1/4	2 7/8
4	9	11/16	7 1/2	8	5/8	2 1/4	2 7/8
5	10	3/4	8 1/2	8	3/4	2 1/2	3 1/4
6	11	13/16	9 1/2	8	3/4	2 1/2	3 3/8
8	13 1/2	15/16	11 3/4	8	3/4	2 3/4	3 5/8
10	16	1	14 1/4	12	7/8	3 1/4	4 1/8
12	19	1 1/16	17	12	7/8	3 1/4	4 1/4

This Standard is known as MSS 150-Pound SP Bronze Flange Standard (No. SP-2-1946). It was developed and adopted as "Standard Practice" by the Manufacturers' Standardization Society of the Valve and Fittings Industry.

The flange diameter, bolt circle, and number and diameter of bolts are the same as for the Cast Iron Class 125 and 150-Pound Steel American Standards, but the thickness and facing of the flanges are different.

300-Pound MSS Standard

This Standard is known as MSS 300-Pound SP Bronze Flange Standards (No. SP-2-1946). It was developed and adopted as "Standard Practice" by the Manufacturers' Standardization Society of the Valve and Fittings Industry.

The flange diameter, bolt circle, and number and diameter of bolts are the same as for the Class 250 Cast Iron and 300-Pound Steel American Standards, but the thickness and facing of the flanges are different.

Size	Dimensions, in Inches						
Inches	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Diameter of Bolts	Length of Bolts	Length of Bolt-Studs with 2 Nuts
1/2	3 3/4	1/2	2 5/8	4	1/2	1 3/4	2 1/4
3/4	4 5/8	17/32	3 1/4	4	5/8	2	2 1/2
1	4 7/8	19/32	3 1/2	4	5/8	2	2 5/8
1 1/4	5 1/4	5/8	3 7/8	4	5/8	2	2 3/4
1 1/2	6 1/8	11/16	4 1/2	4	3/4	2 1/4	3 1/8
2	6 1/2	3/4	5	8	5/8	2 1/4	3
2 1/2	7 1/2	13/16	5 7/8	8	3/4	2 1/2	3 3/8
3	8 1/4	29/32	6 5/8	8	3/4	2 3/4	3 1/2
3 1/2	9	31/32	7 1/4	8	3/4	3	3 5/8
4	10	1 1/16	7 7/8	8	3/4	3	3 7/8
5	11	1 1/8	9 1/4	8	3/4	3 1/4	4
6	12 1/2	1 3/16	10 5/8	12	3/4	3 1/4	4 1/8
8	15	1 3/8	13	12	7/8	3 3/4	4 3/4

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Facing: All 150 and 300-Pound flange faces are plain faced, with two V-shaped concentric grooves between the port and the bolt holes.

Bolt holes: Bolt holes are drilled 1/8-inch larger than the diameter of the bolt.

The bolt holes are in multiples of four, so that valves or fittings can be turned to face in any quarter when being installed. They are drilled to straddle the center line unless otherwise ordered

Spot facing: Bolt holes in Crane Brass Flanged Valves and Flanges are not regularly spot faced.

Gaskets: Full face gaskets should be used. For list prices of gaskets, see page 452.

When brass flanged material is bolted to iron or steel flanges that normally have a raised face, the raised face should be removed to provide a full face bearing for the gasket. Brass flanged material should not be bolted to Cranelap Flanged Pipe Joints.

Templates for Drilling
25-Pound and 125-Pound Cast Iron

Dimensions, in Inches

Size	25-Pound Cast Iron							125-Pound Cast Iron						
	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Diameter of Bolts	Length of Bolts A	Length of Bolts B	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Diameter of Bolts	Length of Bolts	Length of Bolt-Studs with 2 Nuts
1								4¼	7/16	3⅛	4	½	1¾	
1¼								4⅝	½	3½	4	½	2	
1½								5	9/16	3⅞	4	½	2	
2	6	½	4¾	4	⅝	1¾	2	6	⅝	4¾	4	⅝	2¼	
2½	7	9/16	5½	4	⅝	2	2	7	11/16	5½	4	⅝	2½	
3	7½	⅝	6	4	⅝	2	2¼	7½	¾	6	4	⅝	2½	
3½	8½	11/16	7	8	⅝	2¼	2¼	8½	13/16	7	8	⅝	2¾	
4	9	¾	7½	8	⅝	2¼	2½	9	15/16	7½	8	⅝	3	
5	10	¾	8½	8	⅝	2¼	2½	10	15/16	8½	8	¾	3	
6	11	¾	9½	8	⅝	2¼	2½	11	1	9½	8	¾	3¼	
8	13½	¾	11¾	8	⅝	2¼	2¾	13½	1⅛	11¾	8	¾	3½	
10	16	⅞	14¼	12	⅝	2½	3	16	13/16	14¼	12	⅞	3¾	
12	19	1	17	12	⅝	2¾	3	19	1¼	17	12	⅞	3¾	
14	21	1⅛	18¾	12	¾	3¼	3½	21	1⅜	18¾	12	1	4¼	
16	23½	1⅛	21¼	16	¾	3¼	3½	23½	17/16	21¼	16	1	4½	
18	25	1¼	22¾	16	¾	3½	3¾	25	19/16	22¾	16	1⅛	4¾	
20	27½	1¼	25	20	¾	3½	4	27½	111/16	25	20	1⅛	5	
24	32	1⅜	29½	20	¾	3¾	4¼	32	1⅞	29½	20	1¼	5½	
30	38¾	1½	36	28	⅞	4¼		38¾	2⅛	36	28	1¼	6¼	
36	46	1⅝	42¾	32	⅞	5		46	2⅜	42¾	32	1½	7	
42	53	1¾	49½	36	1	5¼		53	2⅝	49½	36	1½	7½	
48	59½	2	56	44	1	5½		59½	2¾	56	44	1½	7¾	
54	66¼	2¼	62¾	44	1	5¾		66¼	3	62¾	44	1¾		10½
60	73	2¼	69¼	52	1⅛	6		73	3⅛	69¼	52	1¾		10¾
72	86½	2½	82½	60	1⅛	6¼		86½	3½	82½	60	1¾		11½
84	99¾	2¾	95½	64	1¼	7¼		99¾	3⅞	95½	64	2		12¾
96	113¼	3	108½	68	1¼	7¾		113¼	4¼	108½	68	2¼		14

Length of Bolts

A — Valve to valve.

B — { Valve to screwed companion flange, or
Valve to special 125-pound fitting with 25-pound drilling.

25-Pound Cast Iron: In sizes 4-inch and larger, the 25-Pound templates for drilling conform to the American Tentative Standard for Cast Iron Pipe Flanges and Flanged Fittings for 25 pounds steam working pressure (B16b2-1931). In sizes 3½-inch and smaller, they are Crane Standard, proportioned from the American Tentative Standard.

125-Pound Cast Iron: The 125-Pound templates for drilling conform to the American Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 125 (B16.1-1948).

Facing: 25-Pound Flanges and 125-Pound Flanges are plain faced, with a smooth finish.

Bolt holes: For bolts smaller than 1¾-inch diameter, bolt holes are drilled ⅛-inch larger than the diameter of the bolt. For bolts 1¾-inch diameter and larger, bolt holes are drilled ¼-inch larger than the diameter of the bolt.

Drilling templates are in multiples of four, so that valves or fittings may be turned to face in any quarter when being installed. Bolt holes straddle the center line unless otherwise ordered.

Spot facing: Bolt holes are not spot faced except on 125-Pound Cast Iron Flanged Fittings sizes 18 to 24-inch inclusive, unless so ordered. An extra charge is made for spot facing.

Templates for Drilling

250-Pound and 800-Pound Hydraulic Cast Iron

Dimensions, in Inches

Size	250-Pound Cast Iron							800-Pound Hydraulic Cast Iron						
	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Diameter of Bolts	Length of Bolts A	Length of Bolt-Studs with 2 Nuts A	Diameter of Flange	Thickness of Flange	Diameter of Bolt Circle	Number of Bolts	Diameter of Bolts	Length of Bolts B	Length of Bolts C
1	4 7/8	11/16	3 1/2	4	5/8	2 1/2								
1 1/4	5 1/4	3/4	3 7/8	4	5/8	2 1/2								
1 1/2	6 1/8	13/16	4 1/2	4	3/4	2 3/4								
2	6 1/2	7/8	5	8	5/8	2 3/4								
2 1/2	7 1/2	1	5 7/8	8	3/4	3 1/4								
3	8 1/4	1 1/8	6 5/8	8	3/4	3 1/2								
3 1/2	9	13/16	7 1/4	8	3/4	3 1/2								
4	10	1 1/4	7 7/8	8	3/4	3 3/4								
5	11	1 3/8	9 1/4	8	3/4	4								
6	12 1/2	17/16	10 5/8	12	3/4	4								
8	15	1 5/8	13	12	7/8	4 1/2								
10	17 1/2	1 7/8	15 1/4	16	1	5 1/4								
12	20 1/2	2	17 3/4	16	1 1/8	5 1/2								
14	23	2 1/8	20 1/4	20	1 1/8	6								
16	25 1/2	2 1/4	22 1/2	20	1 1/4	6 1/4								
18	28	2 3/8	24 3/4	24	1 1/4	6 1/2								
20	30 1/2	2 1/2	27	24	1 1/4	6 3/4								
24	36	2 3/4	32	24	1 1/2	7 3/4	9 1/2							
30	43	3	39 1/4	28	1 3/4	8 1/2	10 1/2							
36	50	3 3/8	46	32	2	9 1/2	11 3/4							
42	57	3 11/16	52 3/4	36	2	10 1/4	12 1/2							
48	65	4	60 3/4	40	2	10 3/4	13							

For sizes smaller than 2-inch, use 600-Pound Steel material.

6 1/2	1 1/4	5	8	5/8	3 3/4	3 1/2
7 1/2	1 3/8	5 7/8	8	3/4	4 1/4	4
8 1/4	1 1/2	6 5/8	8	3/4	4 1/2	4 1/4
9	1 5/8	7 1/4	8	7/8	5	4 3/4
10 3/4	1 7/8	8 1/2	8	7/8	5 1/2	5 1/4
13	2 1/8	10 1/2	8	1	6	5 3/4
14	2 1/4	11 1/2	12	1	6 1/4	6
16 1/2	2 1/2	-13 3/4	12	1 1/8	7	6 3/4
20	2 7/8	17	16	1 1/4	7 3/4	7 1/2
22	3	19 1/4	20	1 1/4	8	7 3/4

For sizes larger than 12-inch, use 600-Pound Steel material.

Length of Bolts or Bolt-Studs

A — 1/16" raised face to 1/16" raised face valve, fitting, or companion flange
B — 1/4" male to 1/4" male valve, fitting, or companion flange
C — 1/4" large male to 3/16" large female valve, fitting, or companion flange
C — 1/4" tongue to 3/16" groove valve, fitting, or companion flange

250-Pound Cast Iron Standard: The 250-Pound templates for drilling conform to the American Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 250 (B16b-1944).

These templates apply also to 500-Pound W.O.G. Ferrosteel Double Disc Gate Valves.

The flanges have a 1/16-inch raised face. The raised face is included in the flange thickness dimension.

In sizes 24-inch and smaller, these templates are the same as for the 300-Pound Steel American Standard.

800-Pound Hydraulic Cast Iron Standard: The 800-Pound Hydraulic templates for drilling conform to the American Standard for Cast Iron Pipe Flanges and Flanged Fittings for a maximum non-shock hydraulic working pressure of 800 pounds at ordinary air temperatures (B16b1-1931).

800-Pound W.O.G. Valves are regularly furnished with a 1/4-inch male (large male) face on the flanges.

The height of the male (1/4") is not included in the dimension for thickness of flange.

Except for flange thickness and length of bolts, these templates are the same as for the 600-Pound Steel American Standard.

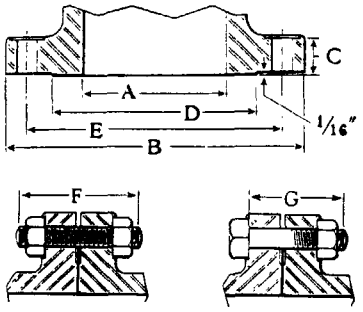
Bolt holes: For bolts smaller than 1 3/4-inch diameter, bolt holes are drilled 1/8-inch larger than the diameter of the bolt. For bolts 1 3/4-inch diameter and larger, bolt holes are drilled 1/4-inch larger than the diameter of the bolt.

Drilling templates are in multiples of four, so that valves or fittings may be turned to face in any quarter when being installed. Bolt holes straddle the center line unless otherwise ordered.

Spot facing: Bolt holes are not spot faced unless so ordered. An extra charge is made for spot facing.

Templates for Drilling

150 and 300-Pound Steel Standards



Length of Bolt-Stud — Length of Machine Bolt

1/16-inch Raised Face Joint

American Standard: The 150 and 300-Pound flange dimensions, drilling templates, and bolt-stud lengths shown in the table at the right conform, respectively, to the American Standard for 150 and 300-Pound Steel Pipe Flanges and Flanged Fittings, B16e-1939.

Facing: Unless otherwise ordered, 150 and 300-Pound Steel Flanged Valves, Fittings, and Companion Flanges are regularly furnished with a 1/16-inch high raised face.

The thickness of flange dimension (dimension "C") includes the 1/16-inch high raised face.

Bolt holes: Bolt holes are drilled 1/8-inch larger than the diameter of the bolt.

Drilling templates are in multiples of four, so that valves or fittings may be turned to face in any quarter when installed. Bolt holes are drilled to straddle the center-line unless otherwise ordered.

The bolt holes are spot faced.

Dimensions, in Inches

Class	Size	A	B	C For Companion Flange	C For Valve or Fitting	D	E	No. of bolts or bolt-studs	Dia. of bolts or bolt-studs	F	G
150 Pound	1/2	1/2	3 1/2	7/16		1 3/8	2 3/8	4	1/2	2 1/4	1 3/4
	3/4	3/4	3 7/8	1/2		1 11/16	2 3/4	4	1/2	2 1/4	2
	1	1	4 1/4	9/16	7/16	2	3 1/8	4	1/2	2 1/2	2
	1 1/4	1 1/4	4 5/8	5/8	1/2	2 1/2	3 1/2	4	1/2	2 1/2	2 1/4
	1 1/2	1 1/2	5	11/16	9/16	2 7/8	3 7/8	4	1/2	2 3/4	2 1/4
	2	2	6	3/4	5/8	3 5/8	4 3/4	4	5/8	3 1/4	2 1/2
	2 1/2	2 1/2	7	7/8	11/16	4 1/8	5 1/2	4	5/8	3 1/2	2 3/4
	3	3	7 1/2	15/16	3/4	5	6	4	5/8	3 1/2	3
	3 1/2	3 1/2	8 1/2	15/16	13/16	5 1/2	7	8	5/8	3 1/2	3
	4	4	9	15/16		6 3/16	7 1/2	8	5/8	3 1/2	3
	5	5	10	15/16		7 5/16	8 1/2	8	3/4	3 3/4	3
	6	6	11	1		8 1/2	9 1/2	8	3/4	4	3 1/4
	8	8	13 1/2	1 1/8		10 5/8	11 3/4	8	3/4	4 1/4	3 1/2
	10	10	16	1 3/16		12 3/4	14 1/4	12	7/8	4 3/4	3 3/4
	12	12	19	1 1/4		15	17	12	7/8	4 3/4	3 3/4
	14	13 1/4	21	1 3/8		16 1/4	18 3/4	12	1	5 1/4	4 1/4
	16	15 1/4	23 1/2	1 7/16		18 1/2	21 1/4	16	1	5 1/2	4 1/2
	18	17 1/4	25	1 9/16		21	22 3/4	16	1 1/8	6	4 3/4
	20	19 1/4	27 1/2	1 11/16		23	25	20	1 1/8	6 1/4	5
	24	23 1/4	32	1 7/8		27 1/4	29 1/2	20	1 1/4	7	5 1/2
300 Pound	1/2	1/2	3 3/4	9/16		1 3/8	2 5/8	4	1/2	2 1/2	2
	3/4	3/4	4 5/8	5/8		1 11/16	3 1/4	4	5/8	3	2 1/4
	1	1	4 7/8	11/16		2	3 1/2	4	5/8	3	2 1/2
	1 1/4	1 1/4	5 1/4	3/4		2 1/2	3 7/8	4	5/8	3 1/4	2 1/2
	1 1/2	1 1/2	6 1/8	13/16		2 7/8	4 1/2	4	3/4	3 1/2	2 3/4
	2	2	6 1/2	7/8		3 5/8	5	8	5/8	3 1/2	2 3/4
	2 1/2	2 1/2	7 1/2	1		4 1/8	5 7/8	8	3/4	4	3 1/4
	3	3	8 1/4	1 1/8		5	6 5/8	8	3/4	4 1/4	3 1/2
	3 1/2	3 1/2	9	1 3/16		5 1/2	7 1/4	8	3/4	4 1/4	3 1/2
	4	4	10	1 1/4		6 3/16	7 7/8	8	3/4	4 1/2	3 3/4
	5	5	11	1 3/8		7 5/16	9 1/4	8	3/4	4 3/4	4
	6	6	12 1/2	1 7/16		8 1/2	10 5/8	12	3/4	4 3/4	4
	8	8	15	1 5/8		10 5/8	13	12	7/8	5 1/2	4 1/2
	10	10	17 1/2	1 7/8		12 3/4	15 1/4	16	1	6 1/4	5 1/4
	12	12	20 1/2	2		15	17 3/4	16	1 1/8	6 3/4	5 1/2
	14	13 1/4	23	2 1/8		16 1/4	20 1/4	20	1 1/8	7	6
	16	15 1/4	25 1/2	2 1/4		18 1/2	22 1/2	20	1 1/4	7 1/2	6 1/4
	18	17	28	2 3/8		21	24 3/4	24	1 1/4	7 3/4	6 1/2
	20	19	30 1/2	2 1/2		23	27	24	1 1/4	8 1/4	6 3/4
	24	23	36	2 3/4		27 1/4	32	24	1 1/2	9 1/4	7 3/4

Bolt and bolt-stud lengths: The lengths indicated as dimensions F and G in the above table apply for flanged joints other than Cranelap, made up of combinations of 150-Pound or of 300-Pound valves, fittings, or companion flanges with 1/16-inch high raised faces.

For flanged joints made up of Cranelaps, or for Cranelaps in combination with valves, fittings, or companion flanges having 1/16-inch raised faces, add to dimension F or G the thickness of the lap for each Cranelap used.

150-Pound Class: The bolt-stud lengths established by the American Standard are adequate for all 150-Pound joints, made up of any combination of valves, fittings, or flanges having the regular 1/16-inch raised face.

300-Pound Class: For male to female or tongue to groove flanged joints, add the height of the male or tongue (1/4-inch) to dimension F or G.

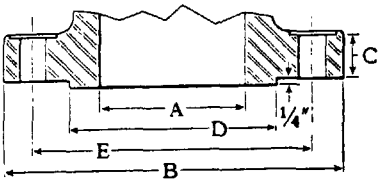
When Cranelaps are used in combinations of male to female flanged joints, add the thickness of the lap for each Cranelap. *Caution:* the male Cranelap must have a minimum lap thickness of 1/4-inch.

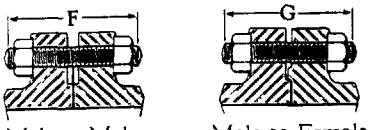
For Cranelaps of tongue to groove flanged joints, add to dimension F or G the thickness of each lap, plus 1/4-inch.

List prices of bolt-studs ..... ***pages 446 and 447***
List prices of machine bolts ..... ***page 445***
Special facings ..... ***pages 448 and 450***
Length of bolt-studs for ring joints ... ***page 450***

Templates for Drilling

400, 600, and 900-Pound Steel Standards





Male to Male Flanged Joint — Male to Female Flanged Joint

Bolt-Stud Length "G" also applies for Tongue to Groove Flanged Joint.

American Standard: The 400, 600, and 900-Pound flange dimensions, drilling templates, and bolt-stud lengths shown in the table at the right conform, respectively, to the American Standard for 400, 600, and 900-Pound Steel Pipe Flanges and Flanged Fittings, B16e-1939.

Facing: Unless otherwise ordered, 400, 600, and 900-Pound Steel Flanged Valves and Fittings are regularly furnished with a 1/4-inch high large male face. Companion Flanges are regularly furnished with 1/4-inch high large male or 3/16-inch deep large female facing, as ordered.

The thickness of flange dimension (dimension "C") does not include the 1/4-inch high large male face.

Bolt holes: Bolt holes are drilled 1/8-inch larger than the diameter of the bolt. Drilling templates are in multiples of four, so that valves or fittings may be turned to face in any quarter when being installed. Bolt holes are drilled to straddle the center line unless otherwise ordered.

Spot facing: The bolt holes are spot faced.

Bolt-stud lengths: The bolt-stud lengths shown in the table at the right apply for flanged joints other than Cranelap, made up of combinations of valves, fittings, or companion flanges with male, female, tongue, or groove faces. Male or tongue faces are 1/4-inch high; female or groove faces are 3/16-inch deep.

Dimensions, in Inches

Class	Size	A	B	C	D	E	No. of bolt-studs	Dia. of bolt-studs	F	G
400 Pound	4	4	10	1 3/8	6 3/16	7 7/8	8	7/8	5 1/2	5 1/4
	5	5	11	1 1/2	7 5/16	9 1/4	8	7/8	5 3/4	5 1/2
	6	6	12 1/2	1 5/8	8 1/2	10 5/8	12	7/8	6	5 3/4
	8	8	15	1 7/8	10 5/8	13	12	1	6 3/4	6 1/2
	10	10	17 1/2	2 1/8	12 3/4	15 1/4	16	1 1/8	7 1/2	7 1/4
	12	12	20 1/2	2 1/4	15	17 3/4	16	1 1/4	8	7 3/4
	14	13 1/8	23	2 3/8	16 1/4	20 1/4	20	1 1/4	8 1/4	8
	16	15	25 1/2	2 1/2	18 1/2	22 1/2	20	1 3/8	8 3/4	8 1/2
	18	17	28	2 5/8	21	24 3/4	24	1 3/8	9	8 3/4
	20	18 7/8	30 1/2	2 3/4	23	27	24	1 1/2	9 3/4	9 1/2
	24	22 5/8	36	3	27 1/4	32	24	1 3/4	10 3/4	10 1/2
600 Pound	1/2	1/2	3 3/4	9/16	1 3/8	2 5/8	4	1/2	3	2 3/4
	3/4	3/4	4 5/8	5/8	1 11/16	3 1/4	4	5/8	3 1/2	3 1/4
	1	1	4 7/8	11/16	2	3 1/2	4	5/8	3 1/2	3 1/4
	1 1/4	1 1/4	5 1/4	13/16	2 1/2	3 7/8	4	5/8	3 3/4	3 1/2
	1 1/2	1 1/2	6 1/8	7/8	2 7/8	4 1/2	4	3/4	4 1/4	4
	2	2	6 1/2	1	3 5/8	5	8	5/8	4 1/4	4
	2 1/2	2 1/2	7 1/2	1 1/8	4 1/8	5 7/8	8	3/4	4 3/4	4 1/2
	3	3	8 1/4	1 1/4	5	6 5/8	8	3/4	5	4 3/4
	3 1/2	3 1/2	9	1 3/8	5 1/2	7 1/4	8	7/8	5 1/2	5 1/4
	4	4	10 3/4	1 1/2	6 3/16	8 1/2	8	7/8	5 3/4	5 1/2
	5	5	13	1 3/4	7 5/16	10 1/2	8	1	6 1/2	6 1/4
	6	6	14	1 7/8	8 1/2	11 1/2	12	1	6 3/4	6 1/2
	8	7 7/8	16 1/2	2 3/16	10 5/8	13 3/4	12	1 1/8	7 3/4	7 1/2
	10	9 3/4	20	2 1/2	12 3/4	17	16	1 1/4	8 1/2	8 1/4
	12	11 3/4	22	2 5/8	15	19 1/4	20	1 1/4	8 3/4	8 1/2
	14	12 7/8	23 3/4	2 3/4	16 1/4	20 3/4	20	1 3/8	9 1/4	9
	16	14 3/4	27	3	18 1/2	23 3/4	20	1 1/2	10	9 3/4
	18	16 1/2	29 1/4	3 1/4	21	25 3/4	20	1 5/8	10 3/4	10 1/2
	20	18 1/4	32	3 1/2	23	28 1/2	24	1 5/8	11 1/2	11 1/4
	24	22	37	4	27 1/4	33	24	1 7/8	13	12 3/4
900 Pound	3	2 7/8	9 1/2	1 1/2	5	7 1/2	8	7/8	5 3/4	5 1/2
	4	3 7/8	11 1/2	1 3/4	6 3/16	9 1/4	8	1 1/8	6 3/4	6 1/2
	5	4 3/4	13 3/4	2	7 5/16	11	8	1 1/4	7 1/2	7 1/4
	6	5 3/4	15	2 3/16	8 1/2	12 1/2	12	1 1/8	7 3/4	7 1/2
	8	7 1/2	18 1/2	2 1/2	10 5/8	15 1/2	12	1 3/8	8 3/4	8 1/2
	10	9 3/8	21 1/2	2 3/4	12 3/4	18 1/2	16	1 3/8	9 1/4	9
	12	11 1/8	24	3 1/8	15	21	20	1 3/8	10	9 3/4
	14	12 1/4	25 1/4	3 3/8	16 1/4	22	20	1 1/2	10 3/4	10 1/2
	16	14	27 3/4	3 1/2	18 1/2	24 1/4	20	1 5/8	11 1/4	11
	18	15 3/4	31	4	21	27	20	1 7/8	13	12 3/4
	20	17 1/2	33 3/4	4 1/4	23	29 1/2	20	2	13 3/4	13 1/2
	24	21	41	5 1/2	27 1/4	35 1/2	20	2 1/2	17 1/4	17

For flanged joints made up of Cranelaps or for Cranelaps in combination with valves, fittings, or companion flanges, new bolt-stud lengths must be established in the following manner:

Bolt-Stud Lengths for Cranelap Joints (Based on length "G" for bolt-studs).

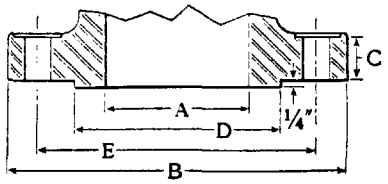
Cranelap to Cranelap . . . . . Deduct 1/4-inch and add thickness of both laps
Cranelap to 1/4-inch male . . . . . Add thickness of one lap
Cranelap to female . . . . . Deduct 1/4-inch and add thickness of one lap*
Cranelap to female Cranelap . . . . . Deduct 1/4-inch and add thickness of both laps*
Tongue or groove Cranelaps . . . . . Add thickness of each lap

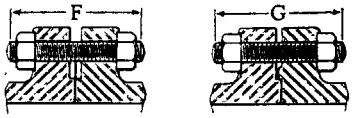
*The Cranelap serving as the male must have a minimum lap thickness of 1/4-inch.

Special facings . . pages 449 to 451
List prices of bolt-studs . pages 446 and 447 *Length of bolt-studs for ring joints . pages 450 and 451*

Templates for Drilling

1500 and 2500-Pound Steel Standards





Male to Male Flanged Joint — Male to Female Flanged Joint

Bolt-Stud Length "G" also applies for Tongue to Groove Flanged Joint.

American Standard: The 1500 and 2500-Pound flange dimensions, drilling templates, and bolt-stud lengths shown in the table at the right conform, respectively, to the American Standard for 1500 and 2500-Pound Steel Pipe Flanges and Flanged Fittings, B16e-1939.

Facing: Unless otherwise ordered, 1500 and 2500-Pound Steel Flanged Valves and Fittings are regularly furnished with 1/4-inch high large male facing.

Companion Flanges are regularly furnished with 1/4-inch high large male or 3/16-inch deep large female facing, as ordered.

The thickness of flange dimension (dimension "C") does not include the 1/4-inch high large male face.

Dimensions, in Inches

Class	Size	A	B	C	D	E	No. of bolt-studs	Dia. of bolt-studs	F	G
1500 Pound	1/2	1/2	4 3/4	7/8	1 3/8	3 1/4	4	3/4	4 1/4	4
	3/4	11/16	5 1/8	1	1 11/16	3 1/2	4	3/4	4 1/2	4 1/4
	1	7/8	5 7/8	1 1/8	2	4	4	7/8	5	4 3/4
	1 1/4	1 1/8	6 1/4	1 1/8	2 1/2	4 3/8	4	7/8	5	4 3/4
	1 1/2	1 3/8	7	1 1/4	2 7/8	4 7/8	4	1	5 1/2	5 1/4
	2	1 7/8	8 1/2	1 1/2	3 5/8	6 1/2	8	7/8	5 3/4	5 1/2
	2 1/2	2 1/4	9 5/8	1 5/8	4 1/8	7 1/2	8	1	6 1/4	6
	3	2 3/4	10 1/2	1 7/8	5	8	8	1 1/8	7	6 3/4
	4	3 5/8	12 1/4	2 1/8	6 3/16	9 1/2	8	1 1/4	7 3/4	7 1/2
	5	4 3/8	14 3/4	2 7/8	7 5/16	11 1/2	8	1 1/2	9 3/4	9 1/2
	6	5 3/8	15 1/2	3 1/4	8 1/2	12 1/2	12	1 3/8	10 1/4	10
	8	7	19	3 5/8	10 5/8	15 1/2	12	1 5/8	11 1/2	11 1/4
	10	8 3/4	23	4 1/4	12 3/4	19	12	1 7/8	13 1/2	13 1/4
	12	10 3/8	26 1/2	4 7/8	15	22 1/2	16	2	15	14 3/4
	14	11 3/8	29 1/2	5 1/4	16 1/4	25	16	2 1/4	16 1/4	16
	16	13	32 1/2	5 3/4	18 1/2	27 3/4	16	2 1/2	17 3/4	17 1/2
	18	14 5/8	36	6 3/8	21	30 1/2	16	2 3/4	19 1/2	19 1/4
	20	16 3/8	38 3/4	7	23	32 3/4	16	3	21 1/2	21 1/4
	24	19 5/8	46	8	27 1/4	39	16	3 1/2	24 1/4	24
2500 Pound	1/2	7/16	5 1/4	13/16	1 3/8	3 1/2	4	3/4	4 3/4	4 1/2
	3/4	9/16	5 1/2	1 1/4	1 11/16	3 3/4	4	3/4	5	4 3/4
	1	3/4	6 1/4	1 3/8	2	4 1/4	4	7/8	5 1/2	5 1/4
	1 1/4	1	7 1/4	1 1/2	2 1/2	5 1/8	4	1	6	5 3/4
	1 1/2	1 1/8	8	1 3/4	2 7/8	5 3/4	4	1 1/8	6 3/4	6 1/2
	2	1 1/2	9 1/4	2	3 5/8	6 3/4	8	1	7	6 3/4
	2 1/2	1 7/8	10 1/2	2 1/4	4 1/8	7 3/4	8	1 1/8	7 3/4	7 1/2
	3	2 1/4	12	2 5/8	5	9	8	1 1/4	8 3/4	8 1/2
	4	2 7/8	14	3	6 3/16	10 3/4	8	1 1/2	10	9 3/4
	5	3 5/8	16 1/2	3 5/8	7 5/16	12 3/4	8	1 3/4	12	11 3/4
	6	4 3/8	19	4 1/4	8 1/2	14 1/2	8	2	13 3/4	13 1/2
	8	5 3/4	21 3/4	5	10 5/8	17 1/4	12	2	15 1/4	15
	10	7 1/4	26 1/2	6 1/2	12 3/4	21 1/4	12	2 1/2	19 1/4	19
	12	8 5/8	30	7 1/4	15	24 3/8	12	2 3/4	21 1/4	21

Bolt holes: Bolt holes are drilled 1/8-inch larger than the diameter of the bolt.

Drilling templates are in multiples of four, so that valves or fittings may be turned to face in any quarter when being installed. The bolt holes are drilled to straddle the center line unless otherwise ordered.

Spot facing: The bolt holes are spot faced.

* * * * *

Bolt-stud lengths: The bolt-stud lengths shown in the above table apply for flanged joints other than Cranelap, made up of combinations of valves, fittings, or companion flanges with male, female, tongue, or groove faces. Male or tongue faces are 1/4-inch high; female or groove faces are 3/16-inch deep.

For flanged joints made up of Cranelaps or for Cranelaps in combination with valves, fittings, or companion flanges, new bolt-stud lengths must be established in the following manner:

Bolt-Stud Lengths for Cranelap Joints (Based on length "G" for bolt-studs).

Cranelap to Cranelap	Deduct 1/4-inch and add thickness of both laps
Cranelap to 1/4-inch male	Add thickness of one lap
Cranelap to female	Deduct 1/4-inch and add thickness of one lap*
Cranelap to female Cranelap	Deduct 1/4-inch and add thickness of both laps*
Tongue or groove Cranelaps	Add thickness of each lap

*The Cranelap serving as the male must have a minimum lap thickness of 1/4-inch.

Special facings . . . page 449 and 451
List prices of bolt-studs . . . pages 446 and 447
Length of bolt-studs for ring joints . . page 451

Crane Thread Lubricant

For Threaded Pipe Joints, Bolt Threads, and Gasket Coating



Prices on application

Crane Thread Lubricant is available in four container sizes: one quart can, 2¾ pounds of compound; one pint can, 1¼ pounds of compound; one-half pint can, 10 ounces of compound; tube, 4 ounces of compound.

Crane Thread Lubricant is used to make better threaded and flanged joints on steam, water, oil, and gas piping. Pipe joints are made tighter, and easy "breaking" is assured. This lubricant has been developed to take the place of ordinary pipe dope or pipe cement. It will not harden or separate.

Recommended use: The unusual lubricating qualities of Crane Thread Lubricant make it ideal for all threaded metal connections for temperatures up to 500° F., and for use on Cranite or corrugated metal gaskets in flanged joints. The lubricant is particularly suited to the requirements of alloy materials such as stainless steel, Monel and nickel, as well as for copper, brass iron, and steel. It can be used on chrome or nickel finished fittings without smearing or discoloring the trim. It is non-poisonous and is therefore suitable for pipe lines handling food products and for all domestic and industrial uses as well.

Crane Thread Lubricant reduces the friction which occurs when making a metal-to-metal joint, preventing the galling or seizing on make-up which takes place if a good lubricant is not used.

When threads are clean and properly cut, the use of Crane Thread Lubricant permits pulling them up to a tight joint with greater ease. Crane Thread Lubricant will not separate or harden, regardless of age. It spreads easily over threaded surfaces, providing a high degree of lubrication.

Application: Consistency is such that application can be made in any convenient way from either the can or the tube. The most common practice is to apply it by brush.

Crane High Temperature Thread Lubricant

For temperatures up to 1000° F.



Available in 1¼ and 6½-pound cans

Price per pound . . **$1.35**

Crane High Temperature Thread Lubricant is the result of years of development and research in an endeavor to find a lubricant having low frictional qualities with particular suitability for high temperature service. The tendency of metal to seize or gall is more pronounced under high temperatures and high loading, and only a proper lubricant can avoid these damaging effects. Threaded pipe joints, made up with Crane High Temperature Thread Lubricant, after having been in service under temperatures as high as 1000° F., can be taken apart readily and re-used; threads are kept smooth and a pressure tight metal to metal contact is maintained.

On bolt-studs used in flanged joints for high pressure-temperature installations, the tendency of seizing or galling of the threads is a common failing because of the high bolt loads and increased friction. Crane High Temperature Thread Lubricant is ideal for use on bolt-studs; it enables the maximum stress to be obtained with a minimum of power applied to the nut. Bolted joints are more easily assembled to tightness under high pressures, and damage of threads incidental to high loading is avoided.

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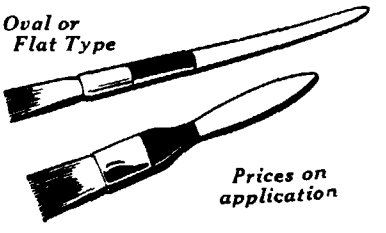
Thread Lubricant Brushes

Thread lubricant can be applied in any convenient way. It is common practice, however, to apply the compound with a brush.

These Thread Lubricant Brushes are specifically made for easy application of thread lubricant to bolts, flanges, gaskets, studs, valves, fittings, etc.

The brushes are well constructed to withstand heavy usage. The bristles are well set in the handle to minimize the usual loss of bristles in hard service. These brushes are available in two types; either oval or flat. Specify the type of brush desired, when ordering.



Machine Bolts

For a variety of services and for temperatures up to a maximum of 500° F., Machine Bolts with square heads and hexagon nuts are the standard practice of the Pipe and Fitting Industry.



Length Inches	List Prices, Per 100							List Prices, Per 100. Quantities of 500 or more of one diameter	
	1/2" Dia.	5/8" Dia.	3/4" Dia.	7/8" Dia.	1" Dia.	1 1/8" Dia.	1 1/4" Dia.	1 3/8" Dia.	1 1/2" Dia.
1 1/4	5.90	9.55							
1 1/2	6.10	9.80	12.65	19.45					
2	6.45	10.30	13.30	20.35	28.20				
2 1/2	6.85	10.80	13.95	21.25	29.35				
3	7.25	11.30	14.60	22.15	30.50			72.80	88.45
3 1/2	7.60	11.80	15.25	23.05	31.65			74.80	90.85
4	7.95	12.30	15.90	23.95	32.80	52.50	63.05	76.80	93.20
4 1/2	8.35	12.80	16.55	24.85	33.95	53.80	64.70	78.80	95.60
5	8.75	13.30	17.20	25.75	35.10	55.10	66.35	80.80	97.95
5 1/2	9.15	13.80	17.85	26.65	36.25	56.40	68.00	82.80	100.35
6	9.55	14.30	18.50	27.55	37.40	57.70	69.65	84.80	102.70
6 1/2	11.25	14.80	19.15	28.45	38.55			86.80	105.10
7	11.70	15.30	19.80	29.35	39.70	60.30	72.95	88.80	107.45
7 1/2	12.15	15.80	20.45	30.25	40.85			90.80	109.85
8	12.60	16.30	21.10	31.15	42.00	62.90	76.25	92.80	112.20
8 1/2	13.05	16.80	21.75	32.05				94.80	114.55
9	13.50	17.30	22.40	32.95	44.30	65.50	79.55	96.80	116.95
9 1/2	13.95	17.80	23.05					98.80	119.35
10	14.40	18.30	23.70	34.75	46.60	68.10	82.85	100.80	121.70
11	15.80	19.30	25.00	36.55	48.90	70.70	86.15	104.80	126.45
12	16.70	20.30	26.30	38.35	51.20	73.30	89.45	108.80	131.20
13	17.60	21.30	27.60	40.15	53.50			112.80	135.95
14	18.50	22.30	28.90	41.95	55.80	78.50	96.05	116.80	140.70
15	19.40	23.30	30.20	43.75	58.10	81.10	99.35	120.80	145.45

For intermediate lengths, use the list price for the next longer length.

List Prices: The list prices shown in the table above cover Machine Bolts having a Regular Unfinished Square Head and equipped with a Heavy Unfinished Hot Pressed Hexagon Nut. Unless otherwise specified on the order, Machine Bolts and Nuts of this description will be regularly furnished.

When so specified, Machine Bolts can be supplied without nuts, with other types of bolt heads, or with several different kinds of nuts. List prices for these different types or combinations are adjusted according to the following table of deductions from or additions to the above list prices:

Deductions from or Additions to the List Prices in the above table, Per 100

			1/2" Dia.	5/8" Dia.	3/4" Dia.	7/8" Dia.	1" Dia.	1 1/8" Dia.	1 1/4" Dia.	1 3/8" Dia.	1 1/2" Dia.
Bolts	Regular Unfin. Sq. Head, Without Nuts	Deduct	2.05	3.10	4.10	6.65	9.10	12.75	16.90	20.20	27.85
	Regular Hexagon Head, Unfinished	Add	.65	1.00	1.40	2.20	3.00				
Nuts	Heavy Hexagon, Unfinished, C.P.	Add	.20	.45	.90	1.35	2.00	2.00	4.00		
	Heavy Hexagon, Semi-finished, C.P.	Add	.50	1.00	1.60	2.05	2.90	3.10	5.40		
	Regular Hexagon, Unfinished, C.P.	Deduct	.60	.25	.05						
		Add				.50	.70	1.25	1.20	5.00	6.10
	Regular Square, Unfinished, H.P.	Deduct	1.10	1.20	1.70	2.75	3.80	4.00	5.30	2.80	4.45

Standards: Machine Bolts and Nuts are made from open-hearth steel conforming to the ASTM Specification A-107—47.

The dimensions of bolt heads and nuts conform to the American Standard ASA-B18.2—1941.

Bolt and nut threads conform to the American Standard ASA-B1.1—1935 Standard on Screw Threads, Coarse Thread Series, Class 2 Fit.

For engineering data on Machine Bolts, see pages 506 and 507.

Extra List Prices, Per 100
For less than 500 of one diameter

Quantities	1 3/8" Dia.	1 1/2" Dia.
400 to 499	2.00	2.25
300 to 399	3.20	3.50
200 to 299	7.20	7.50
100 to 199	19.20	19.60
50 to 99	44.00	44.50
25 to 49	92.00	92.50
10 to 24	240.00	241.00

Crane Triplex and Templex Alloy Steel Bolt-Studs



Bolt-Stud
Threaded Entire Length
With Two Nuts

The list prices apply to Triplex Steel Bolt-Studs equipped with two nuts, each. Prices of Templex Steel Bolt-Studs will be furnished on application.

The lengths shown below do not include the crowned ends.

Each Triplex or Templex Steel Bolt-Stud is equipped with two medium carbon, oil-quenched, semi-finished, heavy, steel hexagon nuts.

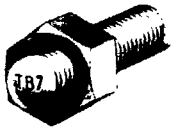
Triplex Steel Bolt-Studs: The merits of Crane Triplex Steel are well known. Triplex Steel Bolt-Studs have been used with uniformly satisfactory results in thousands of steel valve and fitting installations, many of which—particularly in oil refineries—have been operating under extreme pressures and temperatures.

Made to rigid manufacturing tolerances of a high quality chrome-molybdenum steel, they provide liberal strength for the bolting of steel flanged joints.

Templex Steel Bolt-Studs: Templex Steel, a Crane development in bolting materials, is superior to Triplex Steel in creep resistance. On temperatures over 850° F., especially where joints are made up for permanent, long-time service, as in steam power plants, Crane Templex Steel will be found ideal.

A specially heat treated chrome-molybdenum-vanadium steel, Templex offers unusual resistance to creep.

Marking: On one end of each bolt-stud is stamped the identification of the material; Crane Triplex is marked with the symbol "T B7", and Crane Templex is marked with the symbol "T B14". These markings are shown in the accompanying illustrations.



Triplex Steel



Templex Steel

Standard lengths: The lengths of bolt-studs are standardized in increments of ¼-inch in accordance with the American Standard, ASA B16e-1939.

When ordering bolt-studs for Cranelap requirements, lengths should be selected as follows:

A. If calculated length is 1/16-inch or more longer than a standardized length, use the next longer standard ¼-inch length.

B. If calculated length is less than 1/16-inch longer than a standardized length, use the next shorter standard ¼-inch length.

Bolt-stud lengths in ⅛-inch increments are made to order only, at a special price; prices on request.

Threads: Crane Alloy Steel Bolt-Studs are threaded their entire length. Threading, including threading on the accompanying nuts, is in accordance with the American Standard for Screw Threads for High Strength Bolting (ASA B1.4), sizes 1-inch and smaller in diameter with the Coarse-Thread Series, and sizes 1⅛-inch and larger in diameter with the 8-Pitch-Thread Series.

Length Inches	List Prices, Each				
	7/16" Dia.	½" Dia.	⅝" Dia.	¾" Dia.	⅞" Dia.
2	.39	.39	.43		
2¼	.40	.40	.44		
2½	.41	.41	.45	.53	
2¾		.42	.46	.55	
3		.43	.47	.57	.72
3¼		.44	.48	.59	.74
3½		.45	.49	.61	.76
3¾			.50	.63	.78
4			.51	.65	.80
4¼			.52	.67	.82
4½			.53	.69	.84
4¾			.54	.71	.86
5			.55	.73	.88
5¼				.75	.90
5½			.57	.77	.92
5¾				.79	.94
6			.59	.81	.96
6¼				.83	.98
6½				.85	1.00
6¾				.87	1.02
7				.89	1.04
7¼				.91	1.06
7½				.93	1.08
7¾				.95	1.10
8				.97	1.12
8¼					1.14
8½					1.16
8¾					1.18
9					1.20
9¼					1.22
9½					1.24

Standards: Crane Triplex and Templex Steel Bolt-Studs and Nuts conform to the American Standard B16e-1939 and to various A.S.T.M. Specifications. Triplex Steel conforms to A.S.T.M. A 193, Grade B-bolting. Templex Steel conforms to A.S.T.M. A 193, Grade B14 bolting.

The nuts conform to A.S.T.M. Specification A 194, Class 2H; they are made to American Standard "Heavy" Hexagon Nut dimensions, ASA B18.2.

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Description of materials . . . page 9

Engineering data on Bolting . . pages 506 to 508

Crane Triplex and Templex Alloy Steel Bolt-Studs (Cont.)

The list prices apply to Triplex Steel Bolt-Studs equipped with two nuts, each. Prices of Templex Steel Bolt-Studs will be furnished on application.

The lengths shown below do not include the crowned ends.

Each Triplex or Templex Steel Bolt-Stud is equipped with two medium carbon, oil-quenched, semi-finished, heavy, steel hexagon nuts.



Bolt-Stud
Threaded Entire Length
With Two Nuts

Length	List Prices, Each				
Inches	1" Dia.	1⅛" Dia.	1¼" Dia.	1⅜" Dia.	1½" Dia.
5	1.21				
5¼	1.24				
5½	1.27	1.74			
5¾	1.30	1.78			
6	1.33	1.82			
6¼	1.36	1.86			
6½	1.39	1.90	2.45		
6¾	1.42	1.94	2.50		
7	1.45	1.98	2.55		
7¼	1.48	2.02	2.60		
7½	1.51	2.06	2.65		
7¾	1.54	2.10	2.70		
8	1.57	2.14	2.75	3.31	
8¼	1.60	2.18	2.80	3.39	
8½	1.63	2.22	2.85	3.47	4.35
8¾	1.66	2.26	2.90	3.55	4.45
9	1.69	2.30	2.95	3.63	4.55
9¼	1.72	2.34	3.00	3.71	4.65
9½	1.75	2.38	3.05	3.79	4.75
9¾	1.78	2.42	3.10	3.87	4.85
10	1.81	2.46	3.15	3.95	4.95
10¼	1.84	2.50	3.20	4.03	5.05
10½	1.87	2.54	3.25	4.11	5.15
10¾		2.58	3.30	4.19	5.25
11		2.62	3.35	4.27	5.35
11¼		2.66	3.40	4.35	5.45
11½		2.70	3.45	4.43	5.55
11¾		2.74	3.50	4.51	5.65
12		2.78	3.55	4.59	5.75
12¼			3.60	4.67	5.85
12½			3.65	4.75	5.95
12¾			3.70	4.83	6.05
13			3.75	4.91	6.15
13¼			3.80	4.99	6.25
13½			3.85	5.07	6.35
13¾				5.15	6.45
14				5.23	6.55
14¼				5.31	6.65
14½				5.39	6.75
14¾				5.47	6.85
15				5.55	6.95

Length	List Prices, Each		
Inches	1⅝" Dia.	1¾" Dia.	1⅞" Dia.
9½	6.46		
9¾	6.59		
10	6.72	8.55	
10¼	6.85	8.70	
10½	6.98	8.85	
10¾	7.11	9.00	
11	7.24	9.15	
11¼	7.37	9.30	11.30
11½	7.50	9.45	11.45
11¾	7.63	9.60	11.60
12	7.76	9.75	11.75
12¼	7.89	9.90	11.90
12½	8.02	10.05	12.05
12¾	8.15	10.20	12.20
13	8.28	10.35	12.35
13¼	8.41	10.50	12.50
13½	8.54	10.65	12.65
13¾	8.67	10.80	12.80
14	8.80	10.95	12.95
14¼	8.93	11.10	13.10
14½	9.06	11.25	13.25
14¾		11.40	13.40
15	9.32	11.55	13.55
15¼			13.70
15½	9.58	11.85	13.85
15¾			14.00
16	9.84	12.15	14.15
16¼			14.30
16½		12.30	14.45
16¾			
17			14.75
17¼			
17½			15.05
17¾			
18			15.35
18¼			
18½			
18¾			
19			
19¼			
19½			

Length	List Prices, Each		
Inches	2" Dia.	2¼" Dia.	2½" Dia.
12	14.00		
12¼	14.20		
12½	14.40		
12¾	14.60		
13	14.80		
13¼	15.00		
13½	15.20		
13¾	15.40		
14	15.60		
14¼	15.80		
14½	16.00		
14¾	16.20		
15	16.40	21.40	
15¼	16.60	21.60	
15½	16.80	21.80	
15¾	17.00	22.00	
16	17.20	22.20	
16¼		22.40	
16½	17.60	22.60	27.60
16¾			27.80
17	18.00	23.00	28.00
17¼			28.20
17½	18.40	23.40	28.40
17¾			28.60
18	18.80	23.80	28.80
18¼			29.00
18½	19.20	24.20	29.20
18¾			29.40
19	19.60	24.60	29.60
19¼			29.80
19½		25.00	30.00
19¾			30.20
20		25.40	30.40
20¼			30.60
20½		25.80	30.80
21		26.20	31.20
21¼			31.40
21½			31.60
22			32.00
22½			32.40
23			32.80

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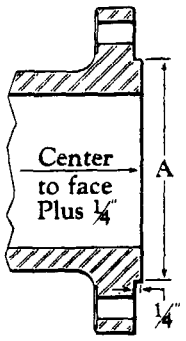
Thread Lubricant

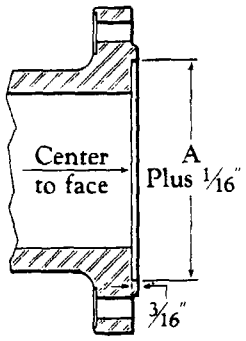
Crane High Temperature Thread Lubricant is recommended for use with alloy steel bolt-studs. On bolting subjected to high temperatures, this lubricant is unsurpassed. Because it reduces friction, maximum stress can be obtained in the bolt-stud with a minimum amount of power applied to the nut. In addition, by minimizing the tendency of the metals to gall or seize, joints can be more readily assembled and taken apart without injuring the bolting. See page 444.

Male, Female, Tongue, and Groove Flange Facings

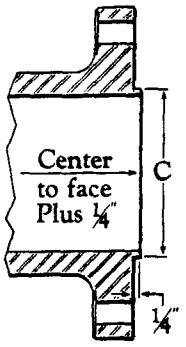
For 300-Pound Steel



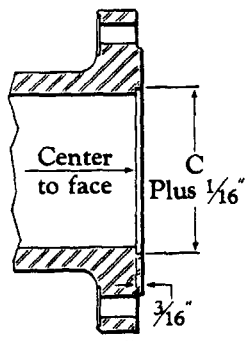
Large Male



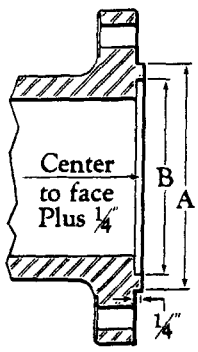
Large Female



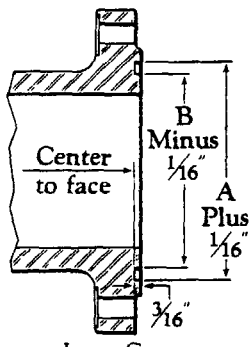
*Small Male



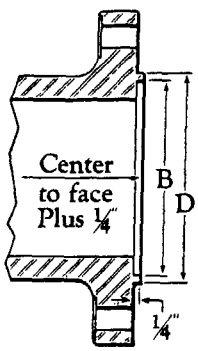
*Small Female



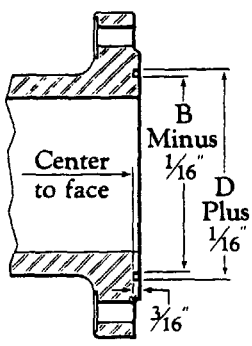
Large Tongue



Large Groove



Small Tongue



Small Groove

Dimensions, in Inches

Class	Size	A	B	C	D
300-Pound Steel	1/2	1 3/8	1	23/32	1 3/8
	3/4	1 11/16	15/16	15/16	1 11/16
	1	2	1 1/2	1 3/16	1 7/8
	1 1/4	2 1/2	1 7/8	1 1/2	2 1/4
	1 1/2	2 7/8	2 1/8	1 3/4	2 1/2
	2	3 5/8	2 7/8	2 1/4	3 1/4
	2 1/2	4 1/8	3 3/8	2 11/16	3 3/4
	3	5	4 1/4	3 5/16	4 5/8
	3 1/2	5 1/2	4 3/4	3 13/16	5 1/8
	4	6 3/16	5 3/16	4 5/16	5 11/16
	5	7 5/16	6 5/16	5 3/8	6 13/16
	6	8 1/2	7 1/2	6 3/8	8
	8	10 5/8	9 3/8	8 3/8	10
	10	12 3/4	11 1/4	10 1/2	12
	12	15	13 1/2	12 1/2	14 1/4
	14	16 1/4	14 3/4	13 3/4	15 1/2
	16	18 1/2	16 3/4	15 3/4	17 5/8
	18	21	19 1/4	17 3/4	20 1/8
	20	23	21	19 3/4	22
	24	27 1/4	25 1/4	23 3/4	26 1/4

Refer to the Crane Discount Sheet for prices.

The dimensions shown above conform to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939.

All of the types of facings can be applied to flanged products in the 300-Pound steel class, conforming to the American Steel Flange Standard, B16e-1939.

Center to face: The illustrations show how regular valve or fitting center to face dimensions are affected by these special facings. Notice: the male or tongue facing increases the regular center to face 1/4-inch; the female or groove facing does not alter the regular center to face.

Regular facing and finish: 300-Pound Steel flanged valves, flanged fittings, and flanges are regularly furnished with a 1/16-inch raised face.

1/16-inch raised faces and 1/4-inch male faces are finished with concentric grooves, approximately 32 grooves per inch known as a "serrated" finish. Female, tongue, and groove faces are regularly furnished with a smooth finish.

***Small male and female:** Small male and female facings, when used with steel screwed flanges, makes the joint directly on the end of the pipe. In these cases the pipe must be thick enough to provide a bearing surface of ample width to prevent crushing of the gasket. If a pipe end is to be used as a mating member in a joint, orders should specify the inside diameter of the pipe. In some instances, it may be necessary to lag up the port diameter of valves and fittings to match the I.D. of the pipe, in which case special prices will apply.

Gaskets: Gaskets for male and female and for tongue and groove joints should cover the bottom of the recess with minimum clearances, allowing for the plus or minus tolerance of 0.016 inch (1/64") which is permitted by the American Standard on the inside and outside diameters of facings

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Dimensions of ring joint facing . pages 450 and 451
Facings on Cranelap Joints . . pages 489 and 490 *Templates for drilling page 441*

Male, Female, Tongue, and Groove Flange Facings

For 400 to 2500-Pound Steel

Dimensions, in Inches

Class	Size	A	B	C	D
400, 600, 900, 1500, or 2500-Pound Steel	½	1⅜	1	23/32	1⅜
	¾	1 11/16	15/16	15/16	1 11/16
	1	2	1½	1 3/16	1⅞
	1¼	2½	1⅞	1½	2¼
	1½	2⅞	2⅛	1¾	2½
	2	3⅝	2⅞	2¼	3¼
	2½	4⅛	3⅜	2 11/16	3¾
	3	5	4¼	3 5/16	4⅝
	3½	5½	4¾	3 13/16	5⅛
	4	6 3/16	5 3/16	4 5/16	5 11/16
	5	7 5/16	6 5/16	5⅜	6 13/16
	6	8½	7½	6⅜	8
	8	10⅝	9⅜	8⅜	10
	10	12¾	11¼	10½	12
	12	15	13½	12½	14¼
	14	16¼	14¾	13¾	15½
	16	18½	16¾	15¾	17⅝
	18	21	19¼	17¾	20⅛
	20	23	21	19¾	22
	24	27¼	25¼	23¾	26¼

Refer to the Crane Discount Sheet for prices.

The dimensions shown above conform to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939.

All of the types of facings can be applied to flanged products in the 400, 600, 900, 1500, and 2500-Pound steel classes, conforming to the American Standard, B 16e-1939.

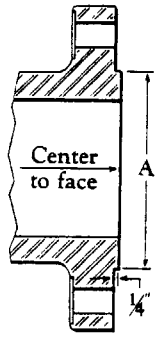
Center to face: The illustrations show how regular valve or fitting center to face dimensions are affected by these special facings. Notice particularly: the male and tongue facings are included in the regular center to face; the female and groove facings require a deduction of ¼-inch from the regular center to face.

Regular facing and finish: Flanged valves and flanged fittings of the classes indicated are regularly furnished with a ¼-inch male face. Companion flanges have a ¼-inch male face or a 3/16-inch female face, as ordered.

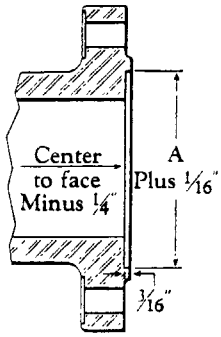
The male faces are finished with concentric grooves, approximately 32 grooves per inch, known as a "serrated" finish. Female, tongue, and groove faces regularly have a smooth finish.

***Small male and female:** Small male and female facing, when used with steel screwed flanges, makes the joint directly on the end of the pipe. In these cases the pipe must be thick enough to provide a bearing surface of ample width to prevent crushing of the gasket. If a pipe end is to be used as a mating member in a joint, orders should specify the inside diameter of the pipe. In some instances, it may be necessary to lag up the port diameter of valves and fittings to match the I.D. of the pipe, in which case special prices will apply.

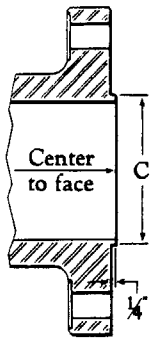
Gaskets: Gaskets for male and female and for tongue and groove joints should cover the bottom of the recess with minimum clearances, allowing for the plus or minus tolerance of 0.016 inch (1/64") which is permitted by the American Standard on the inside and outside diameters of facings.



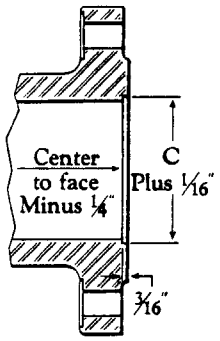
Large Male



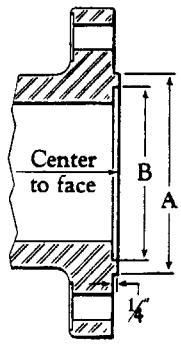
Large Female



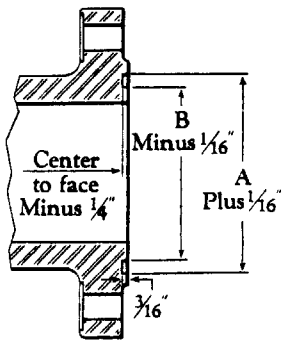
*Small Male



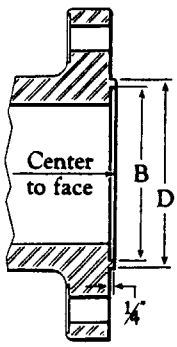
*Small Female



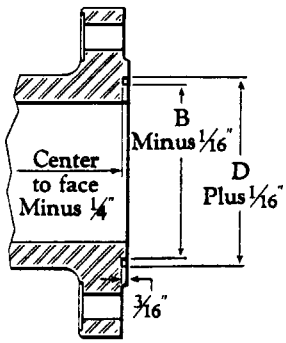
Large Tongue



Large Groove



Small Tongue

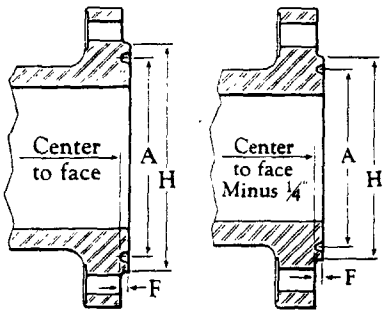


Small Groove

Dimensions of ring joint facing . . pages 450 and 451
Facings on Cranelap Joints . . pages 489 and 490
Templates for drilling . . pages 442 and 443

Ring Joint Facing and Rings

API and American Standard—Dimensions, in Inches

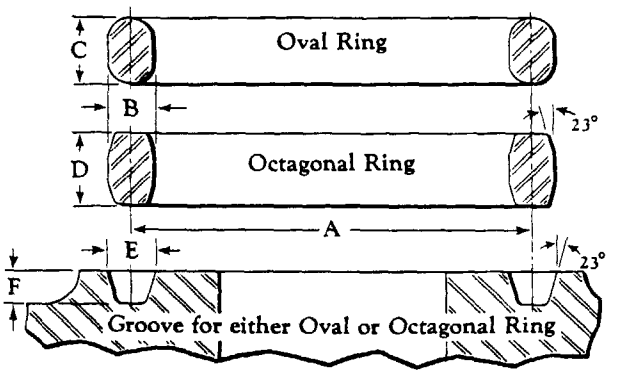


150 and 300-Pound

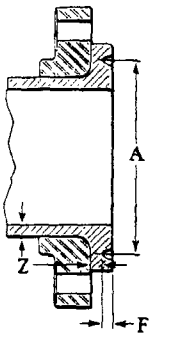
400, 600, 900, 1500 and 2500-Pound

(See explanation of "Center to face" on next page.)

For Valves, Fittings, and Flanges

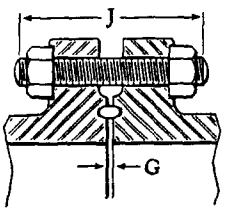


(An octagonal ring only fits groove with flat bottom; and oval ring fits groove with either flat or round bottom.)



("Z" represents pipe thickness.)

Cranelap Joints



"G" is approximate clearance with bolt-studs tight.

Assembled Ring Joint

*Dimension "J" does not apply to Cranelap Joints; see "Bolt-stud lengths" on next page.

†***Caution:*** The 3-inch 300 and 600-Pound Cranelap Ring Joints use Ring No. R 30, having a pitch diameter of 4⅝ inches. When 3-inch 300 or 600-Pound ring joint valves, fittings, or flanges are to be bolted to Cranelap joints, orders must so specify; they will be machined special.

Class	Size	Ring Number	A	B	C	D	E	F	G	H	*J	No. of Bolt-Studs	Dia. of Bolt-Studs
150 Pound	1	R 15	1⅞	5/16	9/16	½	11/32	‡¼	5/32	2½	3	4	½
	1¼	R 17	2¼	5/16	9/16	½	11/32	‡¼	5/32	2⅞	3¼	4	½
	1½	R 19	2 9/16	5/16	9/16	½	11/32	‡¼	5/32	3¼	3¼	4	½
	2	R 22	3¼	5/16	9/16	½	11/32	¼	5/32	4	3¾	4	⅝
	2½	R 25	4	5/16	9/16	½	11/32	¼	5/32	4¾	4	4	⅝
	3	R 29	4½	5/16	9/16	½	11/32	¼	5/32	5¼	4¼	4	⅝
	3½	R 33	5 3/16	5/16	9/16	½	11/32	¼	5/32	6 1/16	4¼	8	⅝
	4	R 36	5⅞	5/16	9/16	½	11/32	¼	5/32	6¾	4¼	8	⅝
	5	R 40	6¾	5/16	9/16	½	11/32	¼	5/32	7⅝	4½	8	¾
	6	R 43	7⅝	5/16	9/16	½	11/32	¼	5/32	8⅝	4½	8	¾
	8	R 48	9¾	5/16	9/16	½	11/32	¼	5/32	10¾	4¾	8	¾
	10	R 52	12	5/16	9/16	½	11/32	¼	5/32	13	5¼	12	⅞
	12	R 56	15	5/16	9/16	½	11/32	¼	5/32	16	5½	12	⅞
	14	R 59	15⅝	5/16	9/16	½	11/32	¼	⅛	16¾	6	12	1
	16	R 64	17⅞	5/16	9/16	½	11/32	¼	⅛	19	6	16	1
	18	R 68	20⅜	5/16	9/16	½	11/32	¼	⅛	21½	6½	16	1⅛
	20	R 72	22	5/16	9/16	½	11/32	¼	⅛	23½	7	20	1⅛
	24	R 76	26½	5/16	9/16	½	11/32	¼	⅛	28	7¾	20	1¼

Class	Size	Ring Number	A	B	C	D	E	F	G 300 Lb.	G 400 Lb.	G 600 Lb.	H	*J 300 Lb.	*J 400 Lb.	*J 600 Lb.	No. of Bolt-Studs 300 Lb.	No. of Bolt-Studs 400 Lb.	No. of Bolt-Studs 600 Lb.	Dia. of Bolt-Studs 300 Lb.	Dia. of Bolt-Studs 400 Lb.	Dia. of Bolt-Studs 600 Lb.
†300, 400, and †600 Pound	½	R 11	1 11/32	¼	7/16	3/8	9/32	‡7/32	⅛		⅛	2	3		3	4		4	½		½
	¾	R 13	1 11/16	5/16	9/16	½	11/32	‡¼	5/32		5/32	2½	3½		3½	4		4	⅝		⅝
	1	R 16	2	5/16	9/16	½	11/32	‡¼	5/32		5/32	2¾	3½		3½	4		4	⅝		⅝
	1¼	R 18	2⅜	5/16	9/16	½	11/32	‡¼	5/32		5/32	3⅛	3¾		3¾	4		4	⅝		⅝
	1½	R 20	2 11/16	5/16	9/16	½	11/32	‡¼	5/32		5/32	3 9/16	4		4¼	4		4	¾		¾
	2	R 23	3¼	7/16	11/16	5/8	15/32	5/16	7/32		3/16	4¼	4¼		4½	8		8	⅝		⅝
	2½	R 26	4	7/16	11/16	5/8	15/32	5/16	7/32		3/16	5	4¾		5	8		8	¾		¾
	†3	†R 31	†4⅞	7/16	11/16	5/8	15/32	5/16	7/32		3/16	5¾	5		5¼	8		8	¾		¾
	3½	R 34	5 3/16	7/16	11/16	5/8	15/32	5/16	7/32		3/16	6¼	5¼		5¾	8		8	¾		⅞
	4	R 37	5⅞	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	6⅞	5¼	5¾	6	8	8	8	¾	⅞	⅞
	5	R 41	7⅛	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	8¼	5½	6	6¾	8	8	8	¾	⅞	1
	6	R 45	8 5/16	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	9½	5¾	6¼	7	12	12	12	¾	⅞	1
	8	R 49	10⅝	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	11⅞	6¼	7	8	12	12	12	⅞	1	1⅛
	10	R 53	12¾	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	14	7¼	7¾	8¾	16	16	16	1	1⅛	1¼
	12	R 57	15	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	16¼	7½	8½	9	16	16	20	1⅛	1¼	1¼
	14	R 61	16½	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	18	7¾	8¾	9½	20	20	20	1⅛	1¼	1⅜
	16	R 65	18½	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	20	8½	9¼	10¼	20	20	20	1¼	1⅜	1½
	18	R 69	21	7/16	11/16	5/8	15/32	5/16	7/32	7/32	3/16	22⅝	8¾	9½	11	24	24	20	1¼	1⅜	1⅝
	20	R 73	23	½	¾	11/16	17/32	3/8	7/32	7/32	3/16	25	9¼	10¼	11¾	24	24	24	1¼	1½	1⅝
	24	R 77	27¼	5/8	⅞	13/16	21/32	7/16	¼	¼	7/32	29½	10¼	11¼	13½	24	24	24	1½	1¾	1⅞

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Dimensions, in Inches (Cont.)

Class	Size	Ring Numbers	A	B	C	D	E	F	G	H	*J	No. of Bolt-Studs	Dia. of Bolt-Studs
900 Pound	3	R 31	4 7/8	7/16	1 1/16	5/8	15/32	5/16	5/32	6 1/8	6	8	7/8
	4	R 37	5 7/8	7/16	1 1/16	5/8	15/32	5/16	5/32	7 1/8	7	8	1 1/8
	5	R 41	7 1/8	7/16	1 1/16	5/8	15/32	5/16	5/32	8 1/2	7 3/4	8	1 1/4
	6	R 45	8 5/16	7/16	1 1/16	5/8	15/32	5/16	5/32	9 1/2	8	12	1 1/8
	8	R 49	10 5/8	7/16	1 1/16	5/8	15/32	5/16	5/32	12 1/8	9	12	1 3/8
	10	R 53	12 3/4	7/16	1 1/16	5/8	15/32	5/16	5/32	14 1/4	9 1/2	16	1 3/8
	12	R 57	15	7/16	1 1/16	5/8	15/32	5/16	5/32	16 1/2	10 1/4	20	1 3/8
	14	R 62	16 1/2	5/8	7/8	1 3/16	21/32	7/16	5/32	18 3/8	11 1/4	20	1 1/2
	16	R 66	18 1/2	5/8	7/8	1 3/16	21/32	7/16	5/32	20 5/8	11 3/4	20	1 5/8
	18	R 70	21	3/4	1	1 5/16	25/32	1/2	3/16	23 3/8	13 1/2	20	1 7/8
	20	R 74	23	3/4	1	1 5/16	25/32	1/2	3/16	25 1/2	14 1/2	20	2
	24	R 78	27 1/4	1	1 5/16	1 1/4	1 1/16	5/8	7/32	30 3/8	18 1/4	20	2 1/2
1500 Pound	1/2	R 12	1 9/16	5/16	9/16	1/2	11/32	‡1/4	5/32	2 3/8	4 1/4	4	3/4
	3/4	R 14	1 3/4	5/16	9/16	1/2	11/32	‡1/4	5/32	2 5/8	4 1/2	4	3/4
	1	R 16	2	5/16	9/16	1/2	11/32	‡1/4	5/32	2 13/16	5	4	7/8
	1 1/4	R 18	2 3/8	5/16	9/16	1/2	11/32	‡1/4	5/32	3 3/16	5	4	7/8
	1 1/2	R 20	2 11/16	5/16	9/16	1/2	11/32	‡1/4	5/32	3 5/8	5 1/2	4	1
	2	R 24	3 3/4	7/16	1 1/16	5/8	15/32	5/16	1/8	4 7/8	6	8	7/8
	2 1/2	R 27	4 1/4	7/16	1 1/16	5/8	15/32	5/16	1/8	5 3/8	6 1/2	8	1
	3	R 35	5 3/8	7/16	1 1/16	5/8	15/32	5/16	1/8	6 5/8	7 1/4	8	1 1/8
	4	R 39	6 3/8	7/16	1 1/16	5/8	15/32	5/16	1/8	7 5/8	8	8	1 1/4
	5	R 44	7 5/8	7/16	1 1/16	5/8	15/32	5/16	1/8	9	10	8	1 1/2
	6	R 46	8 5/16	1/2	3/4	1 1/16	17/32	3/8	1/8	9 3/4	10 3/4	12	1 3/8
	8	R 50	10 5/8	5/8	7/8	1 3/16	21/32	7/16	5/32	12 1/2	12	12	1 5/8
	10	R 54	12 3/4	5/8	7/8	1 3/16	21/32	7/16	5/32	14 5/8	13 3/4	12	1 7/8
	12	R 58	15	7/8	1 1/8	1 1/16	29/32	9/16	3/16	17 1/4	15 3/4	16	2
	14	R 63	16 1/2	1	1 5/16	1 1/4	1 1/16	5/8	7/32	19 1/4	17 1/4	16	2 1/4
	16	R 67	18 1/2	1 1/8	1 7/16	1 3/8	1 3/16	1 1/16	5/16	21 1/2	19	16	2 1/2
	18	R 71	21	1 1/8	1 7/16	1 3/8	1 3/16	1 1/16	5/16	24 1/8	20 3/4	16	2 3/4
	20	R 75	23	1 1/4	1 9/16	1 1/2	1 5/16	1 1/16	3/8	26 1/2	22 3/4	16	3
	24	R 79	27 1/4	1 3/8	1 3/4	1 5/8	1 7/16	1 3/16	7/16	31 1/4	26	16	3 1/2
2500 Pound	1/2	R 13	1 11/16	5/16	9/16	1/2	11/32	‡1/4	5/32	2 9/16	4 3/4	4	3/4
	3/4	R 16	2	5/16	9/16	1/2	11/32	‡1/4	5/32	2 7/8	5	4	3/4
	1	R 18	2 3/8	5/16	9/16	1/2	11/32	‡1/4	5/32	3 1/4	5 1/2	4	7/8
	1 1/4	R 21	2 27/32	7/16	1 1/16	5/8	15/32	5/16	1/8	4	6 1/4	4	1
	1 1/2	R 23	3 1/4	7/16	1 1/16	5/8	15/32	5/16	1/8	4 1/2	7	4	1 1/8
	2	R 26	4	7/16	1 1/16	5/8	15/32	5/16	1/8	5 1/4	7 1/4	8	1
	2 1/2	R 28	4 3/8	1/2	3/4	1 1/16	17/32	3/8	1/8	5 7/8	8	8	1 1/8
	3	R 32	5	1/2	3/4	1 1/16	17/32	3/8	1/8	6 5/8	9 1/4	8	1 1/4
	4	R 38	6 3/16	5/8	7/8	1 3/16	21/32	7/16	5/32	8	10 1/2	8	1 1/2
	5	R 42	7 1/2	3/4	1	1 5/16	25/32	1/2	5/32	9 1/2	12 1/2	8	1 3/4
	6	R 47	9	3/4	1	1 5/16	25/32	1/2	5/32	11	14 1/4	8	2
	8	R 51	11	7/8	1 1/8	1 1/16	29/32	9/16	3/16	13 3/8	16	12	2
	10	R 55	13 1/2	1 1/8	1 7/16	1 3/8	1 3/16	1 1/16	1/4	16 3/4	20 1/4	12	2 1/2
	12	R 60	16	1 1/4	1 9/16	1 1/2	1 5/16	1 1/16	5/16	19 1/2	22 1/4	12	2 3/4

Rings: See page 452. Type "A" or "B" Rings 1/4, 5/16, or 7/16-inch wide are regularly furnished oval shape; 1/2-inch wide or wider Type "A" or Type "B" Rings are octagonal shape.

Standards: The dimensions of the ring joint facing and of the rings conform to the American Standard for Steel Pipe Flanges and Flanged Fittings, B16e-1939 and Addendum B16e4-1940, except that the American Standard does not define octagonal rings of widths less than 1/2-inch. They also conform to the American Petroleum Institute Standard 6-B, Third Edition, May, 1945 (Tentative), and Supplement 2, September, 1947.

The dimensions shown on this and the preceding page apply to ring joint facing and rings for the end flanges of steel valves and flanged fittings, and for steel flanges. The groove (smooth finish) for the ring is cut in a raised face as illustrated on the preceding page.

‡Center to face: When ring joint facing is applied to 150 and 300-Pound valves and fittings, the center to the raised face is equal to the regular center to face dimension (which includes the 1/16-inch raised face) plus the depth of the groove on sizes 2-inch and larger, or plus the depth of the groove minus 1/32-inch on smaller sizes.

On higher pressure ring joint valves and fittings, the center to the raised face is equal to the regular center to face dimension minus 1/4-inch (the height of the large male), plus the depth of the groove on 400, 600, 900, and 1500-Pound sizes 2-inch and larger and on 2500-Pound sizes 1 1/4-inch and larger, or plus the depth of the groove minus 1/32-inch on the smaller sizes.

This practice also applies to loose flanges; that is, the raised face which is equal to the depth of the groove is added to the flange thickness (dimension "B" on pages 290 and 291) except that on the smaller sizes the groove cuts 1/32-inch into the flange thickness.

On Cranelap joints with ring joint facing the depth of the groove is added to the minimum thickness of the lap. See pages 487 to 490 for Cranelap joints.

***Bolt-stud lengths:** The length of bolt-studs indicated as dimension "J" in the tables applies for all combinations of ring joint valves, fittings, and flanges other than Cranelap.

For ring joint combinations made up of valves, fittings, or flanges bolted to Cranelaps, add the pipe thickness to dimension "J". For Cranelap to Cranelap ring joints, add twice the pipe thickness to dimension "J".

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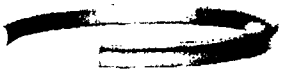
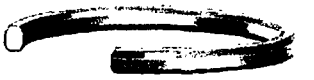
Rings for ring joints page 452
Dimensions of Cranelap Joints page 490
List prices of bolt-studs pages 446 and 447
Templates for drilling and flange dimensions pages 441 to 443

Rings for Ring Joints



Oval Ring
Types A and B

Prices on application



Octagonal Ring
Types A and B

Crane Oval and Octagonal Rings, illustrated above, are available in two grades of material suitable for use in 150, 300, 400, 600, 900, 1500, and 2500-Pound ring joints.

The shape of the ring regularly furnished for various sizes and pressure classes of joints is indicated in the table at the right.

Ordering: Orders for rings should specify the Ring Number and whether Type A or Type B is wanted. When the Type is not specified, Type A Rings will regularly be supplied in the shape shown in the table at the right.

Type A Rings are made of Soft Steel (90 Brinell maximum hardness), either oval or octagonal, as shown in the table at the right; they are recommended for use with Carbon Steel, No. 4 Carbon-Molybdenum Steel, or No. 3 Nickel Steel products.

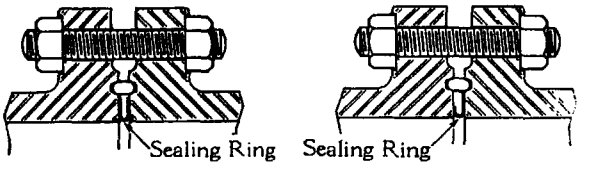
Type B Rings made of 5% Chrome with ½% Molybdenum (130 Brinell maximum hardness), are recommended for corrosive services, as in oil refinery work, and for use with No. 5 Chrome-Molybdenum Steel products. They have the same shape as Type A Rings, being distinguished by a square bead on the outer periphery.

Dimensions of Rings and Ring Joints . . pages 450 and 451
Flanged joint assembly and maintenance . . . . . page 508

Shape of Ring Regularly Furnished For Various Size Ring Joints

Pressure Class	Oval Rings	Octagonal Rings
150-Pound	All sizes	
300-Pound	18" and smaller	20 and 24"
400-Pound		
600-Pound		
900-Pound	12" and smaller	14" and larger
1500-Pound	5" and smaller	6" and larger
2500-Pound	Information on request.	

Corrosion Sealing Rings



For unusually corrosive fluids, ***Corrosion Sealing Rings,*** illustrated above, are recommended for protection of rings. Prices on application.

Gaskets

For Brass Flanged Joints



Full Face Gaskets are furnished without bolt holes unless otherwise ordered; an extra charge is made for punching bolt holes.

Size of Joint Inches	150-Pound MSS Standard Full Face Gaskets — List Prices, Each: 1/16-inch Cloth Inserted Rubber	1/16-inch "CC" Rubber	1/16-inch Cranite	Inside and Outside Diameters Inches	300-Pound MSS Standard Full Face Gaskets — List Prices, Each: 1/16-inch "CC" Rubber	1/16-inch Cranite	Inside and Outside Diameters Inches
1	.15	.18	.18	1 ×4¼	.39	.22	1 ×4⅞
1¼	.21	.26	.19	1¼×4⅝	.39	.26	1¼×5¼
1½	.21	.26	.22	1½×5	.39	.34	1½×6⅛
2	.27	.35	.31	2 ×6	.46	.38	2 ×6½
2½	.34	.43	.44	2½×7	.56	.53	2½×7½
3	.41	.51	.49	3 ×7½	.69	.61	3 ×8¼
3½	.44	.69	.61	3½×8½			
4	.52	.77	.66	4 ×9			
5	.62	1.05	.72	5 ×10			
6	.69	1.25	.81	6 ×11			
8	.96	1.50	1.20	8 ×13½			
10	1.30	2.05	1.70	10 ×16			

Important: Full face gaskets should always be used for Brass Flanged Joints. Metallic gaskets are not recommended.

When brass flanged material is bolted to iron or steel material which normally has a raised face, the raised face should be removed to provide a full face bearing for the gasket. Brass flanged material should not be bolted to Cranelap Flanged Pipe Joints.

Cranite Gaskets: When installing Cranite Gaskets, they should be coated with Crane Thread Lubricant in order to facilitate making tight joints. Cranite Gaskets are satisfactory for use in oil lines where asbestos gaskets are permitted.

Thread Lubricants . . . . page 444 ***Sheet Packings . . . . page 453***
For Gaskets for Iron and Steel Flanged Joints, see pages 454 to 456.

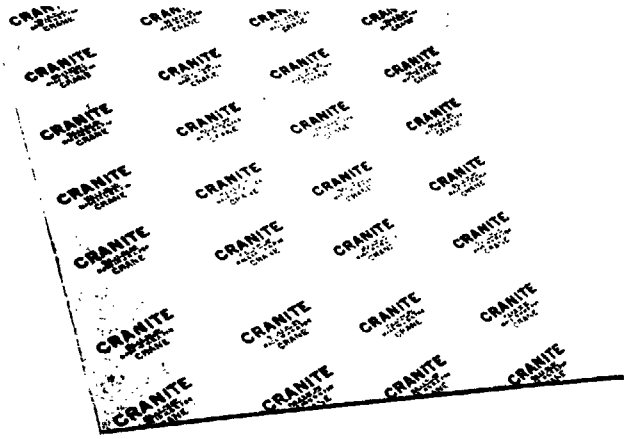
Cranite Sheet Packing

An Asbestos Composition Manufactured Solely for Crane

CRANITE is the highest grade of sheet packing obtainable.

The name "CRANITE" is registered in the United States Patent Office.

The list price of Cranite Sheet Packing is $1.60 per pound.



The 1/16-inch thickness averages .62 pound to the square foot.

Cranite Sheet Packing: Cranite Sheet Packing is made of an asbestos composition, using only selected long fiber asbestos, cross laminated to provide unusual tensile strength. It offers a very uniform and high resistance to compression, is exceptionally strong and rugged, and will not deteriorate with age.

This packing is unhesitatingly recommended for a multitude of services, such as steam, water, oil, dry air, acids, ammonia, alkali, gases, etc., and for temperatures up to 750° F.

Because of the great number of services for which Cranite Sheet Packing can be used, its unusually high quality, and its ability to withstand deterioration, users will find it economical to purchase the packing in quantities and to carry it in stock.

For best results, gaskets cut from Cranite Sheet Packing should be coated with Crane Thread Lubricant when being installed. See page 444 for Crane Thread Lubricants.

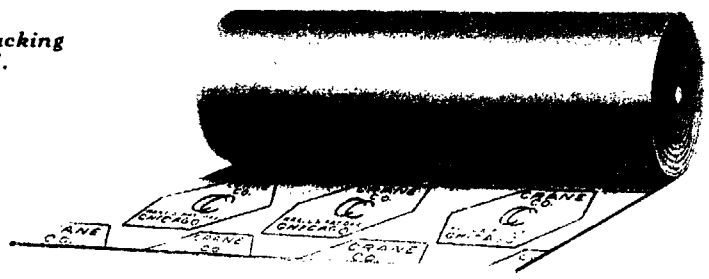
Sizes: Cranite Sheet Packing in the 1/16-inch thickness is regularly furnished in sheets 36 or 48 inches square. Other thicknesses from 1/64 to 1/4-inch, or other sizes up to 120 inches square can be made to order; prices on application.

Cranite Packing has been inspected and is listed by the Underwriters' Laboratories (National Board of Fire Underwriters), Chicago, for use on hazardous liquids.

"CC" Rubber Sheet Packing

Manufactured Solely for Crane

The list price of "CC" Rubber Sheet Packing is $1.05 per pound.



The 1/16-inch thickness averages .61 pound to the square foot.

"CC" Rubber Sheet Packing, manufactured solely for Crane, is especially well adapted for high or low pressure service on saturated steam, hot and cold water, air, gases, etc. It is made up in rolls 36 inches wide, weighing approximately 200 pounds each, and in thicknesses of 1/16-inch, 3/32-inch, and 1/8-inch. "CC" Rubber Sheet Packing can be furnished in rolls up to 72 inches wide.

Gaskets

For Cast Iron Flanged Joints



Ring Gaskets cover the face of the flange to the inside edge of the bolts, and will always be furnished unless otherwise ordered.



Full Face Gaskets are furnished without bolt holes unless otherwise ordered; an extra charge is made for punching bolt holes.

Flanged Joint		Ring Gaskets						Full Face Gaskets					
		List Prices, Each				Diameter, in Inches		List Prices, Each				Diameter, in Inches	
Pressure Class	Size	1/16-inch Cloth Inserted Rubber	1/16-inch "CC" Rubber	4-ounce Canvas	1/16-inch Cranite	Inside	Outside	1/16-inch Cloth Inserted Rubber	1/16-inch "CC" Rubber	4-ounce Canvas	1/16-inch Cranite	Inside	Outside
	Inches												
For 25-Pound Cast Iron Flanged Joints	10	.63	1.05	.37	....	10	13 5/8	1.30	2.05	.81	....	10	16
	12	.86	1.30	.52	....	12	16 3/8	1.70	2.55	1.05	....	12	19
	14	1.05	1.60	.62	....	14	18	1.90	2.90	1.20	....	14	21
	16	1.20	2.05	.72	....	16	20 1/2	2.45	3.65	1.45	....	16	23 1/2
	18	1.30	2.35	.77	....	18	22	2.75	4.10	1.65	....	18	25
	20	1.50	2.55	.90	....	20	24 1/4	2.95	4.50	1.75	....	20	27 1/2
	24	2.10	3.00	1.25	....	24	28 3/4	3.75	5.40	2.30	....	24	32
	30	3.10	4.50	1.90	....	30	35 1/8	5.60	9.10	3.40	....	30	38 3/4
	36	4.30	7.00	2.60	....	36	41 7/8	7.50	13.90	4.55	....	36	46
	42	5.15	8.25	3.10	....	42	48 1/2	....	16.55	5.55	....	42	53
	48	....	9.65	4.10	....	48	55	....	19.25	7.15	....	48	59 1/2
For 125-Pound Cast Iron Flanged Joints	1	.07	.09	.06	.08	1	2 5/8	.15	.18	.13	.18	1	4 1/4
	1 1/4	.10	.13	.09	.09	1 1/4	3	.21	.26	.18	.19	1 1/4	4 5/8
	1 1/2	.10	.13	.09	.12	1 1/2	3 3/8	.21	.26	.18	.22	1 1/2	5
	2	.10	.18	.09	.14	2	4 1/8	.27	.35	.21	.31	2	6
	2 1/2	.13	.22	.10	.17	2 1/2	4 7/8	.34	.43	.27	.44	2 1/2	7
	3	.18	.26	.13	.20	3	5 3/8	.41	.51	.31	.49	3	7 1/2
	3 1/2	.21	.36	.15	.29	3 1/2	6 3/8	.44	.69	.33	.61	3 1/2	8 1/2
	4	.24	.40	.16	.31	4	6 7/8	.52	.77	.35	.66	4	9
	5	.28	.51	.19	.36	5	7 3/4	.62	1.05	.41	.72	5	10
	6	.34	.60	.22	.41	6	8 3/4	.69	1.25	.44	.81	6	11
	8	.44	.77	.27	.56	8	11	.96	1.50	.59	1.20	8	13 1/2
	10	.62	1.05	.37	.75	10	13 3/8	1.30	2.05	.81	1.70	10	16
	12	.86	1.30	.52	1.15	12	16 1/8	1.70	2.55	1.05	2.30	12	19
	14	1.05	1.60	.62	1.20	14	17 3/4	1.90	2.85	1.20	2.60	14	21
	16	1.20	2.05	.72	1.40	16	20 1/4	2.45	3.65	1.50	3.10	16	23 1/2
	18	1.25	2.35	.77	1.20	18	21 5/8	2.75	4.10	1.65	3.20	18	25
	20	1.50	2.55	.90	1.45	20	23 7/8	2.95	4.50	1.75	3.50	20	27 1/2
	24	2.05	2.95	1.25	2.50	24	28 1/4	3.75	5.40	2.30	4.25	24	32
	30	3.10	4.50	1.85	....	30	34 3/4	5.60	9.10	3.40	....	30	38 3/4
	36	4.30	6.95	2.60	....	36	41 1/4	7.50	13.90	4.55	....	36	46
	42	5.15	8.25	3.10	....	42	48	....	16.55	5.55	....	42	53
	48	....	9.65	4.05	....	48	54 1/2	....	19.20	7.15	....	48	59 1/2
For 250-Pound Cast Iron Flanged Joints	1 1/2	....	.18	....	.14	1 1/2	3 3/4						
	2	....	.20	....	.15	2	4 3/8						
	2 1/2	....	.26	....	.19	2 1/2	5 1/8						
	3	....	.33	....	.26	3	5 7/8						
	3 1/2	....	.36	....	.30	3 1/2	6 1/2						
	4	....	.39	....	.36	4	7 1/8						
	5	....	.53	....	.47	5	8 1/2						
	6	....	.64	....	.61	6	9 7/8						
	8	....	.92	....	.81	8	12 1/8						
	10	....	1.20	....	1.05	10	14 1/4						
	12	....	1.55	....	1.25	12	16 5/8						
	14	....	2.15	....	2.10	13 1/4	19 1/8						
	16	....	2.55	....	2.30	15 1/4	21 1/4						
	18	....	2.95	....	2.60	17	23 1/2						
	20	....	3.10	....	3.05	19	25 3/4						
	24	....	4.10	....	3.95	23	30 1/2						

Canvas Gaskets: Canvas Gaskets are furnished uncoated. They should be coated with Crane Thread Lubricant or with red lead and oil when installed.

Cranite Gaskets: When Cranite Gaskets are installed, they should be coated with Crane Thread Lubricant to facilitate making tight joints. Cranite Gaskets are satisfactory for use in oil lines where asbestos gaskets are permitted.

Other materials: Other commercial sheet packing gaskets are made to order; prices on application.

Thread lubricants ..... *page 444*
Sheet packings ..... *page 453*
Gaskets for brass flanged joints ..... *page 452*

800-Pound Hydraulic Cast Iron Joints: Gaskets for 800-Pound Hydraulic Cast Iron Flanged Joints are the same as for 600-Pound Steel Flanged Joints; use the list prices and dimensions shown on page 455.

Gaskets

For Steel Flanged Joints

Cranite Gaskets: Cranite Gaskets are recommended for steam, water, air, gas, and many other similar services, including oil lines on which asbestos gaskets are permitted. Their use is limited to a maximum of 750° F. When being installed, they should be coated with Crane Thread Lubricant to facilitate the making of tight joints.

Corrugated Metallic Gaskets: Corrugated Metallic Gaskets (Copper or Soft Iron) can be furnished when ordered; prices and dimensions on application. They should have a large inside diameter to assure a high unit compressive load; this requirement is mandatory in the case of piping materials used at the higher pressures and temperatures for which they are recommended. The gaskets should be coated with Crane High Temperature Thread Lubricant when being installed.



Ring Gaskets extend to the inside edge of the bolts



Corrugated Metallic Gasket

800-Pound Hydraulic Cast Iron Joints: 800-Pound Hydraulic Cast Iron Flanged Joints use the same gaskets as the 600-Pound Steel, see list prices and dimensions in the table below.

Ring Gaskets—1/16-Inch Thick Cranite

Size of Joint Inches	150-Pound List Price Each	150-Pound I.D. × O.D. Inches	300-Pound List Price Each	300-Pound I.D. × O.D. Inches	400-Pound List Price Each	400-Pound I.D. × O.D. Inches	600-Pound List Price Each	600-Pound I.D. × O.D. Inches	900-Pound List Price Each	900-Pound I.D. × O.D. Inches	1500-Pound List Price Each	1500-Pound I.D. × O.D. Inches
1/2	.06	1/2 × 1 7/8	.08	1/2 × 2 1/8	....	.....	.08	1/2 × 2 1/8	....	.....	.08	1/2 × 2 1/2
3/4	.07	3/4 × 2 1/4	.08	3/4 × 2 5/8	....	.....	.08	3/4 × 2 5/8	....	.....	.09	11/16 × 2 3/4
1	.08	1 × 2 5/8	.09	1 × 2 7/8	....	.....	.09	1 × 2 7/8	....	.....	.11	7/8 × 3 1/8
1 1/4	.09	1 1/4 × 3	.11	1 1/4 × 3 1/4	....	.....	.11	1 1/4 × 3 1/4	....	.....	.13	1 1/8 × 3 1/2
1 1/2	.12	1 1/2 × 3 3/8	.14	1 1/2 × 3 3/4	....	.....	.14	1 1/2 × 3 3/4	....	.....	.15	1 3/8 × 3 7/8
2	.14	2 × 4 1/8	.15	2 × 4 3/8	....	.....	.15	2 × 4 3/8	....	.....	.27	1 7/8 × 5 5/8
2 1/2	.17	2 1/2 × 4 7/8	.19	2 1/2 × 5 1/8	....	.....	.19	2 1/2 × 5 1/8	....	.....	.36	2 1/4 × 6 1/2
3	.20	3 × 5 3/8	.26	3 × 5 7/8	....	.....	.26	3 × 5 7/8	.36	2 7/8 × 6 5/8	.40	2 3/4 × 6 7/8
3 1/2	.29	3 1/2 × 6 3/8	.30	3 1/2 × 6 1/2	....	.....	.29	3 1/2 × 6 3/8	....	.....	....	.....
4	.31	4 × 6 7/8	.36	4 × 7 1/8	.34	4 × 7	.44	4 × 7 5/8	.54	3 7/8 × 8 1/8	.58	3 5/8 × 8 1/4
5	.36	5 × 7 3/4	.47	5 × 8 1/2	.45	5 × 8 3/8	.66	5 × 9 1/2	.72	4 3/4 × 9 3/4	.81	4 3/8 × 10
6	.41	6 × 8 3/4	.61	6 × 9 7/8	.59	6 × 9 3/4	.69	6 × 10 1/2	1.00	5 3/4 × 11 3/8	1.00	5 3/8 × 11 1/8
8	.56	8 × 11	.81	8 × 12 1/8	.78	8 × 12	1.00	7 7/8 × 12 5/8	1.40	7 1/2 × 14 1/8	1.40	7 × 13 7/8
10	.75	10 × 13 3/8	1.05	10 × 14 1/4	1.00	10 × 14 1/8	1.65	9 3/4 × 15 3/4	2.10	9 3/8 × 17 1/8	2.15	8 3/4 × 17 1/8
12	1.15	12 × 16 1/8	1.25	12 × 16 5/8	1.25	12 × 16 1/2	2.00	11 3/4 × 18	2.60	11 1/8 × 19 5/8	3.05	10 3/8 × 20 1/2
14	1.35	13 1/4 × 17 3/4	2.10	13 1/4 × 19 1/8	2.05	13 1/8 × 19	2.25	12 7/8 × 19 3/8	2.70	12 1/4 × 20 1/2	3.80	11 3/8 × 22 3/4
16	1.75	15 1/4 × 20 1/4	2.30	15 1/4 × 21 1/4	2.35	15 × 21 1/8	2.90	14 3/4 × 22 1/4	3.30	14 × 22 5/8	....	.....
18	1.55	17 1/4 × 21 5/8	2.60	17 × 23 1/2	2.55	17 × 23 3/8	3.20	16 1/2 × 24 1/8	3.75	15 3/4 × 25 1/8	....	.....
20	1.80	19 1/4 × 23 7/8	3.05	19 × 25 3/4	3.05	18 7/8 × 25 1/2	3.80	18 1/4 × 26 7/8	4.40	17 1/2 × 27 1/2	....	.....
24	2.95	23 1/4 × 28 1/4	3.95	23 × 30 1/2	4.00	22 5/8 × 30 1/4	4.75	22 × 31 1/8	6.40	21 × 33	....	.....

Large Male and Female Gaskets—1/16-Inch Thick Cranite

Size of Joint Inches	300-Pound List Price Each	300-Pound I.D. × O.D. Inches	400-Pound List Price Each	400-Pound I.D. × O.D. Inches	600-Pound List Price Each	600-Pound I.D. × O.D. Inches	900-Pound List Price Each	900-Pound I.D. × O.D. Inches	1500-Pound List Price Each	1500-Pound I.D. × O.D. Inches
1/2	.04	1/2 × 1 3/8	....	.....	.04	1/2 × 1 3/8	....	.....	.04	1/2 × 1 3/8
3/4	.05	3/4 × 1 11/16	....	.....	.05	3/4 × 1 11/16	....	.....	.05	11/16 × 1 11/16
1	.05	1 × 2	....	.....	.05	1 × 2	....	.....	.06	7/8 × 2
1 1/4	.06	1 1/4 × 2 1/2	....	.....	.06	1 1/4 × 2 1/2	....	.....	.07	1 1/8 × 2 1/2
1 1/2	.07	1 1/2 × 2 7/8	....	.....	.07	1 1/2 × 2 7/8	....	.....	.08	1 3/8 × 2 7/8
2	.11	2 × 3 5/8	....	.....	.11	2 × 3 5/8	....	.....	.12	1 7/8 × 3 5/8
2 1/2	.12	2 1/2 × 4 1/8	....	.....	.12	2 1/2 × 4 1/8	....	.....	.13	2 1/4 × 4 1/8
3	.15	3 × 5	....	.....	.15	3 × 5	.15	2 7/8 × 5	.16	2 3/4 × 5
3 1/2	.16	3 1/2 × 5 1/2	....	.....	.16	3 1/2 × 5 1/2	....	.....	....	.....
4	.24	4 × 6 3/16	.24	4 × 6 3/16	.24	4 × 6 3/16	.25	3 7/8 × 6 3/16	.27	3 5/8 × 6 3/16
5	.29	5 × 7 5/16	.29	5 × 7 5/16	.29	5 × 7 5/16	.31	4 3/4 × 7 5/16	.36	4 3/8 × 7 5/16
6	.36	6 × 8 1/2	.36	6 × 8 1/2	.36	6 × 8 1/2	.39	5 3/4 × 8 1/2	.44	5 3/8 × 8 1/2
8	.47	8 × 10 5/8	.47	8 × 10 5/8	.50	7 7/8 × 10 5/8	.56	7 1/2 × 10 5/8	.63	7 × 10 5/8
10	.61	10 × 12 3/4	.61	10 × 12 3/4	.66	9 3/4 × 12 3/4	.72	9 3/8 × 12 3/4	.88	8 3/4 × 12 3/4
12	.81	12 × 15	.81	12 × 15	.88	11 3/4 × 15	1.00	11 1/8 × 15	1.15	10 3/8 × 15
14	.88	13 1/4 × 16 1/4	.91	13 1/8 × 16 1/4	.97	12 7/8 × 16 1/4	1.15	12 1/4 × 16 1/4	1.25	11 3/8 × 16 1/4
16	1.05	15 1/4 × 18 1/2	1.15	15 × 18 1/2	1.20	14 3/4 × 18 1/2	1.40	14 × 18 1/2	....	.....
18	1.35	17 × 21	1.35	17 × 21	1.55	16 1/2 × 21	1.95	15 3/4 × 21	....	.....
20	1.45	19 × 23	1.50	18 7/8 × 23	1.80	18 1/4 × 23	2.20	17 1/2 × 23	....	.....
24	2.35	23 × 27 1/4	2.50	22 5/8 × 27 1/4	2.85	22 × 27 1/4	3.20	21 × 27 1/4	....	.....

Sheet packings . . . page 453 *Large tongue and groove gaskets . . . page 456* *Thread lubricants . . . page 444*

Gaskets for All Large Tongue and Groove Flanged Joints

Cranite Gaskets are not recommended for temperatures higher than 750° F. They are satisfactory for use in oil lines where asbestos gaskets are permitted. Corrugated Metallic Gaskets (Copper or Soft Iron) are available; prices on application.

Coating Cranite Gaskets with Crane Thread Lubricant and Corrugated Metallic Gaskets with Crane High Temperature Thread Lubricant, before installing, will facilitate making tight joints.

Cranite Gaskets are not recommended for use in small male and female or small tongue and groove joints. Cranite offers uniform and high resistance to compression but the gasket contact area in such joints is so narrow, crushing the gasket is possible.

List Prices and Dimensions of Gaskets

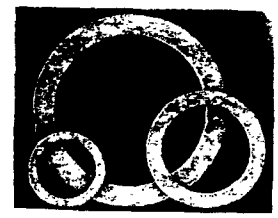
For 800-Pound Hydraulic and 800-Pound W.O.G. Cast Iron, and 300, 400, 600, 900, and 1500-Pound Steel Large Tongue and Groove Flanged Joints

Size of Joint	1/16-inch Cranite		Size of Joint	1/16-inch Cranite	
	List Price	Inside and Outside Diameters		List Price	Inside and Outside Diameters
Inches	Each	Inches	Inches	Each	Inches
1/2	.03	1 ×1 3/8	5	.13	6 5/16×7 5/16
3/4	.03	1 5/16×1 11/16	6	.16	7 1/2 ×8 1/2
1	.03	1 1/2 ×2	8	.25	9 3/8 ×10 5/8
1 1/4	.04	1 7/8 ×2 1/2	10	.36	11 1/4 ×12 3/4
1 1/2	.04	2 1/8 ×2 7/8	12	.42	13 1/2 ×15
2	.05	2 7/8 ×3 5/8	14	.46	14 3/4 ×16 1/4
2 1/2	.06	3 3/8 ×4 1/8	16	.61	16 3/4 ×18 1/2
3	.09	4 1/4 ×5	18	.69	19 1/4 ×21
3 1/2	.10	4 3/4 ×5 1/2	20	.88	21 ×23
4	.12	5 3/16×6 3/16	24	1.05	25 1/4 ×27 1/4

Thread lubricants . . . . page 444
Sheet packings . . . . page 453

Ring Gaskets For Unions or Union Fittings

When ordering ring gaskets, specify the gasket material and the size and kind of union or union fitting.



For ring gaskets for Tongue and Groove Flange Unions, see page 399.

List Prices and Dimensions of Ring Gaskets

Size of Union or Union Fitting	For 150-Pound Malleable Iron Screwed Unions and Union Fittings *Circulating Boiler Fittings			For 125-Pound Cast Iron Flange Unions	
	Rubber	Cranite	Inside and Outside Diameters	1/16-inch "CC" Rubber	Inside and Outside Diameters
Inches	Price per 100	Price per 100	Inches	Price Each	Inches
1/4	.56	1.00	1/2 ×29/32	....	....
3/8	.89	1.25	5/8 ×13/32	....	....
1/2	1.05	1.50	3/4 ×1 1/4	.04	13/16 ×1 3/8
3/4	1.30	1.80	31/32 ×1 17/32	.04	1 1/16 ×1 7/8
1	1.60	2.25	1 7/32 ×1 13/16	.05	1 5/16 ×2 1/8
1 1/4	1.95	2.70	1 9/16 ×2 5/32	.06	1 11/16×2 5/8
1 1/2	2.40	3.35	1 13/16×2 7/16	.06	1 15/16×2 7/8
2	3.20	4.50	2 5/16 ×3 3/32	.06	2 3/8 ×3 1/2
2 1/2	4.20	5.90	2 3/4 ×3 9/16	.07	2 7/8 ×3 7/8
3	5.40	7.60	3 3/8 ×4 1/4	.09	3 1/2 ×4 5/8
3 1/2	....	....	....	.11	4 ×5 1/4
4	....	....	....	.12	4 1/2 ×5 3/4
5	....	....	....	.16	5 9/16 ×7
6	....	....	....	.24	6 5/8 ×8 1/4
8	....	....	....	.34	8 5/8 ×10 1/2

*Circulating Boiler Fittings (No. 586 and No. 589) use the gaskets shown for the 3/4-inch size.

Galvanized Steel Flanged Fittings and Flanges

Extra List Prices for Galvanizing

Size	150-Pound Cast Steel Fittings and Forged Steel Flanges						300-Pound Cast Steel Fittings and Forged Steel Flanges					
	Elbows	Elbows	Crosses	Flanges			Elbows	Elbows	Crosses	Flanges		
	No. 525 D No. 527 D No. 545 D	No. 550 D No. 551 D	No. 537 D No. 539 D	No. 556 Screwed	No. 554½ No. 556½ No. 558½		No. 401 D No. 403 D No. 421 D	No. 425½ D No. 427 D	No. 413 D No. 415 D	No. 291 E Screwed	No. 290 E No. 292 E No. 296 E	
	Reducers No. 547 D No. 548 D	Tees No. 531 D No. 534 D	Laterals No. 541 D No. 543 D	No. 554 Slip-On Welding	No. 568		Reducers No. 423 D No. 423½ D	Tees No. 407 D No. 412 D	Laterals No. 417 D No. 419 D	No. 294 E Slip-On Welding	No. 297 E	
Inches	Extra Each	Extra Each	Extra Each	Extra Each	O.D. In.	Extra Each	Extra Each	Extra Each	Extra Each	Extra Each	O.D. In.	Extra Each
1	3.50	5.20	7.00	.90	4 1/4	1.30	4.40	6.50	8.70	1.20	4 7/8	1.80
1 1/4	3.50	5.20	7.00	.90	4 5/8	1.30	4.40	6.50	8.70	1.20	5 1/4	1.80
1 1/2	3.50	5.20	7.00	.90	5	1.30	4.40	6.50	8.70	1.20	6 1/8	1.80
2	3.50	5.20	7.00	1.00	6	1.50	4.40	6.50	8.70	1.50	6 1/2	2.20
2 1/2	3.60	5.40	7.30	1.10	7	1.60	4.50	6.70	9.00	1.50	7 1/2	2.30
3	4.00	6.00	8.00	1.30	7 1/2	1.80	5.00	7.60	10.00	1.70	8 1/4	2.50
3 1/2	4.70	7.00	9.40	1.50	8 1/2	2.20	6.00	9.00	12.00	2.00	9	3.00
4	5.30	8.00	10.50	1.80	9	2.60	6.50	10.00	13.00	2.40	10	3.60
5	7.00	10.50	14.00	2.00	10	2.90	8.70	13.00	17.50	2.80	11	4.00
6	8.70	13.00	17.50	2.40	11	3.60	11.00	16.50	22.00	3.30	12 1/2	5.00
8	13.00	19.50	26.00	3.60	13 1/2	5.40	16.50	24.50	32.50	5.00	15	7.60
10	21.00	32.00	42.00	5.40	16	8.30	26.00	39.00	52.00	7.60	17 1/2	11.50
12	30.50	45.00	61.00	7.30	19	11.00	37.50	56.50	75.50	10.00	20 1/2	15.00
14	43.50	65.50	87.00	10.00	21	15.00	54.50	81.00	109.00	14.50	23	22.00
16	58.00	87.00	116.00	15.00	23 1/2	23.00	72.50	109.00	145.00	22.00	25 1/2	32.50

Cast Steel Flanged Fittings . . . pages 261 to 268
Forged Steel Flanges . . . pages 285 to 292

Pipe, Pipe Data, and Thread Information

Tubular Products, Wrought Steel and Wrought Iron
- General Notes, Pipe Trade Practice ..... page 458
- Double Random Lengths Carried in Stock ..... page 458

Pipe and Tubes
- Standard Pipe ..... page 459
- Extra Strong Pipe ..... page 460
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- API Standard Threaded Line Pipe ..... page 462
- Large O.D. Pipe ..... page 463
- Water Well Casing ..... page 463
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American Standard for Pipe ..... pages 466 to 469
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Thread Information
- American Standard Taper Pipe Threads ..... page 472
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- Discussion of Threaded Pipe Joints ..... page 475

Pages 458 to 476 constitute the section devoted to Pipe, Pipe Data, and Thread Information. In addition, this catalog contains useful engineering data on pipe and lists of sizes and weights of copper tubing; see the pages referred to below:

Calculating Working Pressure, Stress, or Wall Thickness of Pipe ..... pages 525 to 527
Thermal Expansion and Modulus of Elasticity of Pipe ..... page 531
Deflection of Horizontal Pipe Lines ..... page 533
Calculation of Pipe Bends ..... pages 528 and 529
Length of Pipe in Bends ..... page 530

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Wrought Steel and Genuine Wrought Iron
Tubular Products

Butt-Welded, Lap-Welded, and Seamless Pipe
Casing, Boiler Tubes, and Tubing

General Notes

Pipe Trade Practice

All weights for steel are figured on the basis of one cubic inch of steel weighing .2833 pound. All weights for wrought iron pipe are figured on the basis of one cubic inch of iron weighing .2777 pound.

All material will be cut to length when so ordered, with extreme variation not exceeding one-eighth of an inch over or under, unless otherwise arranged.

All threads, unless otherwise indicated, are in accordance with American (Briggs') Standard.

The outside diameter of all classes of pipe, casing, tubing, tubes, etc., heavier than standards listed, is the same outside diameter as standards listed, the extra thickness always being on the inside and therefore reducing the inside diameter of the pipe.

Tubular material is known either by its nominal inside diameter or its outside diameter, and the tables of weights and dimensions should be consulted for the proper designation for each class of goods. When listed by nominal inside diameter, it is designated "Size", and when listed by outside diameter, "Size O.D."

When ordering pipe 12-inch and smaller designate weight desired, and when ordering tubes designate thickness desired. Above 12-inch inside diameter, pipe and tubing are usually known and spoken of by their outside diameters, and when ordering, thickness desired must be specified.

All Boiler Tubes are known by their outside diameters.

On orders calling for commercial sizes of pipe which are finished with threads and couplings, in sizes ⅛-inch to 12-inch, inclusive, and where orders specify quantity in lineal feet, it is understood that random lengths fitted with threads both ends and coupling one end will be shipped; and the measurement is charged from end to end; that is, overall including coupling.

If cut lengths of any sizes are ordered, instructions must appear on the face of the order whether plain ends, threads only, or threads and couplings are required. The pipe is then cut to the length specified for plain end and threads only, but if cut lengths with threads and couplings are specified the practice is the same with the exception that the couplings are charged separately, whether they are shipped loose or screwed on the pipe.

All data given on the following pages, 459 to 463, inclusive, apply to Wrought Steel Tubular Products. Because of difference in basic weight of steel and wrought iron, inside diameter and thickness dimensions of genuine wrought iron pipe will vary slightly from steel dimensions; that is, smaller inside diameters with correspondingly heavier wall thicknesses. Weights per foot are the same as weights shown for steel pipe.

Pipe Carried in Stock

A distinguishing feature of Crane policy has always been to maintain widely distributed and adequate stocks of all staple lines for the convenience of customers. These include not only valves, fittings, flanges, and accessories, but also large stocks of the various classes of pipe.

Stocks of pipe are carried by each Crane branch in sufficient sizes, classes, and quantities to meet all normal local requirements. Prompt shipment can be made of random lengths or of cut pipe, plain end or threaded. Butt-welded pipe in sizes ⅛ to 3-inch inclusive, both Standard and Extra Strong weights, is normally stocked in 21-foot uniform lengths.

At the Chicago Works, in addition to large stocks of regular pipe, double random lengths of seamless pipe are regularly carried in stock. Averaging 38 feet to 43 feet in length, depending on the size, they are stocked in sizes 4-inch to 24-inch inclusive, both in Standard and Extra Strong weights.

In addition to regular pipe sizes, many wall thicknesses corresponding to A.S.A. Schedule Numbers are stocked. This diversity of sizes, together with the many sizes and grades of seamless alloy pipe and tubing regularly stocked, make it possible for Crane to give prompt service on all pipe requirements.

Standard Pipe

Black and Galvanized

Dimensions, Weights, and Test Pressures

Nominal Size	List Prices	Diameters		Wall Thickness	Nominal Weight Pounds per Foot		Number of Threads per Inch	Test Pressure Pounds per Square Inch		
		Outside	Inside		Plain End	Threads and Couplings		Butt-Weld	Grade A Seamless	Grade B Seamless
Inches	Per Foot Base	Inches	Inches	Inches						
⅛	.05½	.405	.269	.068	.24	.24	27	700		
¼	.06	.540	.364	.088	.42	.42	18	700		
⅜	.06	.675	.493	.091	.57	.57	18	700		
½	.08½	.840	.622	.109	.85	.85	14	700		
¾	.11½	1.050	.824	.113	1.13	1.13	14	700		
1	.17	1.315	1.049	.133	1.68	1.68	11½	700		
1¼	.23	1.660	1.380	.140	2.27	2.28	11½	800		
1½	.27½	1.900	1.610	.145	2.72	2.73	11½	800		
2	.37	2.375	2.067	.154	3.65	3.68	11½	800	1000	1100
2½	.58½	2.875	2.469	.203	5.79	5.82	8	800	1000	1100
3	.76½	3.500	3.068	.216	7.58	7.62	8	800	1000	1100
3½	.92	4.000	3.548	.226	9.11	9.20	8		1200	1300
4	1.09	4.500	4.026	.237	10.79	10.89	8		1200	1300
*4½	1.27	5.000	4.506	.247	12.53	12.64	8		1200	1300
5	1.48	5.563	5.047	.258	14.62	14.81	8		1200	1300
6	1.92	6.625	6.065	.280	18.97	19.18	8		1200	1300
†8	2.50	8.625	8.071	.277	24.70	25.00	8		1200	1300
	2.88		7.981	.322	28.55	29.35			1200	1300
†10	3.20	10.750	10.192	.279	31.20	32.00	8		1000	1200
	3.50		10.136	.307	34.24	35.00			1000	1200
	4.12		10.020	.365	40.48	41.85			1000	1200
†12	4.50	12.750	12.090	.330	43.77	45.00	8		1000	1200
	5.07		12.000	.375	49.56	51.15			1000	1200

*This size is listed as standard but is not commonly used.

Standard Steel Pipe with threads and couplings in sizes larger than 6-inch is designated as Line Pipe; see page 462.

Unless otherwise ordered: Unless otherwise ordered, Standard Pipe is furnished with threads and couplings and in random lengths.

On sizes 3-inch and smaller, butt-weld pipe will be furnished unless otherwise specified.

Cut lengths: For cut lengths, an extra charge will be made above random lengths.

Galvanized: For galvanized pipe, an extra charge will be made above Black.

Threads: The taper of threads is ¾-inch per foot, measured on the diameter for all sizes.

Weights: The permissible variation in weight is 5 per cent above and 5 per cent below.

The weight per foot of pipe with threads and couplings is based on a length of 20 feet, including the coupling.

†8, 10, and 12-inch sizes: On sizes made in more than one weight, weight desired must be specified.

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Extra Strong Pipe

Black and Galvanized

Dimensions, Weights, and Test Pressures

Nominal Size Inches	List Prices Per Foot Base	Diameters Outside Inches	Diameters Inside Inches	Wall Thickness Inches	Nominal Weight per Foot Plain End Pounds	Test Pressure Pounds per Square Inch Butt-Weld	Test Pressure Pounds per Square Inch Grade A Seamless	Test Pressure Pounds per Square Inch Grade B Seamless
1/8	.12	.405	.215	.095	.31	850		
1/4	.07 1/2	.540	.302	.119	.54	850		
3/8	.07 1/2	.675	.423	.126	.74	850		
1/2	.11	.840	.546	.147	1.09	850		
3/4	.15	1.050	.742	.154	1.47	850		
1	.22	1.315	.957	.179	2.17	850		
1 1/4	.30	1.660	1.278	.191	3.00	1100		
1 1/2	.36 1/2	1.900	1.500	.200	3.63	1100		
2	.50 1/2	2.375	1.939	.218	5.02	1100	1500	1600
2 1/2	.77	2.875	2.323	.276	7.66	1100	1500	1600
3	1.03	3.500	2.900	.300	10.25	1100	1500	1600
3 1/2	1.25	4.000	3.364	.318	12.51		1700	1800
4	1.50	4.500	3.826	.337	14.98		1700	1800
* 4 1/2	1.80	5.000	4.290	.355	17.61		1700	1800
5	2.08	5.563	4.813	.375	20.78		1700	1800
6	2.86	6.625	5.761	.432	28.57		1700	1800
8	4.34	8.625	7.625	.500	43.39		1700	2400
10	5.48	10.750	9.750	.500	54.74		1600	1900
12	6.55	12.750	11.750	.500	65.42		1600	1900

*This size is listed as standard but is not commonly used.

Unless otherwise ordered: Unless otherwise ordered, Extra Strong Pipe is furnished with plain ends and in random lengths.

On sizes 3-inch and smaller, butt-weld pipe will be furnished unless otherwise specified.

Random lengths: Random lengths of Extra Strong Pipe are considered to be 12 feet to 22 feet, we to have the privilege, however, of supplying not exceeding 5 per cent of total order in lengths 6 feet to 12 feet.

Cut lengths: For cut lengths, an extra charge will be made above random lengths.

Threads, couplings: For pipe fitted with threads only or with threads and couplings, an extra charge will be made above plain ends.

Galvanized: For galvanized pipe, an extra charge will be made above Black.

Weights: The permissible variation in weight is 5 per cent above and 5 per cent below.

Standard Bundling Schedule

Based on 21-Foot Uniform Lengths

Number of Pieces, Number of Feet, and Weight of Pipe, per Bundle	Size Inches	Standard Pipe Number of Pieces Per Bundle	Standard Pipe Average per Bundle Number of Feet	Standard Pipe Average per Bundle Weight Pounds	Extra Strong Pipe Number of Pieces Per Bundle	Extra Strong Pipe Average per Bundle Number of Feet	Extra Strong Pipe Average per Bundle Weight Pounds
	1/8	30	630	151	30	630	195
	1/4	24	504	212	24	504	272
	3/8	18	378	215	18	378	280
	1/2	12	252	214	12	252	275
	3/4	7	147	166	7	147	216
	1	5	105	176	5	105	228
	1 1/4	3	63	144	3	63	189
	1 1/2	3	63	172	3	63	229

Order sizes 1/8 to 1 1/2-inch by the bundle. Order sizes 2 to 3-inch by lengths, using 21 feet as average length, and larger sizes by lengths, using 20 feet as average length.

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Double Extra Strong Pipe

Black and Galvanized

Dimensions, Weights, and Test Pressures

Nominal Size Inches	List Prices Per Foot Base	Diameters Outside Inches	Diameters Inside Inches	Wall Thickness Inches	Nominal Weight per Foot Plain End Pounds	Test Pressure Pounds per Square Inch Grade A Seamless	Test Pressure Pounds per Square Inch Grade B Seamless
½	*	.840	.252	.294	1.71	1000	1000
¾	*	1.050	.434	.308	2.44	1000	1000
1	*	1.315	.599	.358	3.66	1000	1000
1¼	*	1.660	.896	.382	5.21	1000	1000
1½	*	1.900	1.100	.400	6.41	1000	1000
2	.91	2.375	1.503	.436	9.03	1800	1900
2½	1.37	2.875	1.771	.552	13.70	1800	1900
3	1.86	3.500	2.300	.600	18.58	1800	1900
4	2.76	4.500	3.152	.674	27.54	2000	2100
5	3.86	5.563	4.063	.750	38.55	2000	2100
6	5.32	6.625	4.897	.864	53.16	2000	2100
8	7.25	8.625	6.875	.875	72.42	2800	2800

*Sizes ½ to 1½-inch are available only as seamless pressure tubing; prices on application.

Unless otherwise ordered: Unless otherwise ordered, Double Extra Strong Pipe is furnished with plain ends and in random lengths.

Random lengths: Random lengths of Double Extra Strong Pipe are considered to be 12 feet to 22 feet, we to have the privilege, however, of supplying not exceeding 5 per cent of total order in lengths 6 feet to 12 feet.

Cut lengths: For cut lengths, an extra charge will be made above the price for random lengths.

Threads, couplings: For pipe fitted with threads only or with threads and couplings, an extra charge will be made above plain ends.

Galvanized: For galvanized pipe, an extra charge will be made above Black.

Weights: The permissible variation in weight is 10 per cent above and 10 per cent below.

Reamed and Drifted Pipe

Unless otherwise ordered: Unless otherwise ordered, Reamed and Drifted Pipe is furnished with threads and couplings and in random lengths, 16 feet to 22 feet.

Dimensions, Weights, and Test Pressures

Nominal Size Inches	List Prices Per Foot Base	Diameters Outside Inches	Diameters Inside Inches	Wall Thickness Inches	Nominal Weight Pounds per Foot Plain End	Nominal Weight Pounds per Foot Threads and Couplings	Number of Threads per Inch	Test Pressure Pounds per Square Inch Butt-Weld	Test Pressure Pounds per Square Inch Grade A Seamless
1	.17	1.315	1.049	.133	1.68	1.70	11½	700	
1¼	.23	1.660	1.380	.140	2.27	2.30	11½	800	
1½	.27½	1.900	1.610	.145	2.72	2.75	11½	800	
†2	.37	2.375	2.067	.154	3.65	3.75	11½	800	1000
	.40		2.041	.167	3.94	4.00			1000
2½	.58½	2.875	2.469	.203	5.79	5.90	8	800	1000
3	.76½	3.500	3.068	.216	7.58	7.70	8	800	1000
3½	.92	4.000	3.548	.226	9.11	9.25	8		1200
4	1.09	4.500	4.026	.237	10.79	11.00	8		1200
*4½	1.27	5.000	4.506	.247	12.53	12.80	8		1200
5	1.48	5.563	5.047	.258	14.62	15.00	8		1200
6	1.92	6.625	6.065	.280	18.97	19.45	8		1200
8	2.88	8.625	7.981	.322	28.55	29.35	8		1200
10	4.12	10.750	10.020	.365	40.48	41.85	8		1000
12	5.07	12.750	12.000	.375	49.56	51.15	8		1000

*This size is listed as standard but is not commonly used.

Threads: The taper of threads is ¾-inch per foot, measured on the diameter for all sizes.

Weights: The permissible variation in weight is 5 per cent above and 5 per cent below.

The weight per foot of pipe with threads and couplings is based on a length of 20 feet, including the coupling, but shipping lengths of small sizes will usually average less than 20 feet.

†2-inch size: The 2-inch size is made in two weights; weight desired must be specified.

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General notes . page 458

API Standard Threaded Line Pipe

Dimensions, Weights, and Test Pressures

Nominal Size Inches	List Prices Per Foot Base	Diameters Outside Inches	Diameters Inside Inches	Wall Thickness Inches	Nominal Weight Pounds per Foot Plain End	Nominal Weight Pounds per Foot Threads and Couplings	Number of Threads per Inch	Test Pressure Pounds per Square Inch Butt-Weld	Test Pressure Pounds per Square Inch Grade A Seamless	Test Pressure Pounds per Square Inch Grade B Seamless
1/8	.06	.405	.269	.068	.24	.25	27	700	1000	1000
1/4	.06½	.540	.364	.088	.42	.43	18	700	1000	1000
3/8	.06½	.675	.493	.091	.57	.57	18	700	1000	1000
1/2	.09	.840	.622	.109	.85	.86	14	700	1000	1000
3/4	.12	1.050	.824	.113	1.13	1.14	14	700	1000	1000
1	.17½	1.315	1.049	.133	1.68	1.70	11½	700	1000	1000
1¼	.23½	1.660	1.380	.140	2.27	2.30	11½	800	2500	2500
1½	.28	1.900	1.610	.145	2.72	2.75	11½	800	2300	2500
2	.37½	2.375	2.067	.154	3.65	3.75	11½	800	1000	1100
2½	.59	2.875	2.469	.203	5.79	5.90	8	800	1000	1100
3	.77	3.500	3.068	.216	7.58	7.70	8	800	1000	1100
3½	.93	4.000	3.548	.226	9.11	9.25	8		1200	1300
4	1.10	4.500	4.026	.237	10.79	11.00	8		1200	1300
5	1.50	5.563	5.047	.258	14.62	15.00	8		1200	1300
6	1.94	6.625	6.065	.280	18.97	19.45	8		1200	1300
†8	2.54	8.625	8.071	.277	24.70	25.55	8		1200	1300
	2.92		7.981	.322	28.55	29.35			1200	1300
†10	3.25	10.750	10.192	.279	31.20	32.75	8		1000	1200
	3.55		10.136	.307	34.24	35.75			1000	1200
	4.17		10.020	.365	40.48	41.85			1000	1200
†12	4.55	12.750	12.090	.330	43.77	45.45	8		1000	1200
	5.12		12.000	.375	49.56	51.15			1000	1200

Unless otherwise ordered: Unless otherwise ordered, API Line Pipe is furnished with threads and couplings and in random lengths.

Cut lengths: For cut lengths, an extra charge will be made above random lengths.

Galvanized: For galvanized pipe, an extra charge will be made above Black.

Threads: The taper of threads is ¾-inch per foot, measured on the diameter for all sizes.

Weights: The permissible variation in weight for any length of pipe is 10 per cent above and 3½ per cent below, but the carload weight shall not be more than 1¾ per cent under the calculated weight.

The weight per foot of pipe with threads and couplings is based on a length of 20 feet, including the coupling.

†8, 10, and 12-inch sizes: On sizes made in more than one weight, weight desired must be specified.

General notes page 458

Large O.D. Plain End Pipe

Dimensions, Weights, and Test Pressures

Outside Diameter Inches	Wall Thickness Inches	List Prices Per Foot Base	Nominal Weight Plain End Pounds per Foot	Test Pressure Pounds per Square Inch Grade A Seamless	Grade B Seamless
14	5/16	4.56	45.68	800	950
	3/8	5.45	54.57	950	1100
	7/16	6.33	63.37	1100	1300
	1/2	7.20	72.09	1300	1500
	9/16	8.07	80.73	1400	1700
	5/8	8.92	89.28	1600	1900
	11/16	9.77	97.75	1800	2100
	3/4	10.61	106.13	1900	2200
	7/8	12.26	122.65	2200	2600
16	5/16	5.23	52.36	700	800
	3/8	6.25	62.58	850	1000
	7/16	7.27	72.72	1000	1100
	1/2	8.27	82.77	1100	1300
	9/16	9.27	92.74	1300	1500
	5/8	10.26	102.63	1400	1600
	11/16	11.24	112.43	1500	1800
	3/4	12.21	122.15	1700	2000
	7/8	14.13	141.35	2000	2300
18	1/4	4.73	47.39	500	600
	5/16	5.90	59.03	600	750
	3/8	7.05	70.59	750	900
	7/16	8.20	82.06	900	1000
	1/2	9.34	93.45	1000	1200
	9/16	10.47	104.76	1100	1300
	5/8	11.59	115.98	1200	1500
	11/16	12.71	127.12	1400	1600
	3/4	13.81	138.17	1500	1800
	7/8	16.00	160.04	1700	2000
20	1/4	5.27	52.73	650	750
	5/16	6.57	65.71	550	650
	3/8	7.86	78.60	700	800
	7/16	9.14	91.41	800	900
	1/2	10.41	104.13	900	1000
	9/16	11.67	116.77	1000	1200
	5/8	12.93	129.33	1100	1300
	11/16	14.18	141.80	1200	1400
	3/4	15.41	154.19	1400	1600
	7/8	17.87	178.73	1600	1800
24	5/16	7.90	79.06	450	550
	3/8	9.46	94.62	550	650
	7/16	11.01	110.10	650	750
	1/2	12.54	125.49	750	850
	9/16	14.08	140.80	850	1000
	5/8	15.60	156.03	950	1100
	11/16	17.11	171.17	1000	1200
	3/4	18.62	186.24	1100	1300
26	5/16	Prices on request	85.73	450	500
	3/8		102.63	500	600
	7/16		119.44	600	700
	1/2		136.17	700	800

Weights: The permissible variation in weight is 10 per cent above and 10 per cent below.

Unless otherwise ordered: Unless otherwise ordered, Large O.D. Pipe is furnished with plain ends and in random lengths.

Cut lengths: For cut lengths, an extra charge will be made above random lengths.

Larger sizes: Prices and data on application.

Water Well Casing

Dimensions, Weights, and Test Pressures

Outside Diameter Inches	List Prices Per Foot Base	Diameter Outside Inches	Diameter Inside Inches	Wall Thickness Inches	Nominal Weight Pounds per Foot Plain End	Nominal Weight Pounds per Foot Threads and Couplings	Number of Threads per Inch	Test Pressure Pounds per Square Inch Grade A Seamless
3½	.46	3.500	3.250	.125	4.51	4.60	14	1100
4	.56½	4.000	3.732	.134	5.53	5.65	14	1000
4½	.68½	4.500	4.216	.142	6.61	6.75	14	950
5½	.90	5.500	5.192	.154	8.79	9.00	14	850
6	1.05	6.000	5.672	.164	10.22	10.50	14	850
6⅝	1.30	6.625	6.255	.185	12.72	13.00	11½	850
8⅝	1.75	8.625	8.249	.188	16.94	17.50	11½	650

Unless otherwise ordered: Unless otherwise ordered, Water Well Casing is furnished with threads and couplings, and in random lengths.

Cut lengths: For cut lengths, an extra charge will be made above random lengths.

Galvanized: For galvanized casing, an extra charge will be made above Black.

Threads: The taper of threads is ⅜-inch per foot, measured on the diameter for all sizes. The thickness of walls makes it impracticable to cut threads of coarser pitch than shown in the table.

Weights: The permissible variation in weight is 5 per cent above and 5 per cent below. The weight per foot of casing with threads and couplings is based on a length of 20 feet, including the coupling.

General notes . . . . page 458

Boiler Tubes

Prices on application

Sizes, Dimensions, and Manufacturing Weights

Outside Diameter Inches	Wall Thickness Minimum B.W.G.	Wall Thickness Minimum Decimal of Inch	Manufacturing Weights Pounds per Foot
1	13	.095	1.037
1¼	13	.095	1.328
1½	13	.095	1.619
1¾	13	.095	1.910
2	13	.095	2.201
	12	.109	2.503
	11	.120	2.726
2¼	13	.095	2.492
	12	.109	2.837
2½	12	.109	3.171
2¾	12	.109	3.504
3	12	.109	3.838
	10	.134	4.652
3¼	11	.120	4.555
3½	11	.120	4.921
	10	.134	5.469
	9	.148	6.012
4	10	.134	6.286
	9	.148	6.915
4½	10	.134	7.103
	9	.148	7.817
5	9	.148	8.720
6	7	.180	12.750

Under the permissible variations allowed in the A.S.T.M. Standard Specification A-83-40, and the A.S.M.E. Boiler Code, the tubing furnished on an order cannot be lighter in weight than that of the gauge thickness specified. Since manufacturing to exact specifications is impossible, the variations are represented by heavier wall thicknesses and overweight. Prices are based on actual weight.

Dimensions and Weights for boiler tube sizes not listed will be furnished on application.

General notes . . . . page 458

Red Brass and Copper Pipe

Prices on application

Standard Pipe Sizes—Dimensions and Weights

Nominal Size (Iron Pipe Size) Inches	Regular Diameters Outside Inches	Regular Diameters Inside Inches	Regular Wall Thickness Inches	Regular Weight, Pounds Per Linear Foot Red Brass	Regular Weight, Pounds Per Linear Foot Copper
⅛	.405	.281	.062	.253	.259
¼	.540	.375	.082	.447	.457
⅜	.675	.494	.090	.627	.641
½	.840	.625	.107	.934	.955
¾	1.050	.822	.114	1.27	1.30
1	1.315	1.062	.126	1.78	1.82
1¼	1.660	1.368	.146	2.63	2.69
1½	1.900	1.600	.150	3.13	3.20
2	2.375	2.062	.156	4.12	4.22
2½	2.875	2.500	.187	5.99	6.12
3	3.500	3.062	.219	8.56	8.75
3½	4.000	3.500	.250	11.2	11.4
4	4.500	4.000	.250	12.7	12.9
5	5.563	5.063	.250	15.8	16.2
6	6.625	6.125	.250	19.0	19.4
8	8.625	8.000	.312	30.9	31.6
10	10.750	10.019	.365	45.2	46.2
12	12.750	12.000	.375	55.3	56.5

Ordering: Unless otherwise ordered, red brass or copper pipe is furnished with plain ends.

When brass pipe is ordered, regular weight red brass pipe will be furnished unless another type is specified.

Lengths: Commercial length regularly available is 12 feet.

Weights: Actual weights of red brass and copper pipe will vary slightly from the theoretical weights shown in the accompanying table.

Gauge tubing: Seamless brass or copper tubing in nominal or outside diameters, sizes ⅛ to 10-in. can be supplied in any gauge. Prices are furnished on application.

Extra strong pipe: Red brass and copper pipe, made to the extra strong thicknesses and regular outside diameter up to 10-inch nominal pipe size can be furnished on special order, when so specified.

Prices and complete information are furnished on application.

For Types K, L, and M Copper Tube for Solder-Joint Valves and Fittings, see page 408.

Ric-wil Insulated Pipe Units

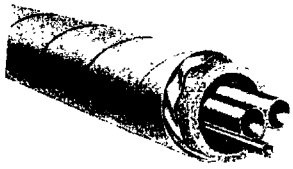
For Steam, Hot Water, Oil, or Refrigeration Lines

Single or Multiple Pipes



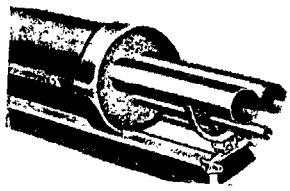
Prefabricated complete units with one or more pipes. Available in any specified combination. Covering is helical corrugated conduit, coated, and wrapped with asphalt saturated asbestos felt. Available in 21-foot lengths for easy installation. Insulation is applied to any or all pipes in any thickness specified.

For Process Liquids



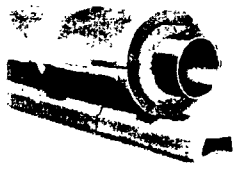
An adaption of the multiple system used where a steam or hot water line heats fluids in other lines. Pipes are insulated from the exterior but not from each other. Sizes and specifications as required. Conduit is the same as for other insulated pipe units.

Standard Tile Conduit



The Standard Tile Conduit is vitrified, glazed A.S.T.M. standard tile housing, acid and weather-proof, with foundation type base drain supporting weight of piping through correctly engineered pipe support. For single or multiple pipe systems, with filler type insulation or sectional pipe covering.

Super-Tile Conduit



Super-Tile Conduit has the same advantages as Standard Tile but with walls approximately double-thick for strength under heavy traffic or where overhead load is above normal. Will support static load of 6 tons per wheel under actual installation conditions. Base drain is made of extra heavy tile.

Foilclad

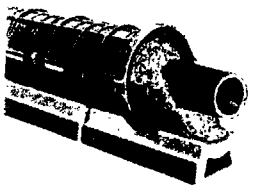
For Overhead Lines



Ric-wil Foilclad Pipe Units are specifically designed to fulfill every requirement for protection of overhead steam, hot water, and brine distribution lines for oil refineries, railroad yards, or for any application where conditions make it desirable to run pipe lines overhead.

Pipe and insulation are protected and waterproofed by a double coating of machine-applied, high temperature asphalt. Unit is then wrapped with asbestos felt and covered with a final spiral wrapping of copper or aluminum foil for maximum insulation and protection.

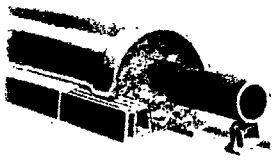
Cast Iron Conduit



A heavy reinforced cast iron conduit for use where underground pipe lines run close to, or under, railroad tracks. It is durable, watertight, vibration-proof, and is furnished with clamps for extra tightness.

Tile Conduit

Universal Type



Recommended for installation conditions where the use of a concrete pad is necessary. Side walls are double-cell vitrified, trapezoidal block design. Arch may be Standard Tile, Super Tile, or Cast Iron.

40

Insulated Piping Accessories

Ric-wil accessories are available in all type systems; standard and special fittings, factory fabricated or field fabricated expansion devices, alignment guides, anchors, etc.

Prices on application

Proposed American Standard for Wrought-Steel and Wrought-Iron Pipe

**Introductory Notes*

1 Scope. These standards shall be known as the "American Standard for Wrought-Steel and Wrought-Iron Pipe". The word "pipe" is used as distinguished from "tubing", restricting the term "pipe" and therefore the scope of these standards, to apply to tubular products of dimensions and materials commonly used for pipe lines and connections.

2 Size. The size of all pipe in these standards is identified by the "nominal pipe size". For 14 inches and larger, "nominal pipe size" corresponds with the outside diameter of the pipe.

3 Materials. The dimensional standards for pipe described herein are based on products such as are covered by the A.S.T.M. and A.P.I. specifications outlined in Table 1.

4 Wall Thickness. The nominal wall thicknesses are given in Tables 2 and 4 for steel pipe, and in Table 6 for wrought-iron pipe.

5 Weights. The nominal weights of steel pipe are listed in Tables 3 and 5, and correspond with the respective wall thicknesses given in Tables 2 and 4. The nominal weights of wrought-iron pipe are listed in Table 7, and correspond with the respective wall thicknesses given in Table 6.

6 Permissible Variations. Unless otherwise provided by the specification, the actual wall thickness at any point shall not be more than 12.5 per cent under the nominal wall thickness shown in the tables. Permissible variations for other dimensions are indicated in each specification.

7 Screw Threads. Unless otherwise specified, the screw threads of threaded pipe shall conform to American Standard for Pipe Threads ASA B2 (taper threads).

8 Schedule Wall Pipe. The schedule numbers under Tables 2 and 3 indicate for subjoined wall thickness, for the pressure/stress ratios designated, pipe of approximately uniform strength to resist internal pressure.

When the selection of wall thickness depends primarily upon capacity to resist internal pressure under given conditions, the designer shall compute the exact value of wall thickness suitable for conditions for which the pipe is required as prescribed in detail in the A.S.M.E. Boiler Code, American Standard Code for Pressure Piping (ASA B31.1), etc., whichever governs the construction. A thickness will be selected from the schedules of nominal thickness contained herein to suit the value computed to fulfill the conditions for which the pipe is desired.

9 Standard Wall, Extra Strong Wall, and Double Extra Strong Wall Pipe. The wall thicknesses shown under Table 4 are those which have been traditional in commercial lists for "standard", "extra strong", and "double extra strong" pipe. Up to 10-inch inclusive standard wall and Schedule 40 pipe are the same dimensionally. The same is true of extra strong wall and Schedule 80 up to 8-inch inclusive. Double extra strong wall has no corresponding schedule number. Above these limiting sizes to and including 24-inch, wall thicknesses are uniformly ⅜-inch for standard wall and ½-inch for extra strong wall.

10 Wrought-Iron Pipe. The wall thicknesses for wrought-iron pipe shown in Table 6, and the weights per foot in Table 7 are those which have always been customary for this commodity. The weights in Table 7, being basically those for all wrought ferrous pipe, correspond with those for welded and seamless steel pipe in Table 5, but because of the difference in weight per cubic foot of the two materials, the wall thicknesses for wrought-iron pipe in Table 6 are slightly greater than those for wrought-steel pipe in Table 4.

Table 1-Specifications for Pipe with ASA Designations and Titles of Standard Specifications

ASA Designation	ASTM or API Designation	Title
B36.1	ASTM A53	Welded and Seamless Steel Pipe
B36.2	ASTM A72	Welded Wrought-Iron Pipe
B36.3	ASTM A106	Seamless Steel Pipe for High-Temperature Service
B36.4	ASTM A134	Electric-Fusion-Welded Steel Pipe, Sizes 30" and Over
B36.5	ASTM A135	Electric-Resistance-Welded Steel Pipe
B36.9	ASTM A139	Electric-Fusion-Welded Steel Pipe, Sizes 4" to but not including 30"
B36.11	ASTM A155	Electric-Fusion-Welded Steel Pipe for High Temperature Service
G8.7	ASTM A120	Welded and Seamless Steel Pipe for Ordinary Uses
—	API 5L	Line Pipe
—	ASTM A158	Seamless Alloy-Steel Pipe for High-Temperature Service
—	ASTM A206	Seamless Carbon-Molybdenum Alloy-Steel Pipe for High-Temperature Service
—	ASTM A211	Spiral-Welded Steel or Iron Pipe
—	ASTM A253	Welded Alloyed Open-Hearth Iron Pipe
—	ASTM A280	Seamless Chromium-Molybdenum Alloy-Steel Pipe for Service at High Temperature
—	ASTM A315	Seamless 1 Per Cent Chromium, 0.5 Per Cent Molybdenum Alloy-Steel Pipe for Service at High Temperature (Tentative)

**Editorial Note—May, 1949:* Pages 466 to 469 are a partial reprint of a proposed revision of American Standard B36.10, which has not yet been approved. It is being included in preference to the 1939 edition for general engineering interest and comment.

See Editorial Note on page 466.

Table 2
Dimensions of Welded and Seamless Steel Pipe
Listed by Schedule Numbers

Nominal Pipe Size Inches	Outside Diam. Inches	Nominal Wall Thickness, Inches									
		Sched 10	Sched 20	Sched 30	Sched 40	Sched 60	Sched 80	Sched 100	Sched 120	Sched 140	Sched 160
⅛	0.405				0.068		0.095				
¼	0.540				0.088		0.119				
⅜	0.675				0.091		0.126				
½	0.840				0.109		0.147				0.187
¾	1.050				0.113		0.154				0.218
1	1.315				0.133		0.179				0.250
1¼	1.660				0.140		0.191				0.250
1½	1.900				0.145		0.200				0.281
2	2.375				0.154		0.218				0.343
2½	2.875				0.203		0.276				0.375
3	3.500				0.216		0.300				0.437
3½	4.000				0.226		0.318				
4	4.500				0.237		0.337		0.437		0.531
5	5.563				0.258		0.375		0.500		0.625
6	6.625				0.280		0.432		0.562		0.718
8	8.625		0.250	0.277	0.322	0.406	0.500	0.593	0.718	0.812	0.906
10	10.75		0.250	0.307	0.365	0.500	0.593	0.718	0.843	1.000	1.125
12	12.75		0.250	0.330	0.406	0.562	0.687	0.843	1.000	1.125	1.312
14	14.0	0.250	0.312	0.375	0.437	0.593	0.750	0.937	1.093	1.250	1.406
16	16.0	0.250	0.312	0.375	0.500	0.656	0.843	1.031	1.218	1.437	1.593
18	18.0	0.250	0.312	0.437	0.562	0.750	0.937	1.156	1.375	1.562	1.781
20	20.0	0.250	0.375	0.500	0.593	0.812	1.031	1.281	1.500	1.750	1.968
24	24.0	0.250	0.375	0.562	0.687	0.968	1.218	1.531	1.812	2.062	2.343
30	30.0	0.312	0.500	0.625							

The decimal thicknesses listed for the respective pipe sizes represent their nominal or average wall dimensions. For tolerances on wall thicknesses, see appropriate material specifications.

Thicknesses shown in bold face type for Schedule 40 are identical with thicknesses shown in bold face type for "Standard Wall" pipe in Table 4. Those in bold face type in Schedules 60 and 80 are identical with thicknesses in bold face type for "Extra Strong Wall" pipe in Table 4.

Some of the larger, heavier wall sections are beyond the capabilities of seamless mill production and must be obtained from turned-and-bored billets or other sources.

Table 3
Nominal Weights of Welded and Seamless Steel Pipe[1]
Listed by Schedule Numbers

Nominal Pipe Size (Inches)	Sched 10	Sched 20	Schedule 30		Schedule 40		Sched 60	Sched 80	Sched 100	Sched 120	Sched 140	Sched 160
	Plain Ends	Plain Ends	Plain Ends	Threads[2] and Couplings	Plain Ends	Threads[2] and Couplings	Plain Ends	Plain Ends	Plain Ends	Plain Ends	Plain Ends	Plain Ends
⅛					0.24	0.24		0.31				
¼					0.42	0.42		0.54				
⅜					0.57	0.57		0.74				
½					0.85	0.85		1.09				1.30
¾					1.13	1.13		1.47				1.94
1					1.68	1.68		2.17				2.84
1¼					2.27	2.28		3.00				3.76
1½					2.72	2.73		3.63				4.86
2					3.65	3.68		5.02				7.44
2½					5.79	5.82		7.66				10.01
3					7.58	7.62		10.25				14.32
3½					9.11	9.20		12.51				
4					10.79	10.89		14.98				22.51
5					14.62	14.81		20.78				32.96
6					18.97	19.18		28.57				45.30
8		22.36	24.70	25.55	28.55	29.35	35.64	43.39	50.87	60.63	67.76	74.69
10		28.04	34.24	35.75	40.48	41.85	54.74	64.33	76.93	89.20	104.13	115.65
12		33.38	43.77	45.45	53.53		73.16	88.51	107.20	125.49	133.68	160.27
14	36.71	45.68	54.57		63.37		84.91	106.13	130.73	150.67	170.22	189.12
16	42.05	52.36	62.58		82.77		107.50	136.46	164.83	192.29	223.64	245.11
18	47.39	59.03	82.06		104.75		138.17	170.75	207.96	244.14	274.23	308.51
20	52.73	78.60	104.13		122.91		166.40	208.87	256.10	296.37	341.10	379.01
24	63.41	94.62	140.80		171.17		238.11	296.36	367.40	429.39	483.13	541.94
30	98.93	157.53	196.08									

[1] Weights are given in pounds per linear foot and are for pipe with plain ends except for sizes which are commercially available with threads and couplings for which both weights are listed. Weights are calculated on the basis of 1 cu. in. of steel = 0.2833 pounds.

[2] The weights of line pipe with couplings are slightly greater than shown in Schedules 30 and 40 and may be found in A.P.I. Specification 5-L.

Weights shown in bold face type in Schedule 40 are identical with weights shown in bold face type for "Standard Wall Pipe" in Table 5. Those shown in bold face type in Schedules 60 and 80 are identical with weights shown in bold face type for "Extra Strong Wall" pipe in Table 5.

See Editorial Note on page 466.

Table 4
Dimensions of Welded and Seamless Steel Pipe
Listed as Standard Wall, Extra Strong Wall, and Double Extra Strong Wall

Nominal Pipe Size	Outside Diam.	Nominal Wall Thickness, Inches		
		Standard Wall	Extra Strong Wall	Double Extra Strong Wall
Inches	Inches	Plain Ends		
⅛	0.405	**0.068**	**0.095**	
¼	0.540	**0.088**	**0.119**	
⅜	0.675	**0.091**	**0.126**	
½	0.840	**0.109**	**0.147**	0.294
¾	1.050	**0.113**	**0.154**	0.308
1	1.315	**0.133**	**0.179**	0.358
1¼	1.660	**0.140**	**0.191**	0.382
1½	1.900	**0.145**	**0.200**	0.400
2	2.375	**0.154**	**0.218**	0.436
2½	2.875	**0.203**	**0.276**	0.552
3	3.500	**0.216**	**0.300**	0.600
3½	4.000	**0.226**	**0.318**	
4	4.500	**0.237**	**0.337**	0.674
5	5.563	**0.258**	**0.375**	0.750
6	6.625	**0.280**	**0.432**	0.864
8	8.625	**0.322**	**0.500**	0.875
10	10.75	**0.365**	0.500	
12	12.75	0.375	0.500	
14	14.0	0.375	0.500	
16	16.0	0.375	0.500	
18	18.0	0.375	0.500	
20	20.0	0.375	0.500	
24	24.0	0.375	0.500	

The decimal thicknesses listed for the respective pipe sizes represent their nominal or average wall dimensions. For tolerances on wall thicknesses, see appropriate material specifications

Thicknesses shown in bold face type for "Standard Wall" are identical with corresponding thicknesses shown in bold face type for Schedule 40 in Table 2. Those shown in bold face type for "Extra Strong Wall" are identical with corresponding thicknesses shown in bold face type in Schedules 60 and 80 in Table 2

Double Extra Strong Wall has no corresponding schedule numbers. (See Paragraph 9, Introductory Notes.) Dimensions are identical with "Double Extra Strong Pipe" shown as an Appendix to B36.10-1939.

Table 5
Nominal Weights of Welded and Seamless Steel Pipe[1]
Listed as Standard Wall, Extra Strong Wall, and Double Extra Strong Wall

Nominal Pipe Size	Standard Wall		Extra Strong Wall	Double Extra Strong Wall
	Plain Ends	Threads and Couplings		
Inches			Plain Ends	Plain Ends
⅛	**0.24**	**0.24**	**0.31**	
¼	**0.42**	**0.42**	**0.54**	
⅜	**0.57**	**0.57**	**0.74**	
½	**0.85**	**0.85**	**1.09**	1.71
¾	**1.13**	**1.13**	**1.47**	2.44
1	**1.68**	**1.68**	**2.17**	3.66
1¼	**2.27**	**2.28**	**3.00**	5.21
1½	**2.72**	**2.73**	**3.63**	6.41
2	**3.65**	**3.68**	**5.02**	9.03
2½	**5.79**	**5.82**	**7.66**	13.70
3	**7.58**	**7.62**	**10.25**	18.58
3½	**9.11**	**9.20**	**12.51**	
4	**10.79**	**10.89**	**14.98**	27.54
5	**14.62**	**14.81**	**20.78**	38.55
6	**18.97**	**19.18**	**28.57**	53.16
8	**28.55**	**29.35**	**43.39**	72.42
10	**40.48**	**41.85**	54.74	
12	49.56	51.15	65.42	
14	54.57		72.09	
16	62.58		82.77	
18	70.59		92.45	
20	78.60		104.13	
24	94.62		125.49	

[1] Weights are given in pounds per linear foot and are for pipe with plain ends except for sizes which are commercially available with threads and couplings for which both weights are listed. Weights are calculated on the basis of 1 cu. in. of steel = 0.2833 pounds.

Weights shown in bold face type for Standard Wall are identical with weights shown in bold face type for Schedule 40 in Table 3. Those shown in bold face type for Extra Strong Wall are identical with weights shown in bold face type for Schedules 60 and 80 in Table 3. All weights in Table 5 are identical with those in Table 7 for Wrought-Iron Pipe.

See Editorial Note on page 466.

Table 6
Dimensions of Welded Wrought-Iron Pipe
Listed as Standard Wall, Extra Strong Wall, and Double Extra Strong Wall

The decimal thicknesses listed for the respective pipe sizes represent their nominal or average wall dimensions. For tolerances on wall thicknesses, see appropriate material specifications.

Thicknesses of all of the sizes shown are slightly greater than those of corresponding sizes for steel pipe shown in Tables 2 and 4 to compensate for the difference in weights per cubic foot of wrought-steel and wrought-iron. See Introductory Note 10.

Nominal Pipe Size, Inches	Outside Diam., Inches	Nominal Wall Thickness, Inches: Standard Wall	Extra Strong Wall	Double Extra Strong Wall
1/8	0.405	0.069	0.099	
1/4	0.540	0.090	0.122	
3/8	0.675	0.093	0.129	
1/2	0.840	0.111	0.151	0.307
3/4	1.050	0.115	0.157	0.318
1	1.315	0.136	0.183	0.369
1 1/4	1.660	0.143	0.195	0.393
1 1/2	1.900	0.148	0.204	0.411
2	2.375	0.158	0.223	0.447
2 1/2	2.875	0.208	0.282	0.567
3	3.500	0.221	0.306	0.615
3 1/2	4.000	0.231	0.325	
4	4.500	0.242	0.344	0.690
5	5.563	0.263	0.383	0.768
6	6.625	0.286	0.441	0.884
8	8.625	0.329	0.510	0.895
10	10.75	0.372	0.510	
12	12.75	0.383	0.510	
14	14.0	0.383	0.510	
16	16.0	0.383	0.510	
18	18.0	0.383	0.510	
20	20.0	0.383	0.510	
24	24.0	0.383	0.510	

Table 7
Nominal Weights of Welded Wrought-Iron Pipe[1]
Listed as Standard Wall, Extra Strong Wall, and Double Extra Strong Wall

Nominal Pipe Size, Inches	Standard Wall: Plain Ends	Standard Wall: Threads and Couplings	Extra Strong Wall: Plain Ends	Double Extra Strong Wall: Plain Ends
1/8	0.24	0.24	0.31	
1/4	0.42	0.42	0.54	
3/8	0.57	0.57	0.74	
1/2	0.85	0.85	1.09	1.71
3/4	1.13	1.13	1.47	2.44
1	1.68	1.68	2.17	3.66
1 1/4	2.27	2.28	3.00	5.21
1 1/2	2.72	2.73	3.63	6.41
2	3.65	3.68	5.02	9.03
2 1/2	5.79	5.82	7.66	13.70
3	7.58	7.62	10.25	18.58
3 1/2	9.11	9.20	12.51	
4	10.79	10.89	14.98	27.54
5	14.62	14.81	20.78	38.55
6	18.97	19.18	28.57	53.16
8	28.55	29.35	43.39	72.42
10	40.48	41.85	54.74	
12	49.56	51.15	65.42	
14	54.57		72.09	
16	62.58		82.77	
18	70.59		93.45	
20	78.60		104.13	
24	94.62		125.49	

[1] Weights are given in pounds per linear foot and are for pipe with plain ends except for sizes which are commercially available with threads and couplings for which both weights are given.

Weights shown in bold face type for Standard Wall are identical with weights shown in bold face type in Table 3. Those shown in bold face type for Extra Strong Wall are identical with weights shown in bold face type for Schedules 60 and 80 in Table 3. All weights in Table 7 are identical with those shown in Table 5 for Wrought-Steel Pipe.

Simplified method for calculating working pressure, stress, or wall thickness of steel pipe.... ... pages 525 to 527

Commercial Wrought Steel Pipe Data

Note 1: The letters "s", "x", and "xx" in the column of Schedule Numbers indicate Standard, Extra Strong, and Double Extra Strong Pipe, respectively.

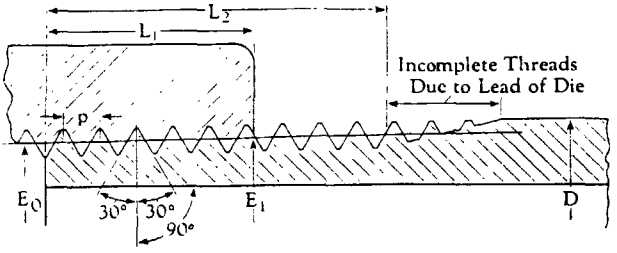
Note 2: The values shown in square feet for the Transverse Internal Area also represent the volume in cubic feet per foot of pipe length.

Nominal Pipe Size	Outside Diameter (D)	Schedule No. *See Note 1*	Wall Thickness (t)	Inside Diameter (d)	Area of Metal (A)	Transverse Internal Area		Moment of Inertia (I)	Weight of Pipe	Weight of Water	External Surface	Section Modulus
						Square Inches	*See Note 2* Square Feet	Inches to 4th Power	Pounds per foot	Pounds per foot of pipe	Sq. Ft. per foot of pipe	$(2\frac{I}{D})$
Inches	Inches		Inches	Inches	Square Inches							
1/8	0.405	40s	.068	.269	.0720	.0568	.00040	.00106	.244	.025	.106	.00525
		80x	.095	.215	.0925	.0364	.00025	.00122	.314	.016	.106	.00600
1/4	0.540	40s	.088	.364	.1250	.1041	.00072	.00331	.424	.045	.141	.01227
		80x	.119	.302	.1574	.0716	.00050	.00377	.535	.031	.141	.01395
3/8	0.675	40s	.091	.493	.1670	.1910	.00133	.00729	.567	.083	.178	.02160
		80x	.126	.423	.2173	.1405	.00098	.00862	.738	.061	.178	.02554
1/2	0.840	40s	.109	.622	.2503	.3040	.00211	.01709	.850	.132	.220	.04069
		80x	.147	.546	.3200	.2340	.00163	.02008	1.087	.102	.220	.04780
		160	.187	.466	.3836	.1706	.00118	.02212	1.300	.074	.220	.05269
		...xx	.294	.252	.5043	.050	.00035	.0242	1.714	.022	.220	.05772
3/4	1.050	40s	.113	.824	.3326	.5330	.00371	.03704	1.130	.231	.275	.07055
		80x	.154	.742	.4335	.4330	.00300	.04479	1.473	.188	.275	.08531
		160	.218	.614	.5698	.2961	.00206	.05269	1.940	.128	.275	.10038
		...xx	.308	.434	.7180	.148	.00103	.05792	2.440	.064	.275	.11030
1	1.315	40s	.133	1.049	.4939	.8640	.00600	.08734	1.678	.375	.344	.1328
		80x	.179	.957	.6388	.7190	.00499	.1056	2.171	.312	.344	.1606
		160	.250	.815	.8365	.5217	.00362	.1251	2.840	.230	.344	.1903
		...xx	.358	.599	1.0760	.282	.00196	.1405	3.659	.122	.344	.2136
1 1/4	1.660	40s	.140	1.380	.6685	1.495	.01040	.1947	2.272	.649	.435	.2346
		80x	.191	1.278	.8815	1.283	.00891	.2418	2.996	.555	.435	.2913
		160	.250	1.160	1.1070	1.057	.00734	.2839	3.764	.458	.435	.3421
		...xx	.382	.896	1.534	.630	.00438	.3411	5.214	.273	.435	.4110
1 1/2	1.900	40s	.145	1.610	.7995	2.036	.01414	.3099	2.717	.882	.497	.3262
		80x	.200	1.500	1.068	1.767	.01225	.3912	3.631	.765	.497	.4118
		160	.281	1.338	1.429	1.406	.00976	.4824	4.862	.608	.497	.5080
		...xx	.400	1.100	1.885	.950	.00660	.5678	6.408	.42	.497	.5977
2	2.375	40s	.154	2.067	1.075	3.355	.02330	.6657	3.652	1.45	.622	.5606
		80x	.218	1.939	1.477	2.953	.02050	.8679	5.022	1.28	.622	.7309
		160	.343	1.689	2.190	2.241	.01556	1.162	7.440	.97	.622	.979
		...xx	.436	1.503	2.656	1.774	.01232	1.311	9.029	.77	.622	1.3110
2 1/2	2.875	40s	.203	2.469	1.704	4.788	.03322	1.530	5.79	2.07	.753	1.064
		80x	.276	2.323	2.254	4.238	.02942	1.924	7.66	1.87	.753	1.339
		160	.375	2.125	2.945	3.546	.02463	2.353	10.01	1.54	.753	1.638
		...xx	.552	1.771	4.028	2.464	.01710	2.871	13.70	1.07	.753	1.997
3	3.500	40s	.216	3.068	2.228	7.393	.05130	3.017	7.58	3.20	.916	1.724
		80x	.300	2.900	3.016	6.605	.04587	3.894	10.25	2.86	.916	2.225
		160	.437	2.626	4.205	5.416	.03761	5.032	14.32	2.35	.916	2.876
		...xx	.600	2.300	5.466	4.155	.02885	5.993	18.58	1.80	.916	3.424
3 1/2	4.000	40s	.226	3.548	2.680	9.886	.06870	4.788	9.11	4.29	1.047	2.394
		80x	.318	3.364	3.678	8.888	.06170	6.280	12.51	3.84	1.047	3.140
4	4.500	40s	.237	4.026	3.174	12.73	.08840	7.233	10.79	5.50	1.178	3.214
		80x	.337	3.826	4.407	11.50	.07986	9.610	14.98	4.98	1.178	4.271
		120	.437	3.626	5.578	10.33	.0717	11.65	19.00	4.47	1.178	5.176
		160	.531	3.438	6.621	9.28	.0645	13.27	22.51	4.02	1.178	5.900
		...xx	.674	3.152	8.101	7.80	.0542	15.28	27.54	3.38	1.178	6.793
5	5.563	40s	.258	5.047	4.300	20.01	.1390	15.16	14.62	8.67	1.456	5.451
		80x	.375	4.813	6.112	18.19	.1263	20.67	20.78	7.88	1.456	7.431
		120	.500	4.563	7.953	16.35	.1136	25.73	27.10	7.09	1.456	9.253
		160	.625	4.313	9.696	14.61	.1015	30.03	32.96	6.33	1.456	10.800
		...xx	.750	4.063	11.340	12.97	.0901	33.63	38.55	5.61	1.456	12.090
6	6.625	40s	.280	6.065	5.581	28.89	.2006	28.14	18.97	12.51	1.734	8.46
		80x	.432	5.761	8.405	26.07	.1810	40.49	28.57	11.29	1.734	12.22
		120	.562	5.501	10.70	23.77	.1650	49.61	36.40	10.30	1.734	15.07
		160	.718	5.189	13.32	21.15	.1469	58.97	45.30	9.16	1.734	17.81
		...xx	.864	4.897	15.64	18.84	.1308	66.33	53.16	8.16	1.734	20.02
8	8.625	20	.250	8.125	6.57	51.85	.3601	57.72	22.36	22.47	2.258	13.39
		30	.277	8.071	7.26	51.16	.3553	63.35	24.70	22.17	2.258	14.69
		40s	.322	7.981	8.40	50.03	.3474	72.49	28.55	21.70	2.258	16.81
		60	.406	7.813	10.48	47.94	.3329	88.73	35.64	20.77	2.258	20.58
		80x	.500	7.625	12.76	45.66	.3171	105.7	43.39	19.78	2.258	24.51
		100	.593	7.439	14.96	43.46	.3018	121.3	50.87	18.83	2.258	28.14
		120	.718	7.189	17.84	40.59	.2819	140.5	60.63	17.59	2.258	32.61
		140	.812	7.001	19.93	38.50	.2673	153.7	67.76	16.68	2.258	35.65
		...xx	.875	6.875	21.30	37.12	.2578	162.0	72.42	16.10	2.258	37.56
		160	.906	6.813	21.97	36.46	.2532	165.9	74.69	15.80	2.258	38.48

Commercial Wrought Steel Pipe Data (*continued*)

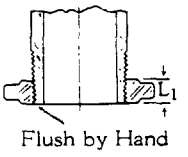
Nominal Pipe Size Inches	Outside Diameter (D) Inches	Schedule No. *See Note 1*	Wall Thickness (t) Inches	Inside Diameter (d) Inches	Area of Metal (A) Square Inches	Transverse Internal Area: Square Inches	Transverse Internal Area: *See Note 2* Square Feet	Moment of Inertia (I) Inches to 4th Power	Weight of Pipe Pounds per foot	Weight of Water Pounds per foot of pipe	External Surface Sq. Ft. per foot of pipe	Section Modulus $(2\frac{I}{D})$
		20	.250	10.250	8.24	82.52	.5731	113.7	28.04	35.76	2.814	21.12
		30	.307	10.136	10.07	80.69	.5603	137.4	34.24	34.96	2.814	25.57
		40s	.365	10.020	11.90	78.86	.5475	160.7	40.48	34.20	2.814	29.90
		60x	.500	9.750	16.10	74.66	.5185	212.0	54.74	32.35	2.814	39.43
10	10.750	80	.593	9.564	18.92	71.84	.4989	244.8	64.33	31.13	2.814	45.56
		100	.718	9.314	22.63	68.13	.4732	286.1	76.93	29.53	2.814	53.25
		120	.843	9.064	26.24	64.53	.4481	324.2	89.20	27.96	2.814	60.34
		140	1.000	8.750	30.63	60.13	.4176	367.8	104.13	26.06	2.814	68.43
		160	1.125	8.500	34.02	56.75	.3941	399.3	115.65	24.59	2.814	74.31
		20	.250	12.250	9.82	117.86	.8185	191.8	33.38	51.07	3.338	30.2
		30	.330	12.090	12.87	114.80	.7972	248.4	43.77	49.74	3.338	39.9
		..s	.375	12.000	14.58	113.10	.7854	279.3	49.56	49.00	3.338	43.8
		40	.406	11.938	15.77	111.93	.7773	300.3	53.53	48.50	3.338	47.1
		..x	.500	11.750	19.24	108.43	.7528	361.5	65.42	46.92	3.338	56.7
12	12.75	60	.562	11.626	21.52	106.16	.7372	400.4	73.16	46.00	3.338	62.8
		80	.687	11.376	26.03	101.64	.7058	475.1	88.51	44.04	3.338	74.6
		100	.843	11.064	31.53	96.14	.6677	561.6	107.20	41.66	3.338	88.1
		120	1.000	10.750	36.91	90.76	.6303	641.6	125.49	39.33	3.338	100.7
		140	1.125	10.500	41.08	86.59	.6013	700.5	133.68	37.52	3.338	109.9
		160	1.312	10.126	47.14	80.53	.5592	781.1	160.27	34.89	3.338	122.6
		10	.250	13.500	10.80	143.14	.9940	255.3	36.71	62.03	3.665	36.6
		20	.312	13.376	13.42	140.52	.9758	314.4	45.68	60.89	3.665	45.0
		30s	.375	13.250	16.05	137.88	.9575	372.8	54.57	59.75	3.665	53.2
		40	.437	13.126	18.61	135.32	.9397	429.1	63.37	58.64	3.665	61.3
		..x	.500	13.000	21.21	132.73	.9217	483.9	72.09	57.46	3.665	69.1
14	14.00	60	.593	12.814	24.98	128.96	.8956	562.3	84.91	55.86	3.665	80.3
		80	.750	12.500	31.22	122.72	.8522	687.3	106.13	53.18	3.665	98.2
		100	.937	12.126	38.45	115.49	.8020	824.4	130.73	50.04	3.665	117.2
		120	1.093	11.814	44.32	109.62	.7612	929.5	150.67	47.45	3.665	132.8
		140	1.250	11.500	50.07	103.87	.7213	1027.0	170.22	45.01	3.665	146.8
		160	1.406	11.188	55.63	98.31	.6827	1117.0	189.12	42.60	3.665	159.6
		10	.250	15.500	12.37	188.69	1.3103	383.7	42.05	81.74	4.189	48.1
		20	.312	15.376	15.38	185.69	1.2895	473.2	52.36	80.50	4.189	59.2
		30s	.375	15.250	18.41	182.65	1.2684	562.1	62.58	79.12	4.189	70.3
		40x	.500	15.000	24.35	176.72	1.2272	731.9	82.77	76.58	4.189	91.5
		60	.656	14.688	31.62	169.44	1.1766	932.4	107.50	73.42	4.189	116.6
16	16.00	80	.843	14.314	40.14	160.92	1.1175	1156.6	136.46	69.73	4.189	144.6
		100	1.031	13.938	48.48	152.58	1.0596	1364.0	164.83	66.12	4.189	170.7
		120	1.218	13.564	56.56	144.50	1.0035	1555.8	192.29	62.62	4.189	194.5
		140	1.437	13.126	65.74	135.32	.9397	1760.3	223.64	58.64	4.189	220.0
		160	1.593	12.814	72.10	128.96	.8956	1893.5	245.11	55.83	4.189	236.7
		10	.250	17.500	13.94	240.53	1.6703	549.1	47.39	104.21	4.712	61.1
		20	.312	17.376	17.34	237.13	1.6467	678.2	59.03	102.77	4.712	75.5
		..s	.375	17.250	20.76	233.71	1.6230	806.5	70.59	101.18	4.712	89.6
		30	.437	17.126	24.11	230.36	1.5997	930.3	82.06	99.84	4.712	104.0
		..x	.500	17.000	27.49	226.98	1.5763	1053.2	92.45	98.27	4.712	150.5
18	18.00	40	.562	16.876	30.79	223.68	1.5533	1172.0	104.75	96.93	4.712	130.9
		60	.750	16.500	40.64	213.83	1.4849	1514.4	138.17	92.57	4.712	168.3
		80	.937	16.126	50.23	204.24	1.4183	1833.0	170.75	88.50	4.712	203.8
		100	1.156	15.688	61.17	193.30	1.3423	2180.0	207.96	83.76	4.712	242.3
		120	1.375	15.250	71.81	182.66	1.2684	2497.9	244.14	79.07	4.712	277.6
		140	1.562	14.876	80.66	173.80	1.2070	2479.0	274.23	75.32	4.712	305.5
		160	1.781	14.438	90.75	163.72	1.1369	3020.0	308.51	70.88	4.712	335.6
		10	.250	19.500	15.51	298.65	2.0740	756.4	52.73	129.42	5.236	75.9
		20s	.375	19.250	23.12	290.04	2.0142	1113.0	78.60	125.67	5.236	111.3
		30x	.500	19.000	30.63	283.53	1.9690	1457.0	104.13	122.87	5.236	145.7
		40	.593	18.814	36.15	278.00	1.9305	1703.0	122.91	120.46	5.236	170.4
		60	.812	18.376	48.95	265.21	1.8417	2257.0	166.40	114.92	5.236	225.7
20	20.00	80	1.031	17.938	61.44	252.72	1.7550	2772.0	208.87	109.51	5.236	277.1
		100	1.281	17.438	75.33	238.83	1.6585	3314.9	256.10	103.39	5.236	331.5
		120	1.500	17.000	87.18	226.98	1.5762	3754.0	296.37	98.35	5.236	375.5
		140	1.750	16.500	100.33	213.82	1.4849	4216.0	341.10	92.66	5.236	421.7
		160	1.968	16.064	111.49	202.67	1.4074	4585.4	379.01	87.74	5.236	458.5
		10	.250	23.500	18.65	433.74	3.0121	1315.0	63.41	187.95	6.283	110.0
		20s	.375	23.250	27.83	424.56	2.9483	1942.0	94.62	183.95	6.283	161.9
		..x	.500	23.000	36.91	415.48	2.8853	2549.1	125.49	179.87	6.283	364.2
		30	.562	22.876	41.39	411.00	2.8542	2843.0	140.80	178.09	6.283	237.0
		40	.687	22.626	50.31	402.07	2.7921	3424.0	171.17	174.23	6.283	285.2
24	24.00	60	.968	22.064	70.04	382.35	2.6552	4652.5	238.11	165.52	6.283	387.7
		80	1.218	21.564	87.17	365.22	2.5362	5672.0	296.36	158.26	6.283	472.8
		100	1.531	20.938	108.07	344.32	2.3911	6851.6	367.40	149.06	6.283	571.0
		120	1.812	20.376	126.31	326.08	2.2645	7824.8	429.39	141.17	6.283	652.1
		140	2.062	19.876	142.11	310.28	2.1547	8625.0	483.13	134.45	6.283	718.9
		160	2.343	19.314	159.41	292.98	2.0346	9455.3	541.94	126.84	6.283	787.9

American Standard Taper Pipe Threads (NPT)

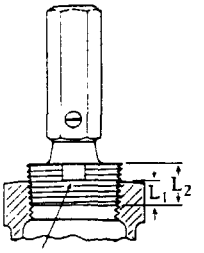


$E_0 = D - (0.050D + 1.1)p$
$E_1 = E_0 + 0.0625\ L_1$
$L_2 = (0.80D + 6.8)p$

p = Pitch
Depth of thread = $0.80p$
Total Taper ¾-inch per Foot



Tolerance on Product:
One turn large or small from notch on plug gauge or face of ring gauge.



Notch flush with face of fitting. If chamfered, notch flush with bottom of chamfer

Dimensions, in Inches

Nominal Pipe Size	D Outside Diameter of Pipe	E_0 Pitch Diameter at End of External Thread	E_1† Pitch Diameter at End of Internal Thread	L_1¶ Normal Engagement by Hand between External and Internal Threads	L_2§ Length of Effective Thread	p Pitch of Thread	Depth of Thread	Number of Threads Per Inch
⅛	0.405	0.36351	0.37476	0.180	0.2639	0.03704	0.02963	27
¼	0.540	0.47739	0.48989	0.200	0.4018	0.05556	0.04444	18
⅜	0.675	0.61201	0.62701	0.240	0.4078	0.05556	0.04444	18
½	0.840	0.75843	0.77843	0.320	0.5337	0.07143	0.05714	14
¾	1.050	0.96768	0.98887	0.339	0.5457	0.07143	0.05714	14
1	1.315	1.21363	1.23863	0.400	0.6828	0.08696	0.06957	11½
1¼	1.660	1.55713	1.58338	0.420	0.7068	0.08696	0.06957	11½
1½	1.900	1.79609	1.82234	0.420	0.7235	0.08696	0.06957	11½
2	2.375	2.26902	2.29627	0.436	0.7565	0.08696	0.06957	11½
2½	2.875	2.71953	2.76216	0.682	1.1375	0.12500	0.10000	8
3	3.500	3.34062	3.38850	0.766	1.2000	0.12500	0.10000	8
3½	4.000	3.83750	3.88881	0.821	1.2500	0.12500	0.10000	8
4	4.500	4.33438	4.38712	0.844	1.3000	0.12500	0.10000	8
5	5.563	5.39073	5.44929	0.937	1.4063	0.12500	0.10000	8
6	6.625	6.44609	6.50597	0.958	1.5125	0.12500	0.10000	8
8	8.625	8.43359	8.50003	1.063	1.7125	0.12500	0.10000	8
10	10.750	10.54531	10.62094	1.210	1.9250	0.12500	0.10000	8
12	12.750	12.53281	12.61781	1.360	2.1250	0.12500	0.10000	8
14 O.D.	14.000	13.77500	13.87262	1.562	2.2500	0.12500	0.10000	8
16 O.D.	16.000	15.76250	15.87575	1.812	2.4500	0.12500	0.10000	8
18 O.D.	18.000	17.75000	17.87500	2.000	2.6500	0.12500	0.10000	8
20 O.D.	20.000	19.73750	19.87031	2.125	2.8500	0.12500	0.10000	8
24 O.D.	24.000	23.71250	23.86094	2.375	3.2500	0.12500	0.10000	8

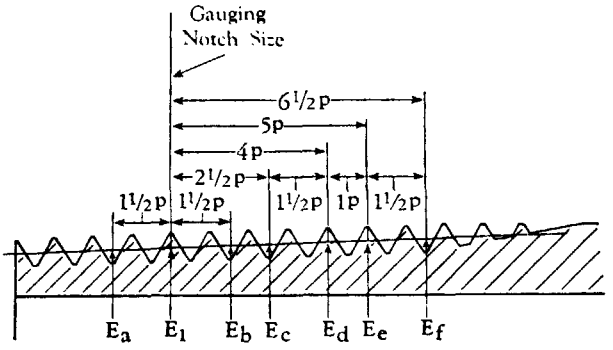
40

†Also pitch diameter at gauging notch.
§Also length of plug gauge.
¶Also length of ring gauge and length from gauging notch to small end of plug gauge

The above information taken from the American Standard for Pipe Threads, A. S. A.—B2.1-1945.

Crane Railing Pipe Threads . . . page 198

American Standard Straight Pipe Threads



Dimensions, in Inches

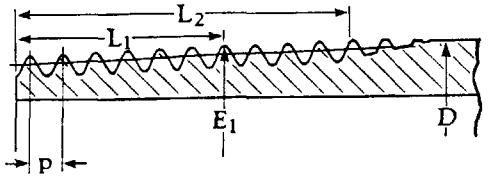
Nominal Pipe Size	Number of Threads per Inch	Pitch of Thread p	Increase in Pitch Diameter per Turn	Pitch Diameter									
				Straight Thread Couplings* (Internal Thread) for use with Taper Thread Pipe for Pressure Tight Joints (NPSC)		Straight Thread (Free Fitting) Mechanical Joints† (NPSM)				Straight Thread (Loose Fitting) Mechanical Joints† Locknut Connections (NPSL)			
						External		Internal		External		Internal	
				Min. E_a	Max. E_b	Min. E_a	Max. E_1	Min. E_1	Max. E_b	Min. E_c	Max. E_d	Min. E_e	Max. E_f
⅛	27	0.03704	0.00231	0.3713	0.3782	0.3713	0.3748	0.3748	0.3782	0.3805	0.3840	0.3863	0.3898
¼	18	0.05556	0.00347	0.4847	0.4951	0.4847	0.4899	0.4899	0.4951	0.4986	0.5038	0.5073	0.5125
⅜	18	0.05556	0.00347	0.6218	0.6322	0.6218	0.6270	0.6270	0.6322	0.6357	0.6409	0.6444	0.6496
½	14	0.07143	0.00446	0.7717	0.7851	0.7717	0.7784	0.7784	0.7851	0.7896	0.7963	0.8008	0.8075
¾	14	0.07143	0.00446	0.9822	0.9956	0.9822	0.9889	0.9889	0.9956	1.0000	1.0067	1.0112	1.0179
1	11½	0.08696	0.00543	1.2305	1.2468	1.2305	1.2386	1.2386	1.2468	1.2523	1.2604	1.2658	1.2739
1¼	11½	0.08696	0.00543	1.5752	1.5915	1.5752	1.5834	1.5834	1.5915	1.5970	1.6051	1.6106	1.6187
1½	11½	0.08696	0.00543	1.8142	1.8305	1.8142	1.8223	1.8223	1.8305	1.8360	1.8441	1.8495	1.8576
2	11½	0.08696	0.00543	2.2881	2.3044	2.2881	2.2963	2.2963	2.3044	2.3099	2.3180	2.3234	2.3315
2½	8	0.12500	0.00781	2.7505	2.7739	2.7505	2.7622	2.7622	2.7739	2.7817	2.7934	2.8012	2.8129
3	8	0.12500	0.00781	3.3768	3.4002	3.3768	3.3885	3.3885	3.4002	3.4081	3.4198	3.4276	3.4393
3½	8	0.12500	0.00781	3.8771	3.9005	3.8771	3.8888	3.8888	3.9005	3.9084	3.9201	3.9279	3.9396
4	8	0.12500	0.00781	4.3754	4.3988	4.3754	4.3871	4.3871	4.3988	4.4067	4.4184	4.4262	4.4379
5	8	0.12500	0.00781			5.4376	5.4493	5.4493	5.4610	5.4688	5.4805	5.4884	5.5001
6	8	0.12500	0.00781			6.4943	6.5060	6.5060	6.5177	6.5255	6.5372	6.5450	6.5567
8	8	0.12500	0.00781							8.5196	8.5313	8.5391	8.5508
10	8	0.12500	0.00781							10.6405	10.6522	10.6600	10.6717
12	8	0.12500	0.00781							12.6374	12.6491	12.6569	12.6686

*Straight pipe threads in couplings are gauged with American Standard Taper Pipe Thread plug gauges, the notch (P.D. = E_1) to come flush at bottom of chamfer with gauging tolerance of one and one-half turns large or small. While this theoretically provides maximum and minimum pitch diameters as shown, the actual pitch diameters of the tapped hole will be slightly smaller than the values given.

†Mechanical joint straight pipe threads are gauged with straight thread gauges.

Crane Railing Pipe Threads . . . . page 198

British Standard Taper Pipe Threads



Whitworth 55° Form of Thread

Total Taper ¾-inch per Foot

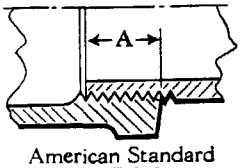
This information is taken from the British Engineering Standards Association Report No. 21-1938.

Dimensions, in Inches

Pipe Size (Nominal Bore)	D Approximate Outside Diameter of Pipe	E_1 Pitch Diameter at End of Internal Thread	L_1 Normal Engagement by Hand between External and Internal Threads	L_2 Length of Effective Thread	p Pitch of Threads	Depth of Threads	Number of Threads Per Inch
1/8	13/32	0.3601	0.1563	0.2545	0.03571	0.0229	28
1/4	17/32	0.4843	0.2367	0.3814	0.05263	0.0337	19
3/8	11/16	0.6223	0.2500	0.3947	0.05263	0.0337	19
1/2	27/32	0.7793	0.3214	0.5178	0.07143	0.0457	14
3/4	1 1/16	0.9953	0.3750	0.5714	0.07143	0.0457	14
1	1 11/32	1.2508	0.4091	0.6591	0.09091	0.0582	11
1 1/4	1 11/16	1.5918	0.5000	0.7500	0.09091	0.0582	11
1 1/2	1 29/32	1.8238	0.5000	0.7500	0.09091	0.0582	11
2	2 3/8	2.2888	0.6250	0.9204	0.09091	0.0582	11
2 1/2	3	2.9018	0.6875	1.0511	0.09091	0.0582	11
3	3 1/2	3.4018	0.8125	1.1761	0.09091	0.0582	11
3 1/2	4	3.8918	0.8750	1.2386	0.09091	0.0582	11
4	4 1/2	4.3918	1.0000	1.4091	0.09091	0.0582	11
5	5 1/2	5.3918	1.1250	1.5795	0.09091	0.0582	11
6	6 1/2	6.3918	1.1250	1.5795	0.09091	0.0582	11
7	7 1/2	7.3860	1.3750	1.9250	0.10000	0.0640	10
8	8 1/2	8.3860	1.5000	2.0500	0.10000	0.0640	10
9	9 1/2	9.3860	1.5000	2.0500	0.10000	0.0640	10
10	10 1/2	10.3860	1.6250	2.1750	0.10000	0.0640	10
11	11 1/2	11.3700	1.6250	2.3125	0.1250	0.0800	8
12	12 1/2	12.3700	1.6250	2.3125	0.1250	0.0800	8

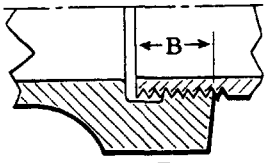
Normal Engagement

Between Male and Female Threads to Make Tight Joints



American Standard and A.P.I. Line Pipe Threads

For normal engagement on Crane Railing Pipe Threads, see page 198.



Shoulder Type Drainage Fitting Threads

Dimensions, in Inches

Size	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14
A	1/4	3/8	3/8	1/2	9/16	11/16	11/16	11/16	3/4	15/16	1	1 1/16	1 1/8	1 1/4	1 5/16	1 7/16	1 5/8	1 3/4	
B*						9/16	5/8	5/8	5/8	7/8	15/16	1	1 1/16	1 3/16	1 1/4	1 3/8	1 9/16	1 11/16	1 7/8

Dimensions given do not allow for variations in tapping or threading.

*Using American Standard Taper Male Thread with Crane shoulder type Drainage Fittings. The external thread, however, should not be threaded small to gauge and not more than one turn large

Information on threaded pipe joints page 475

Threaded Pipe Joints

Threads

In screwed joints having strength, tightness, and durability, it is necessary to have clean-cut and uniform threads.

The threads should be tapered and smooth, cut with the correct taper, lead, thread angle, and diameters. Reasonable manufacturing tolerances are allowed on all of the thread elements to take care of variations in threading. The diameters should be such as to allow sufficient hand engagement and yet allow enough threads for wrench or power make-up.

The thread lengths should be long enough to compensate for pipe strains usually present in the various types of thread joint services. A short thread is satisfactory for joints where little or no pipe strains exist, but longer threads are required where extreme pipe strains are encountered, such as in Oil Field Casing Thread joints.

Standardized Threads

Several Standards have been established covering pipe threads for various purposes. The oldest and probably most commonly used is the American Standard for Pipe Threads, known as A.S.A. Standard B-2.1. There are also the American Petroleum Institute Standards No. 5A, 6A, and 5L covering Oil Field Tubular Goods, such as Line Pipe and Casing Threads.

Thread Assembling

In making up screwed pipe joints it is very important that the threads in both parts be thoroughly cleaned. Any threads which may have become burred or bent should be straightened or removed and afterward a good grade of lubricant should be applied to the threads. The lubricant reduces the friction which allows the two parts to be pulled up further, resulting in a more effective pipe joint. Pipe joints should not be screwed together too rapidly and thereby avoid objectionably raising the temperature of the two parts. For Crane Thread Lubricants, see page 444.

Normal Engagements

The normal amount of engagement to make a tight joint for various types of screwed material is given in the table on page 474. These dimensions have been established from tests made under practical working conditions.

The normal engagement specified for American Standard Pipe Thread and A.P.I. Line Pipe Thread joints is based on parts being threaded to the American Standard for Pipe Threads or the A.P.I. Standard for Line Pipe Threads. The shoulder type Drainage Fitting Thread engagement is based on using Crane Fittings and American Standard Pipe Thread dimensions on the external thread but holding the external thread to a special tolerance as covered in the foot note of the table.

In order to obtain the thread engagements listed in the table it is necessary to vary the torque or power applied according to the size, metal and weight of material used. For example, it requires considerably less power to make up a screwed joint using a light brass valve than a high pressure steel valve.

Screwed Companion Flanges

The normal length of thread engagement listed in the table on page 474 does not apply to Screwed Companion Flanges. The length of thread engagement for Screwed Companion Flanges depends upon the weight of the flange, considering pressure, and the type of thread joint employed.

There are two types of threaded flange joints in general use; one where the pipe and the flange are refaced after assembly as distinguished from the other in which the pipe and the flange are not refaced. Pipe threaded for a refaced job should have a thread sufficiently long to extend slightly beyond the face of the flange when assembled, to allow for refacing. For the joint which is not to be refaced, the thread on the pipe should be slightly shorter so that the end of the threaded pipe will be about one thread from the face of the flange when assembled.

Leaky Joints

Leaky joints can usually be traced either to faulty threading or an improper lubricant. Frequently the trouble lies in the thread on the pipe which may have been cut with dull or improperly adjusted threading tools resulting in wavy, shaved, rough or chewed threads.

Wavy threads are noticeable both to the eye and touch, due to circumferential waves or longitudinal flats of slightly helical form rather than the desired true circular form. Shaved threads appear to have been threaded with two dies, one not matching the other, giving a double thread appearance at the start of the thread. Rough or chewed threads are noticeably rough and torn.

Should the threads have any of these defects it is possible that leaky joints might result.

Crane Threaded Products

Crane threaded materials have smooth, accurately cut threads properly gauged and carefully inspected for taper, lead, thread angle, height, out-of-roundness, and alignment.

They are threaded in compliance with established Standards as the requirements may be, and the start of each thread is properly chamfered for ease in assembling.

Crane has taken extraordinary precautions to insure satisfactory thread joints by maintaining constantly careful inspection of not only the product itself but the threading equipment as well, which is the best available.

A complete gauging system has also been established which includes Master Gauges approved by the National Bureau of Standards, Reference Gauges, and Working Gauges. These gauges are checked periodically and frequently so as to keep them well within the allowable tolerances. In fact, Crane threading is held to much closer tolerances than actually required to make a tight joint.

Cast Iron Water Pipe



Class 150 and Class 250 Cast Iron Water Pipe meet †Federal Specification WW-P-421.

Pipe sizes 3 to 12 inches use Class D fittings; pipe sizes 14 to 24 inches use Class B or Class D fittings (depending on O.D. of pipe).

A.W.W.A. Class A body pattern covers pipe sizes 4 to 12 inches; A.W.W.A. Class C-D body pattern covers pipe sizes 14 to 24 inches. Class A-B body pattern can also be furnished in the 14 to 24-inch pipe sizes.

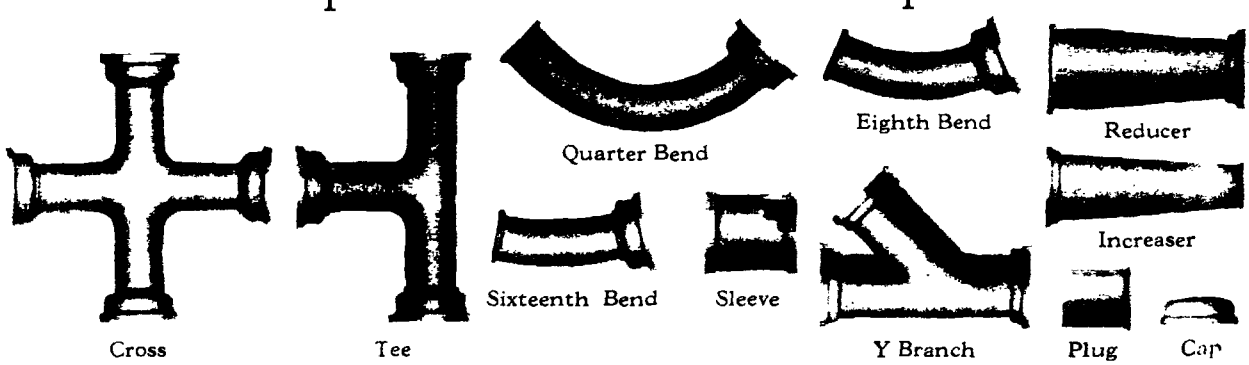
In the following table of sizes, dimensions, and weights, weight of pipe is taken to the nearest 5 pounds and weight of pipe per foot including bell is based on weight of pipe taken to nearest pound.

Sizes, Dimensions, and Weights

Nominal I.D. Inches	Actual O.D. Inches	CLASS 150 — 150 Pounds Working Pressure — 346-Foot Head				CLASS 200 — 200 Pounds Working Pressure — 462-Foot Head				CLASS 250 — 250 Pounds Working Pressure — 576-Foot Head			
		Thickness Inches	Weight, Pounds: Plain End per Ft.	Weight, Pounds: Per Ft. with Bell	Weight, Pounds: 16-Ft. Length	Thickness Inches	Weight, Pounds: Plain End per Ft.	Weight, Pounds: Per Ft. with Bell	Weight, Pounds: 16-Ft. Length	Thickness Inches	Weight, Pounds: Plain End per Ft.	Weight, Pounds: Per Ft. with Bell	Weight, Pounds: 16-Ft. Length
*3										.36	12.7	13.8	220
4	4.80	.34	15	16.1	255					.38	17	18.1	290
6	6.90	.37	24	25.7	410					.43	27	28.7	460
8	9.05	.42	36	38.6	615	.46	39	41.6	665	.50	42	44.6	715
10	11.10	.47	49	52.2	835	.52	54	57.2	915	.57	59	62.3	995
12	13.20	.50	62	66.1	1055	.57	70	74.1	1185	.62	77	81.1	1300
14	15.65	.55	82	86.9	1390	.62	91	97.0	1550	.69	102	108.0	1730
16	17.80	.60	102	108.1	1730	.68	114	121.6	1945	.75	126	133.6	2135
18	19.92	.65	123	130.4	2085	.74	139	147.9	2365	.83	156	164.9	2640
20	22.06	.68	143	152.0	2430	.78	163	173.6	2775	.88	183	193.6	3095
24	26.32	.76	191	202.9	3245	.88	219	233.1	3730	1.00	248	262.1	4195

*The 3-inch inside diameter is Manufacturer's Standard.
†Federal Specification WW-P-421 includes sizes 4 to 24 inches Class 150 and Class 250 only.

Specials for Cast Iron Water Pipe



Weights of Tees, Crosses, Y Branches, Reducers, and Increasers

Size Inches		3×2	3×3	4×2	4×3	4×4	6×3	6×4	6×6	8×4	8×6	8×8	10×4	10×6	10×8	10×10	12×4	12×6	12×8	12×10	12	12
Weight Pounds	Tee		94		120	128	170	183	200	255	270	294	338	351	371	395	445	458	474	491	512	
	Cross		125		153	166	204	221	257	294	325	372	377	406	443	493	486	512	545	577	623	
	Y Branch		78			103		167	181	234	268	291		366	398	434		520	553	588		32
	Reducer	35		40	45		88	97		119	143		146	169	198		179	202	231	261		
	Increaser	39		44	50		100	104		132	150		162	180	201		201	218	240	267		

Weights of Bends, Sleeves, Plugs, and Caps

Size Inches		3	4	6	8	10	12
Weight Pounds	Quarter Bend	65	82	130	200	278	366
	Eighth Bend	53	66	105	150	202	265
	Sixteenth Bend	53	66	105	150	202	265
	Sleeve (Short)	36	47	68	104	123	174
	Plug	7	8	14	25	38	50
	Cap	20	27	40	59	84	142

Weight of Lead and Hemp Required Per Joint

(Based on Lead 2 Inches Thick)

Pipe Size In.		3	4	6	8	10	12	14	16	18	20	24
Lead	Lbs.	6	7½	10¼	13¼	16	19	22	30	33¾	37	44
Hemp	Lbs.	.18	.21	.31	.44	.53	.61	.81	.94	1	1¼	1½

Other specials for cast iron water pipe such as; split tees, split sleeves, flange and spigot, flange and bell, and flanges are available.

Prices on application

Crane Fabricated Piping

Crane Shop Fabricating Facilities ..... pages 478 to 483
Crane Pipe Bends ..... pages 484 to 486

Crane Flanging Processes:
- Screwed Flanged Joints ..... page 487
- The Cranelap Joint ..... pages 487 to 490
- Welded Flanged Joints ..... page 491

Flange Facings and Finishes ..... pages 492 and 493
Crane Welded Piping ..... pages 494 and 495
Unit Fabrication of Piping and Valves ..... pages 496 and 497
Dimensions of Crane Welded Headers ..... pages 498 and 499

Crane Pipe Coils:
- Comments ..... page 500
- Cylindrical and Flat Spiral Types ..... page 501
- Flat and Oval Types ..... page 502
- Box Type ..... page 503
- Minimum Dimensions ..... page 503

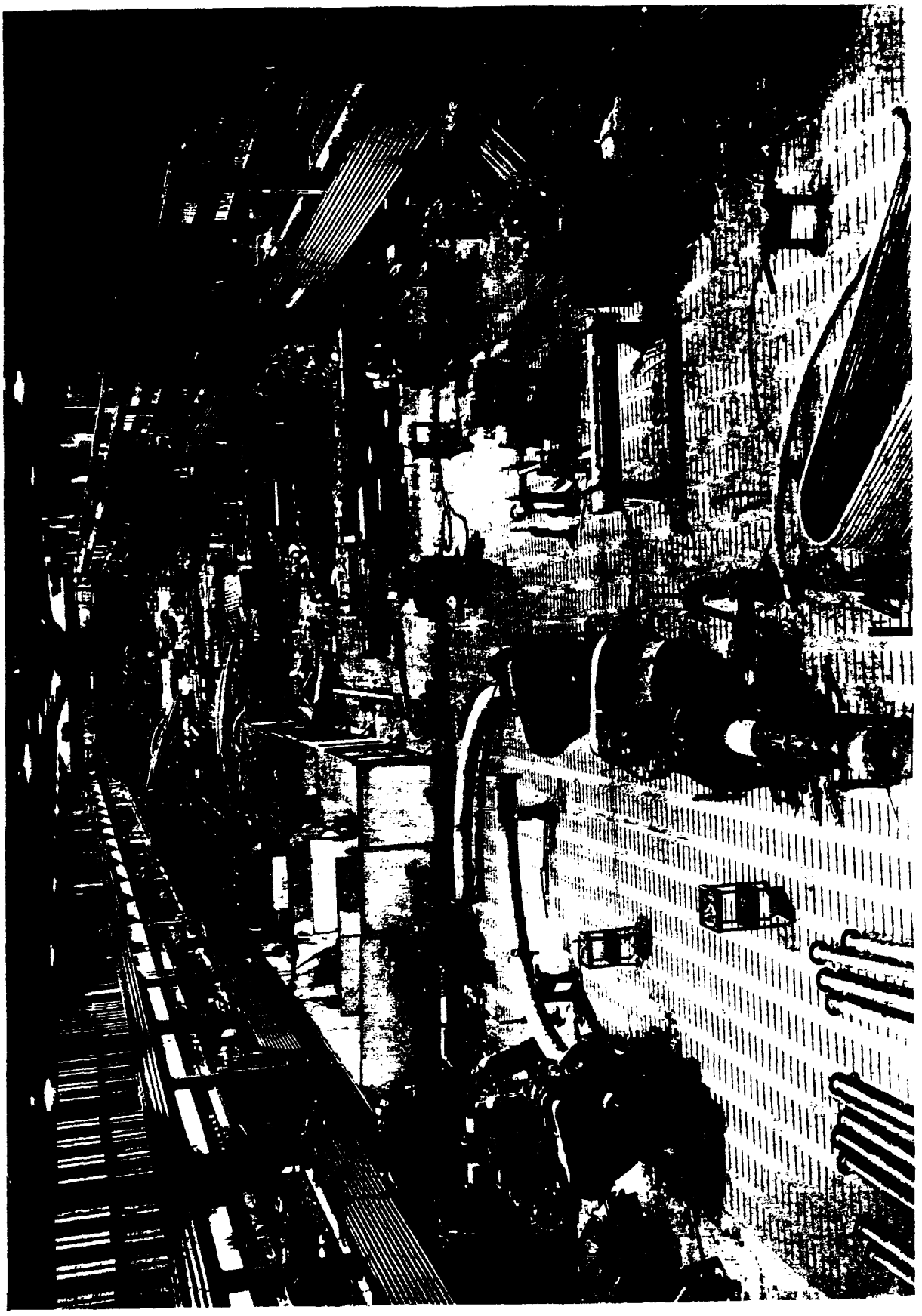
Welded Double Pipe Heat Exchangers ..... page 504

The increasing use of higher pressures and temperatures has elevated the art of designing, erecting, and purchasing fabricated piping to its rightful position of importance. Discriminating buyers now realize that the purchase of piping requires the same careful thought and attention to details as does the selection of steam generators, prime movers, refinery cracking stills, valves, and other major items of modern plants.

Years ago, Crane realized the desirability of having the production and development of fabricated piping go hand in hand with the constant improvement in valves, fittings, and allied articles. In this manner, materials of uniform design, workmanship, and performance have been developed.

The nature of fabricated piping precludes any attempt to list completely the variety of materials and operations available in a modern fabricating shop. The special and peculiar requirements of industry and its processes daily present problems which must be solved. Attention is invited to the following pages which tell a brief story about Crane Fabricated Piping; additional information will be furnished on request.

Integrated piping systems from a single manufacturing source — one responsibility for proper and complete fabrication



A portion of the Crane Pipe Fabricating Shop in Chicago

One Source of Supply

Exacting users of materials for piping installations will recognize the advantages of purchasing the fabricated piping from a manufacturer who also produces a complete line of valves, fittings, bolts, gaskets, and accessories.

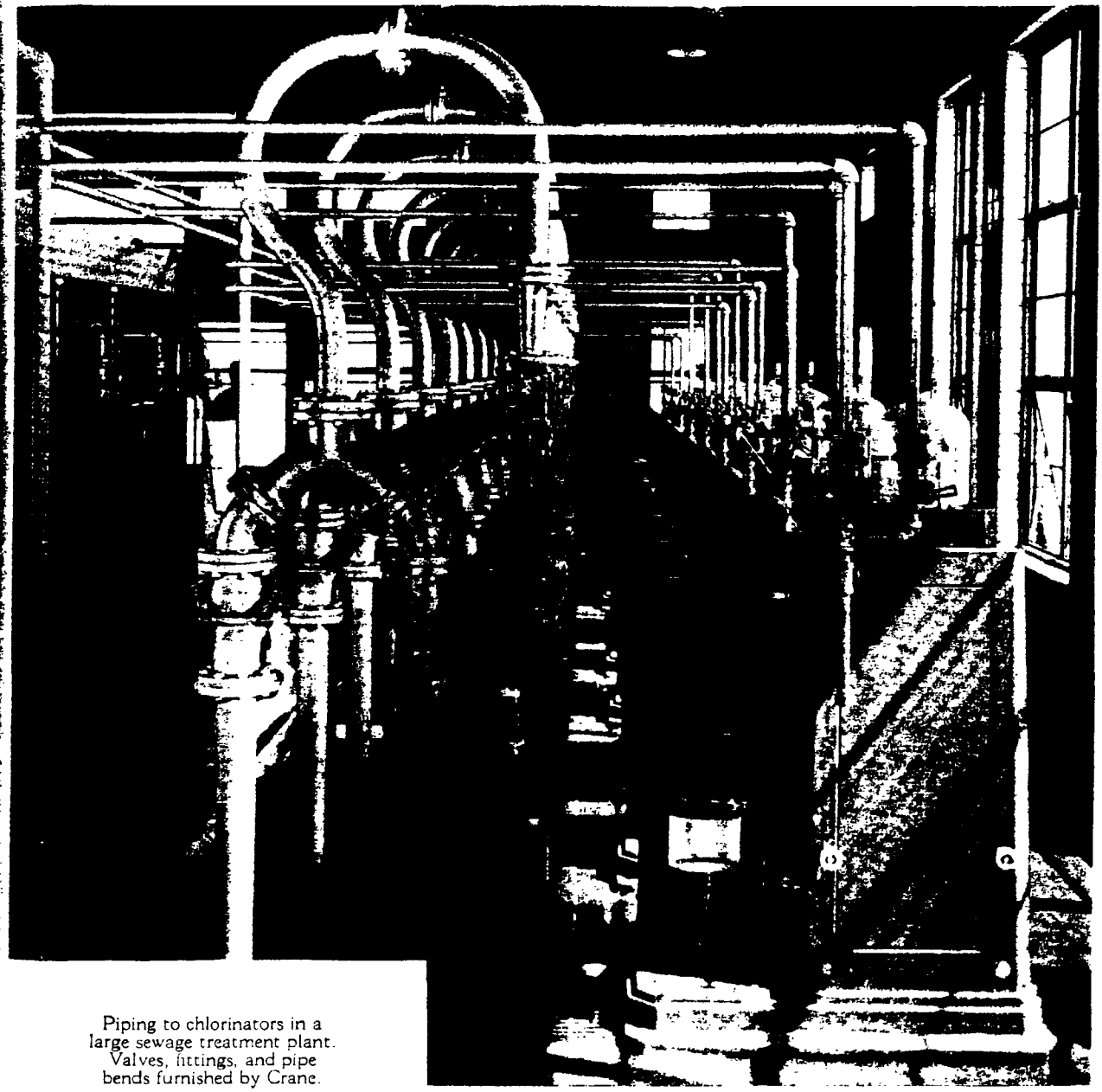
One responsibility: When the task of furnishing all of the material rests with Crane, there is but one responsibility—one uniform standard of materials, workmanship, and service. Whether the joints used are threaded, flanged, or beveled for welding, the same standards and gauging systems are used uniformly on all of the products.

This assures the user that the component parts of the piping system will fit accurately, provide reliability and safety, and will be easily installed, with a minimum of erection and of maintenance costs.

Simplicity of ordering: An order for the complete piping job is handled as an integral unit; there is not the division of responsibility regarding the dimensions and related details of the various items that occurs when the component parts of a piping system are ordered from several sources of supply.

Time saving: There is a saving in time and expense when orders and detailed drawings are prepared for only one source of supply. The delays caused by shipments from several sources are eliminated.

Ease of maintenance: When repairs or replacements are necessary because of the demands of service, they are effected easily when all of the original material was secured from one source of supply.



Piping to chlorinators in a large sewage treatment plant. Valves, fittings, and pipe bends furnished by Crane.

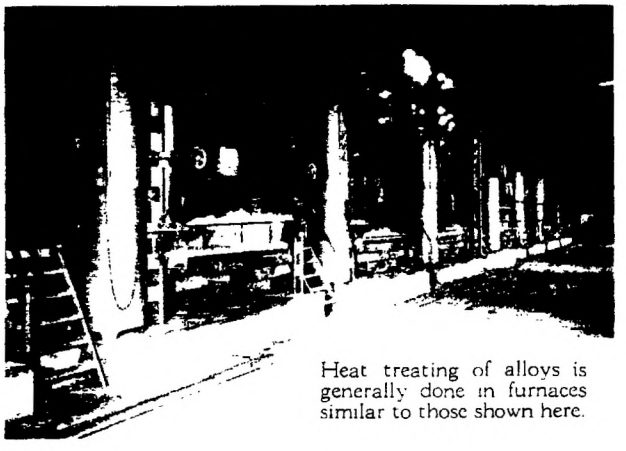
Advantages of Crane Shop Fabrication

Accuracy: A piping system, when placed in service, should develop the predetermined results and fulfill all of the expectations of a proper design. This should be accomplished expeditiously and at a minimum of final erected cost consistent with the use of good materials and workmanship. Obviously, this purpose will be defeated unless each piece, large or small, of both simple and complex piping systems, receives the attention necessary to assure accuracy and a high quality of workmanship. Crane shop fabrication accomplishes this desirable end.

Proficiency: In the Crane fabricating shops the mechanics are employed solely on the production of fabricated piping. Such continuity of practice means that they do not lose their proficiency, particularly desirable for welding and other complex operations.

Safety: Safety is a prime requisite of every piping installation. Crane shop fabrication assures purchasers that every necessary precaution has been employed to eliminate hidden hazards of piping.

A weld may appear excellent on the exterior, yet under the surface it may contain gas pockets or have faulty penetration. A threaded flange joint gives no indication in its external appearance, of improper threading. These are but two of the many hidden hazards of piping.



Heat treating of alloys is generally done in furnaces similar to those shown here.

Shop appliances: Shop fabrication requires the use of special machinery, clamps, jigs, and other convenient appliances which are impractical for field service. This equipment permits the alignment and squaring-up of all flanged faces or ends of piping, also accuracy of dimensions and angles—all within the closest practical limits. Such characteristics assure the final fitting of every piece into position without alteration or improper strain, resulting in increased safety and a saving of time and labor.

Stress relieving, annealing, or heat treating, when necessary, are readily performed in the shop. All of these advantages are almost impossible of accomplishment in the field.

Working conditions: Working conditions, almost invariably, are better in the shop than in the field. The shop has facilities for handling heavy or bulky pieces, therefore each mechanic is working at all times in a comfortable position and is not concerned about his safety.

Testing: Crane shop fabrication assures dependability because the product is tested and proved sound before shipment. Piping which is fabricated in the field usually must be installed in its final position before it can be tested, and, in the event of failure, the removal for replacement or repair proves expensive and causes delay.

Simplified assembly: The erecting force in the field should only be called upon to assemble a piping system. It should neither be expected to design and fabricate piping, nor to manufacture economically under adverse field conditions, a product comparable with that of the modern fabricating shop.

Unit fabrication: For further information on unit fabrication, see pages 496 and 497.



Shop fabrication requires the use of special machinery, clamps, jigs, etc.

Scope of Crane Shop Facilities

Crane can advantageously supply piping for any industry.

Shops at strategic points: Many shops are maintained for supplying the piping needs of industry. A goodly number of the Crane branch houses are equipped for the simpler jobs—the larger branch houses for more elaborate jobs—and fabricating shops embracing the full line of pipe fabrication are located at strategic centers throughout the country.

All types of joints: Any type of joint can be furnished—screwed, flanged, welded, or special. The selection of any type of joint presents a basic engineering or mechanical problem. Crane makes its recommendations accordingly—having an all-inclusive line, it can exercise a degree of impartiality conducive to best serving the interests of the purchaser.

Large stocks: Large stocks of the various kinds of pipe, flanges, valves, fittings, and accessories are carried at all fabricating shops and branches.

Crane is prepared for the job, whether it calls for a single piece of pipe cut to length, or the complete piping equipment of an industry.

Metallurgical and Engineering Control

Laboratories: In the year 1888, Crane established a chemical laboratory with full control over the raw materials used in its products. Constantly expanded, this service has grown into complete research, metallurgical, and testing laboratories. Long a dominant factor in the development of Crane products, all of the accumulated data held by these departments—the applied experience of Crane engineers and research men—are utilized in the production of Crane Fabricated Piping.

Engineering: All fabrication of piping in the Crane shops is under a system of constant procedure control. A thorough gauging system is employed in all operations.

Trained engineers are responsible at all times for the design, superintendence during manufacture, and constant checking of the product.

The services outlined eliminate guesswork in the production of Crane Fabricated Piping.



Studying design through photoelasticity in Crane Research Laboratory.



Constant checking and gauging of Crane Fabricated Piping assures perfect alignment.

Estimating and Ordering

Estimates: A reliable estimate of the cost of any piping system will be furnished promptly upon receipt of an inquiry accompanied by blueprints and specifications.

No matter how complex the layout or how involved the specification, a complete and accurate quotation is assured.

Orders: Crane has specialized for many years in the handling of orders for fabricated piping. Men, well trained and experienced in this work, enter the shop orders direct from complete blueprints, detail sketches, or bills of material, constantly checking all dimensions and details.

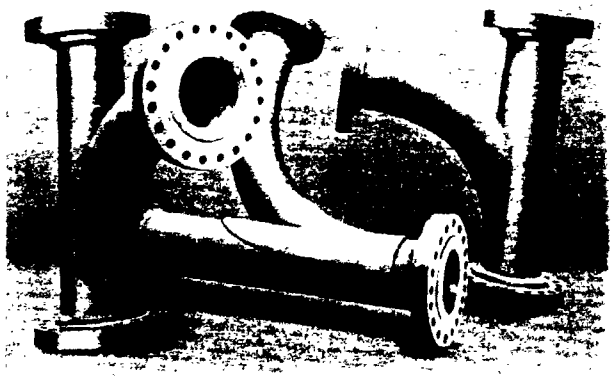
Submit inquiries to the nearest Crane representative.

Crane Shop Fabricating Facilities

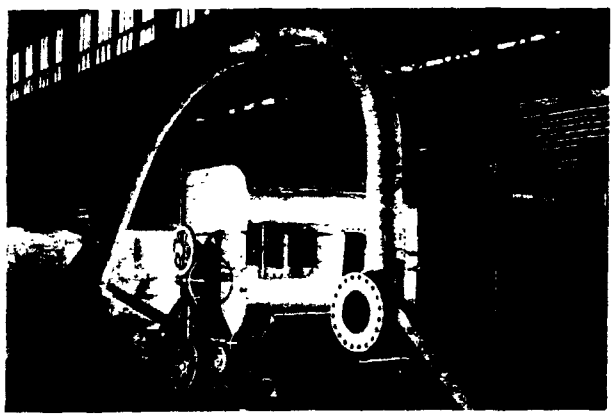
The Crane shops are fully equipped with machinery and facilities for the various operations required in the production of a complete line of fabricated piping.

Much of the shop equipment is special—designed and built to develop the manufacturing technique necessary for the fabrication of piping of uniform accuracy and quality of workmanship.

Many forms of special jigs and appliances are employed constantly to supplement the effectiveness of the machines and other facilities.



Typical assemblies of pre-fabricated piping including bends, reinforced welded outlet connections, and flanged ends.



X-raying a welded joint on a steam turbine pipe bend.

Pipe Bending

In Crane shops, the art of bending pipe has been developed to a high degree—pipe bends of many sizes and shapes are in constant production.

Pipe bends have a wide range of usefulness. No two general piping installations are alike, hence pipe bends are especially adapted to solve the many problems of space requirements. The proper proportions of a pipe bend usually are essentially a matter of bending pipe to the dimensions necessary to fit into the available space.

To meet these needs of industry, Crane pipe bending facilities are available; shops are equipped to fabricate pipe bends from a large range of sizes, weights and kinds of pipe. See pages 484 to 486.

Welding

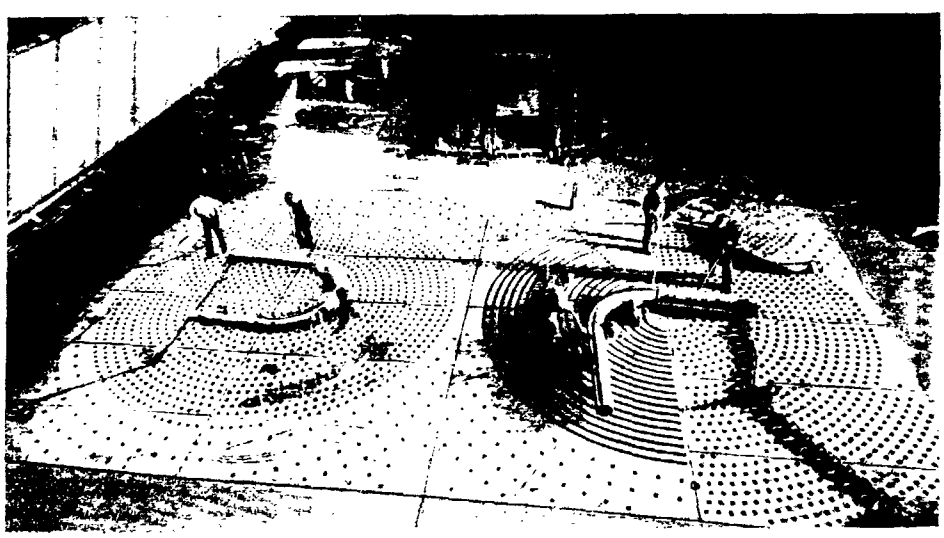
Crane pioneered in the welding of fabricated piping. For more than thirty-five years welding has been used in the fabrication of Crane headers and other products. Untiring research and experiment in the shops and laboratories during this long period are responsible for the constant refinement in the technique of Crane welding.

Crane welders use all modern methods of welding with equal facility, and are subjected periodically to qualification tests.

Crane Fabricated Piping includes an almost infinite variety of shop-welded product. For detailed information on welding, see pages 494 to 499.

Flanging

Crane shop facilities include equipment for producing the many types of flanged joints in current use. These can be furnished not only in their regular forms but also in the various modifications and special adaptations required. Precision gauges govern every operation, assuring the utmost accuracy. For details, see pages 487 to 491.



Illustrated at the left is a pipe bending plate in a Crane Pipe Fabricating Shop.

The pipe is packed with sand, heated to a proper temperature, and pulled to the required shape by the use of power winches. Extreme care is exercised to insure a uniform bend, free from wrinkles, and of maximum strength.

Crane Shop Fabricating Facilities (Cont.)

Finishing

Special finishing machines enable Crane shops to furnish fabricated piping with a variety of finishes — regular and special. See pages 492 and 493

Cutting, beveling, threading, making-on screwed flanges, facing all types of flanges, machining Cranelap joints and various other operations for finishing the ends of Crane Fabricated Piping are performed on these machines with precision and a close adherence to accurate gauging standards.

Swedging

Swedging facilities are available for all sizes of pipe. The facilities include furnaces for heating, powerful forging hammers, and dies to assure accurate fabrication.

Cutting and Threading Pipe

Crane shops are equipped to cut and thread pipe for all commercial services; regular and special threads can be furnished.

The accurate threading to gauge, so characteristic of Crane screwed products, is similarly found in pipe cut to length and threaded in Crane shops.

Testing

Crane shop facilities include equipment for testing fabricated piping as specified in the various codes, or in accordance with the provisions of a specification. The usual hydrostatic tests are supplemented by air-under-water, and other special tests if required.

Cleaning Fabricated Piping

All fabricated piping is regularly cleaned internally by a mechanically driven rotary cleaning tool, or with a wire brush, or blown out with compressed air to remove loose foreign material resulting from fabrication. When specified on orders, special cleaning by pickling, or sand-blasting, or both, will be performed at an extra charge.



Cranelapping machine and furnace in a fabricated piping shop. A large pipe, at forging heat, is ready for lapping.

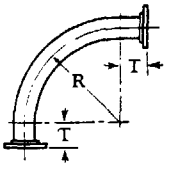


Pipe fabrication in the Montreal Plant of Crane, Limited

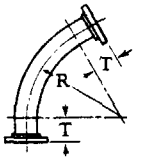
Standard Types of Pipe Bends

Crane Pipe Bends are made from pipe which is filled with sand, heated carefully until the entire sand core produces a uniform temperature, then clamped on the bending floor to forms which have been accurately laid out. Power winches are applied to draw the pipe around the forms, and the point of power application is repeatedly shifted to prevent the formation of wrinkles on the inside wall. A new heat is made for each bend.

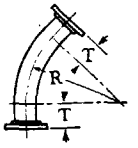
All bends are completed in the pipe before beveling, threading, or flanging, to assure dimensional accuracy. A system of repeated checking assures that every dimension and angle of the completed pipe bend will be accurate, and that the ends or flanges will be square with the axis of the pipe. Crane Pipe Bends are full area, free from wrinkles, buckles, and thin spots; they are cleaned of all scale, chips, and oil. They are easy to erect, fitting into place exactly.



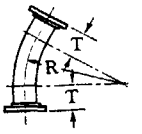
No. 1
Quarter Bend, 90°



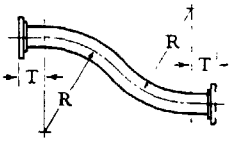
No. 1½
Angle Bend, 46° to 89°



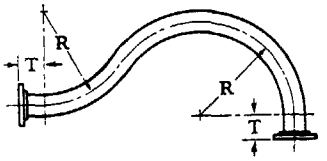
No. 3
45° Bend



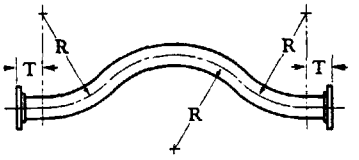
No. 3½
Angle Bend, Under 45°



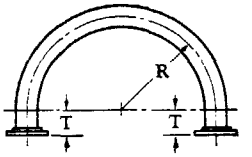
No. 5
Offset Bend



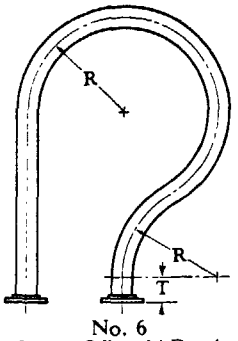
No. 2, Single Offset Quarter Bend



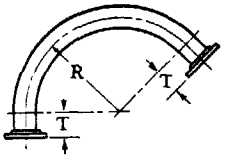
No. 4, Crossover Bend



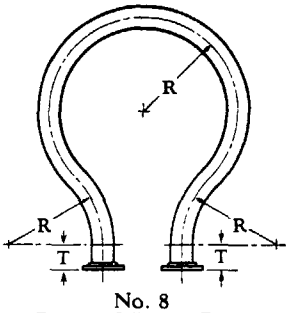
No. 7, U-Bend — 180°



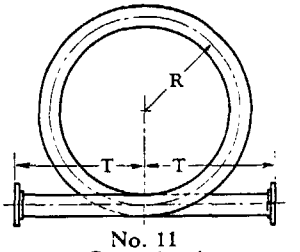
No. 6
Single Offset U-Bend



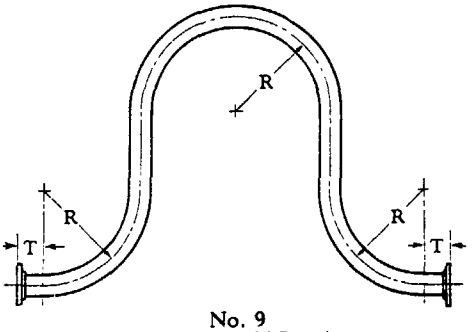
No. 7½
Angle Bend
91° to 179°



No. 8
Double Offset U-Bend



No. 11
Circle Bend

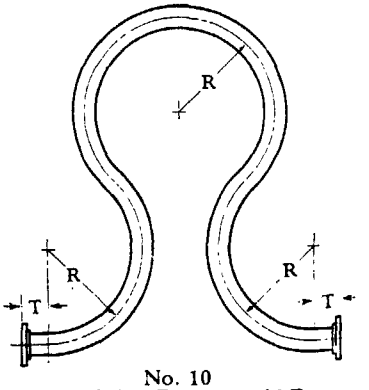


No. 9
Expansion U-Bend

For table of radii and tangents, see page 485.

For notes on pipe bends, see pages 485 and 486.

To calculate working pressure, stress, or wall thickness of pipe, see pages 523 to 527.



No. 10
Double Offset Expansion U-Be

Cautionary note regarding the use of minimum radii and tangents:

The table and notes on page 485 outline the minimum radii and tangents which can be furnished for various conditions. *The use of such minimum dimensions is not desirable, nor is it recommended except when absolutely necessary.*

The radii of pipe bends preferably should equal or exceed the dimensions shown in column "A", defining "Minimum Recommended Radius".

When possible, the tangents of pipe bends should be greater than the dimensions shown in column "C", defining "Minimum Length of Tangent".

The tangents can be of any dimensions up to the limits imposed by the length of pipe available or the shipping facilities. See paragraphs on "Long Lengths of Pipe", page 486.

Standard Types of Pipe Bends (Cont.)

Radii and Tangents of Pipe Bends, in Inches

Size of Pipe	Column "A" R Minimum Recommended Radius Steel or Genuine Wrought Iron Pipe Standard or Extra Strong Weight	Column "B" R Shortest Radii to which pipe can be bent (*See Note below*)								Column "C" T Minimum Length of Tangent (*See Note below*) Steel or Genuine Wrought Iron Pipe Standard or Extra Strong Weight	
		Steel Pipe Only				Genuine Wrought Iron Pipe					
		Threaded Ends, Screwed, or Welded Flanges		Cranelap Joints		Threaded Ends, Screwed, or Welded Flanges		Cranelap Joints			
		Standard Weight Pipe	Extra Strong Weight Pipe	Standard Weight Pipe	Extra Strong Weight Pipe	Standard Weight Pipe	Extra Strong Weight Pipe	Standard Weight Pipe	Extra Strong Weight Pipe	Threaded Ends or Screwed Flanges	Cranelap Joints
1/4	1 1/4	1	5/8			1 1/4	1			1	
3/8	1 7/8	1 1/4	3/4			1 7/8	1 1/2			1 1/4	
1/2	2 1/2	1 1/2	1	2	2	2 1/2	2	2 1/2	2	1 1/2	2
3/4	3 3/4	1 3/4	1 1/4	3	3	3	2 1/2	3	3	1 3/4	2
1	5	2	1 1/2	4	4	4	3	4	4	2	2
1 1/4	6 1/4	2 1/4	1 3/4	4	4	5	4	5	4	2	2 1/2
1 1/2	7 1/2	2 1/2	2	5	5	6	5	6	5	2 1/2	3
2	10	3	2 1/2	6	6	8	5	8	6	3	4
2 1/2	12 1/2	5	4 1/4	10	10	10	8	10	10	4	5
3	15	8	6	12	12	12	10	12	12	4	6
3 1/2	17 1/2	10	8	12	12	14	12	14	12	5	6
4	20	12	10	14	14	16	12	16	14	5	6
5	25	18	14	18	14	20	15	20	15	6	7
6	30	22	15	22	15	26	18	26	18	7	7
8	40	30	23	30	23	30	28	30	28	9	8
10	50	36	30	36	30	36	32	36	32	12	10
12	60	46	36	46	36	46	42	46	42	14	10
*14 OD	70	60	48	60	48	60	54	60	54	16	14
*16 OD	96	80	60	80	60	80	70	80	70	18	16
*18 OD	108	90	66	90	66	90	80	90	80	18	18
*20 OD	120	100	72	100	72	100	90	100	90	18	18
*24 OD	144	144	108	144	108	144	122	144	122	18	20

*For sizes 14-inch O.D. and larger, the radii shown are based upon pipe with a wall thickness of 7/16-inch or lighter under the "Standard Weight Pipe" column, and a wall thickness of 1/2-inch or heavier under the "Extra Strong Weight Pipe" column.

Length of Pipe in Bends and Calculation of Pipe Bends . . . . pages 528 to 530

Notes on Standard Types of Pipe Bends

Minimum recommended radius: The figures shown in column "A" represent a schedule of dimensions that is consistent with good practice for determining ordinary minimum radii of pipe bends.

Shortest radius: The dimensions shown in column "B" are based upon actual manufacturing conditions and should not be lowered. *Refer to the cautionary note on page 484.*

Minimum length of tangent: The dimensions shown in column "C" are based upon actual manufacturing conditions for tangents with a threaded end, screwed flange, or Cranelap joint. These dimensions must be maintained without deviation for minimum lengths. *Refer to the cautionary note on page 484.*

Tangents for pipe bends with plain or beveled ends: Pipe bends with the ends plain or beveled for welding can be furnished without tangents. However, for convenience in erection, it is recommended that pipe bends with beveled ends have tangents at least equal to the minimum lengths given in the table for threaded ends in column "C". Such tangents will provide space for applying jigs or clamps to line up and fasten the piping before welding.

Tangents for pipe bends with welding flanges: Pipe bends fitted with slip-on welding flanges can be furnished with a minimum length of tangent equal to the length through the hub of the slip-on welding flange being used.

Pipe bends fitted with welding neck flanges can be furnished without tangents, since these flanges may be butt-welded directly at the end of the arc of pipe bends with beveled ends.

This is only recommended when minimum dimensions must be maintained. When possible, the use of a tangent is desirable for the same reasons as outlined in the paragraph pertaining to pipe bends with beveled ends.

For dimensions of flanges, see pages 290 and 291.

Continued on page 486

Comments on Pipe Bends

Compound and unusual bends: Crane facilities are not limited to the production of common types of pipe bends such as shown on page 484. Compound and unusual bends can be supplied in any practical shape. Some of the photographs in this section of the catalog illustrate a few of the uncommon types made in Crane shops. Compound bends, or bends in more than one plane, do not require any tangent or straight portion between the arcs.

Long lengths of pipe: When designing or ordering pipe bends, the maximum available lengths of welded or seamless pipe should be considered.

Steel pipe is carried in stock in extra long or double random lengths for the fabrication of bends requiring long lengths of pipe, and for eliminating an intermediate joint when practical and desirable; refer to page 458.

Genuine wrought iron pipe is available only in average mill lengths of approximately 19 feet. When the required lengths are not available, two or more pieces of pipe can either be welded together or provided with intermediate flanged joints to produce a desired bend. The intermediate joint should be definitely located if it is an important factor in erection.

Shipping facilities present the only practical limit to the shape or length of pipe bends. Care must be used, when ordering large or complicated pipe bends, to keep the over-all dimensions within the maximum shipping facilities and clearances between the factory and destination.

Ends of pipe bends: Ends of pipe bends can be furnished plain, beveled for welding, threaded, or flanged. A list of all types of flanged joints will be found on pages 487 to 491.

Special materials: Pipe bends can be made from special piping materials such as brass, aluminum, nickel, Monel, silicon bronze, stainless steels and other alloy steels, as well as rubber-lined pipe. Facilities are available for heat-treating alloy steels after fabrication, if required.

Commercial pipe bends: *Pipe bends when made to approximate dimensions only*, for down-spouts, ash handling, railings, and other non-fluid and non-pressure mechanical purposes, can be furnished at prices lower than those of regular pipe bends.

Galvanizing: Pipe bends can be furnished either galvanized on the inside and outside, or galvanized on the outside only.

Painting: Pipe bends are painted on the outside as a protection against rust in transit.

Protectors: The flanged ends of all pipe bends are provided with flange protectors before shipment; threaded ends have thread protectors.

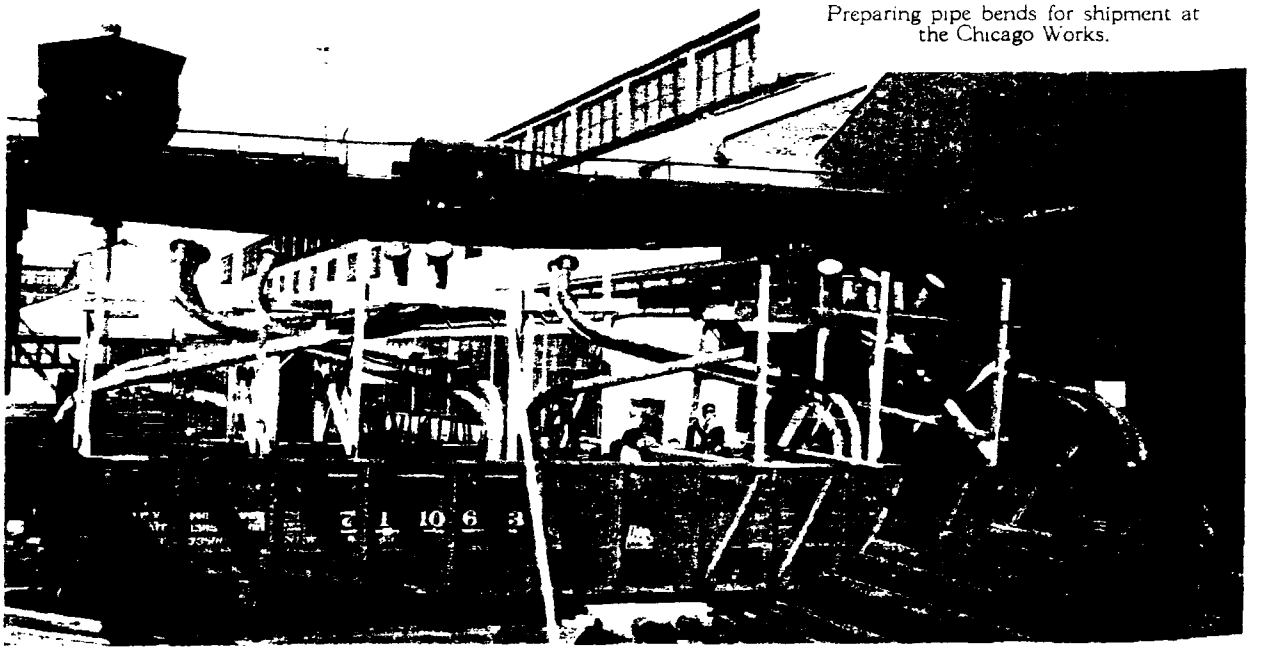
Pipe: For information on pipe, see pages 457 to 471.

Engineering data: Additional information and engineering data will be found on the following pages:

Calculation of pipe bends . . . pages 528 and 529
Length of pipe in bends . . . . . page 530
Calculating working pressure, stress, or wall thickness . . . . pages 523 to 527
Thermal expansion and modulus of elasticity of pipe . . . . . page 531

Prices: Prices on all pipe bends are on application.

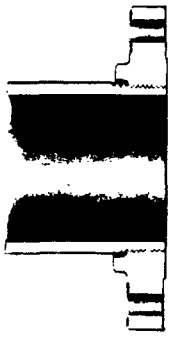
Inquiries and orders: Inquiries and orders should specify: quantity; size, weight, and kind of pipe and whether black or galvanized; complete dimensions; kind of end connections (plain, beveled, threaded, or flanged). If flanged ends are wanted, specify the kind of flanges, facings, and type of joints.



Preparing pipe bends for shipment at the Chicago Works.

Flanging Processes

Screwed Flanged Joints



Screwed Flange
Made On and Refaced

Brass Flanges ..... *page 194*
Iron Flanges ..... *pages 206 to 208*
Steel Flanges ..... *pages 285 to 292*
18-8 Mo Flanges ..... *page 373*
Drilling Templates .. *pages 438 to 443*
Facings ..... *pages 492 and 493*
Thread Lubricants ..... *page 444*

The screwed flanged joint has proved its general utility and satisfactory performance, primarily for the low and moderate pressure and temperature services — especially when fabricated in the Crane shops, using proper threading and pull-up machines.



Screwed Flange
Made On, Not Refaced

Application: The screwed flanged joint can be applied to straight pipe, pipe bends, the ends and nozzles of welded headers, and to the flanged ends of welded assemblies. It can be applied to butt-welded, lap-welded, and seamless steel pipe, or genuine wrought iron pipe, of practically all commercial weights and thicknesses.

Flanges: Any of the screwed flanges listed in this catalog can be used — cast iron, forged steel, and brass, straight or reducing sizes.

Special piping materials: The screwed flanged joint can be furnished on special piping materials such as brass, copper, aluminum, nickel, stainless steels, and Monel. Flanges of the same material can be furnished. Full information on application.

Threading: The threading of both the pipe and the flange is to accurate gauge. The flange is secure on the pipe after the joint is made up.

Alignment of bolt holes: Crane shop fabrication assures proper alignment of the bolt holes in all flanges. When specified, special alignment of the bolt holes can be furnished.

Screwed flange, made on and refaced: After the flange and the pipe have been properly threaded, the flange is made up tight by a powerful machine until the end of the pipe projects slightly beyond the face of the flange. A light refacing cut is then taken across both the flange face and the pipe end.

The refacing assures that the end of the pipe will be flush with the face of the flange, thus providing a proper gasket-bearing surface to the inside of the pipe. It also assures perfect alignment of the pipe.

Screwed flange, made on, not refaced: After the flange and the pipe have been properly threaded, the flange is made up tight by a powerful machine until the end of the pipe is within one-half to one thread from the face of the flange.

The Cranelap Joint

The Cranelap joint approaches more closely than any other type the function of an all-purpose flanged pipe joint. It eliminates the individual, inherent disadvantages of the other types of joints.

The Cranelap joint is predominantly the most effective and practical joint. With either plain facing or the numerous modifications, it has given such universal satisfaction over a long period of time that it is recommended for intermediate and moderately high pressure steam and water lines, and for many other difficult services. The wide range of utility and service applications makes the Cranelap joint a modern flanged joint with very few limitations.

Cranelap joints are well suited for low pressure service, particularly in those sizes where large flange diameters are employed.

In the Cranelap joint the end of the pipe is lapped to produce a square corner at the junction of the inside periphery of the pipe and the face of the lap. When bolted up, the joint is made directly on the pipe itself; there is no thread in the flange to leak under distortion due to bolting load, pressure and temperature, or expansion and contraction strains.

These laps are made by a process which is a combination of upsetting and forging, the operation being performed while the metal is at a proper forging heat.

CRANELAP JOINTS

150-Pound	600-Pound
300-Pound	900-Pound
400-Pound	1500-Pound

Additional description .. *pages 488 and 489*
Dimensions ..... *page 490*
Facings ..... *pages 492 and 493*

Regular Cranelap joints are made on both steel and genuine wrought iron pipe. See note on page 488.

Prices on application



Regular
Cranelap Joint
with plain face,
serrated finish.

41

(*Continued on next page*)

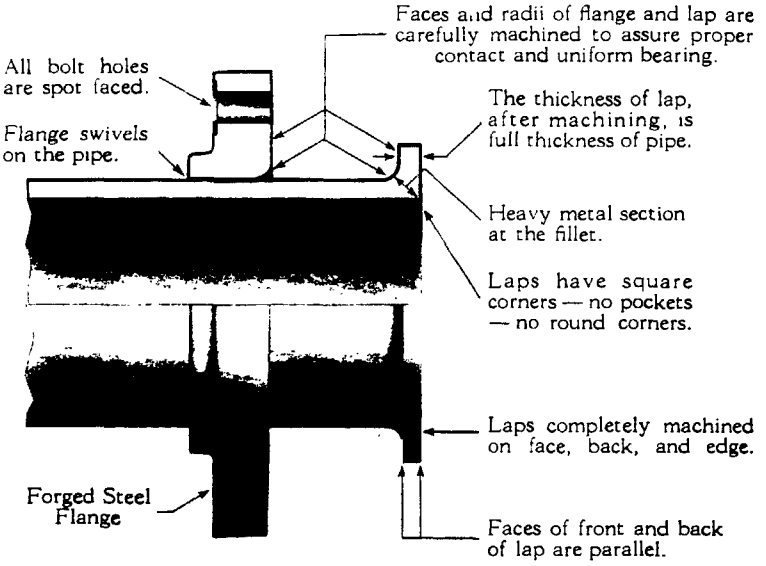
Flanging Processes
The Cranelap Joint (Cont.)

Features and Advantages

Square corner laps: The Cranelap joint has a square corner lap—it should not be confused or compared with a joint having a round corner lap.

The square corner lap assures a smooth joint on the inside of the pipe, without a pocket or depression. The formation of the square corner provides a metal thickness at the turn, or fillet, which is much heavier in section than the round corner lap; consequently much greater strength is developed.

Full thickness laps: The rough laps of all plain Cranelap joints are of sufficient thickness to produce, after machining both the front and the back, a finished thickness of lap equal to or greater than the wall thickness of the pipe on which the lap is made.



Male and female, tongue and groove, double thickness, ring joint, and radial back Cranelap joints have the laps of sufficient thickness to permit machining without reducing the thickness of the lap at any point to less than that of the pipe wall.

Machining of the laps and flanges: All laps are completely machined on the front, back, and edge. The back of the lap is machined to provide a face which is parallel to the front or contact face. The face and the radius of the flange are carefully machined to match the corresponding face and radius of the lap on the pipe. The bolt holes of the flanges are spot faced.

The features of the machining outlined above are important. The spot facing of the bolt holes of the flange provides a uniform bearing surface for the nuts of the bolts or studs. In addition, the facing of the flange and the parallel facing of the back and front of the lap assure an even bearing throughout the joint, and a uniform pressure on the gasket.

Swivel flanges of forged steel: Flanges on Cranelap joints swivel on the pipe, facilitating alignment of the piping. This makes erection easier, because the swivel flange accommodates itself readily to any variations in the position of adjacent bolt holes.

All flanges used on Cranelap joints are of forged steel—unbreakable, and of high strength. This type of joint precludes the use of any flange material other than steel.

Marine service: Cranelap joints comply with the regulations of the following bureaus: U. S. Coast Guard, Marine Engineering Regulations and Material Specifications—Lloyds Register of Shipping, Ships Registered in U.S.A.—American Bureau of Shipping, Special Inspection Required.

Notes on Cranelap Joints

Pipe: Cranelap joints with plain face are regularly made from lapwelded steel or lapwelded genuine wrought iron pipe, using standard, extra strong, or double extra strong weights—or from seamless steel pipe in any of the regular thicknesses.

Cranelap joints with radial back, double thickness or 200% lap, ring joint, male and female, or tongue and groove facing require the use of lap-welded or seamless steel pipe only, and of a wall thickness equal to extra strong weight or heavier.

In sizes smaller than are obtainable in lapwelded steel pipe, all Cranelap joints are made only on seamless steel pipe. For pipe, see pages 457 to 471.

Van Stone joints: Whenever Van Stone joints are specified, Cranelap joints will be furnished.

Plain face: Cranelap joints with plain face, serrated finish, as illustrated on page 493, will always be furnished unless otherwise specified.

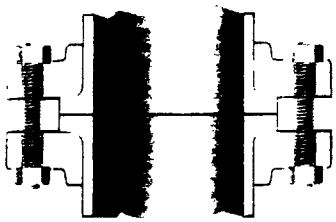
Application of Cranelap joints: Cranelap joints can be applied to straight pipe, pipe bends, the ends and nozzles of welded headers, and the flanged ends of welded assemblies.

Cranelap joints on special piping materials: Cranelap joints can be fabricated on many special piping materials—brass, aluminum, nickel, Monel, and stainless steels, as well as numerous other alloy steels. Facilities are available for heat-treating when required.

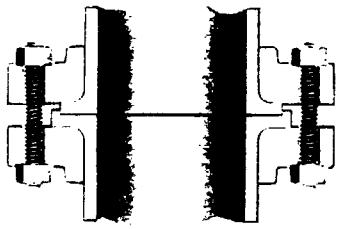
Information and prices furnished on application.

Flanging Processes

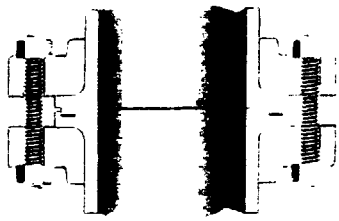
Modifications of the Cranelap Joint and Facings



Double Thickness or 200% Lap, Cranelap Joint



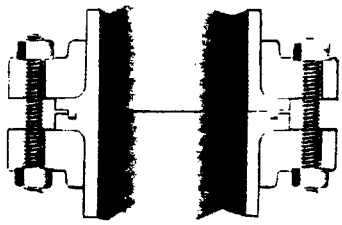
Large Male and Female Cranelap Joint (female in the lap)



Large Tongue and Groove Cranelap Joint

In addition to the plain face Cranelap joint shown on the preceding page, various modifications can be furnished, as shown on this page. Modified Cranelap joints require the use of lapwelded or seamless steel pipe only, and of a wall thickness equal to or heavier than extra strong weight. They are applicable to primary service pressures of 300 pounds or higher.

Modified Cranelap joints have the laps completely machined — on the face, back, and edge. All except the radial back have a straight face on the back.



Small Tongue and Groove Cranelap Joint

Double Thickness, or 200% Lap, Cranelap Joints

Double thickness Cranelap joints are exactly the same as the regular Cranelap joint with plain face, except that the thickness of the lap, after machining, is twice the wall thickness of the pipe used.

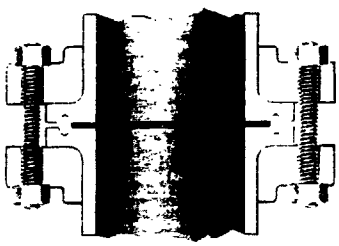
For dimensions of double thickness Cranelap joints, use the dimensions of plain Cranelap flanges on page 490. A dimension of twice the wall thickness of the pipe should be used in establishing the thickness of the lap for obtaining dimension "L".

Large Male and Female Cranelap Joints

In the lapped end with male face, the thickness of the lap, after machining, will be the wall thickness of the pipe used, except that the minimum thickness of lap will be ¼-inch when the wall thickness of the pipe is less than ¼-inch, such as on 2-inch and smaller extra strong pipe. In the lapped end with female face, the thickness of the lap, after machining, will be the wall thickness of the pipe used, plus the depth of the female facing.

Large or Small Tongue and Groove Cranelap Joints

In either the large tongue and groove or the small tongue and groove Cranelap joint the thickness of the lap, after machining, will be the wall thickness of the pipe used, plus the height of the tongue or the depth of the groove.



Ring Joint Cranelap Joint

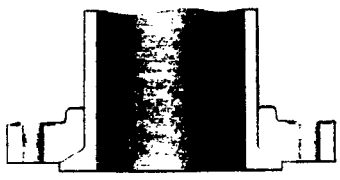
Ring Joint Cranelap Joints

The ring joint Cranelap joint is furnished with a specially designed groove which employs a steel ring, this combination making a pressure-tight joint. The joint has a thickness of lap, after machining, equal to the wall thickness of the pipe used, plus the depth of the groove. For dimensions of ring joints, see pages 450 and 451.

Radial Back Cranelap Joints

Radial back Cranelap joints derive their name from the shape of the back — they have a radial back instead of the straight back as furnished on other Cranelap joints. Regular 300, 400, 600, 900 or 1500-Pound Forged Steel Cranelap Flanges are used, except that the faces have a radius machined to fit the radius on the back of the lap on the pipe.

Dimensions of radial back Cranelap joints are furnished on application.

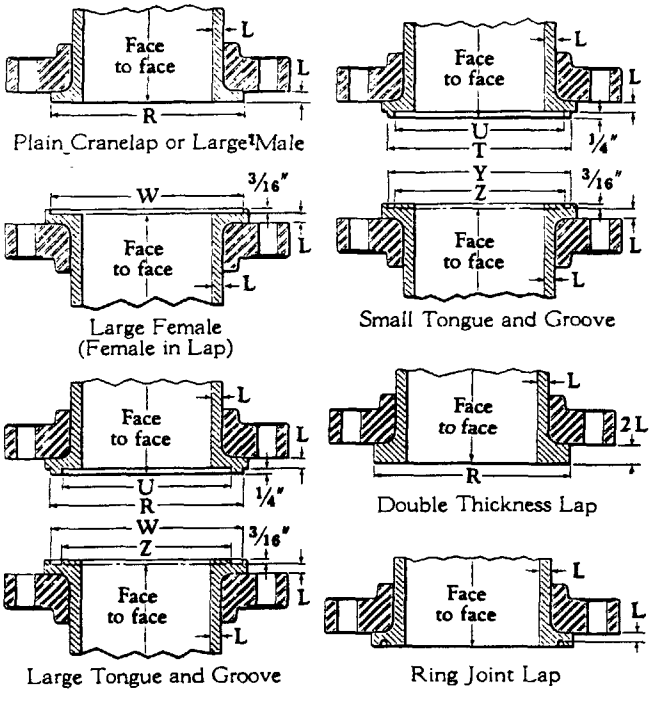


Radial Back Cranelap Joint

Prices on application ***Dimensions... page 490***

Flanging Processes

Dimensions of Cranelap Joints



Dimensions, in Inches

Size of pipe	R	T	U	W	Y	Z
½	1⅜	1⅜	1	1⁷⁄₁₆	1⁷⁄₁₆	1⁵⁄₁₆
¾	1¹¹⁄₁₆	1¹¹⁄₁₆	1⁵⁄₁₆	1¾	1¾	1¼
1	2	1⅞	1½	2¹⁄₁₆	1¹⁵⁄₁₆	1⁷⁄₁₆
1¼	2½	2¼	1⅞	2⁹⁄₁₆	2⁵⁄₁₆	1¹³⁄₁₆
1½	2⅞	2½	2⅛	2¹⁵⁄₁₆	2⁹⁄₁₆	2¹⁄₁₆
2	3⅝	3¼	2⅞	3¹¹⁄₁₆	3⁵⁄₁₆	2¹³⁄₁₆
2½	4⅛	3¾	3⅜	4³⁄₁₆	3¹³⁄₁₆	3⁵⁄₁₆
3	5	4⅝	4¼	5¹⁄₁₆	4¹¹⁄₁₆	4³⁄₁₆
3½	5½	5⅛	4¾	5⁹⁄₁₆	5³⁄₁₆	4¹¹⁄₁₆
4	6³⁄₁₆	5¹¹⁄₁₆	5³⁄₁₆	6¼	5¾	5⅛
5	7⁵⁄₁₆	6¹³⁄₁₆	6⁵⁄₁₆	7⅜	6⅞	6¼
6	8½	8	7½	8⁹⁄₁₆	8¹⁄₁₆	7⁷⁄₁₆
8	10⅝	10	9⅜	10¹¹⁄₁₆	10¹⁄₁₆	9⁵⁄₁₆
10	12¾	12	11¼	12¹³⁄₁₆	12¹⁄₁₆	11³⁄₁₆
12	15	14¼	13½	15¹⁄₁₆	14⁵⁄₁₆	13⁷⁄₁₆
14 OD	16¼	15½	14¾	16⁵⁄₁₆	15⁹⁄₁₆	14¹¹⁄₁₆
16 OD	18½	17⅝	16¾	18⁹⁄₁₆	17¹¹⁄₁₆	16¹¹⁄₁₆
18 OD	21	20⅛	19¼	21¹⁄₁₆	20³⁄₁₆	19³⁄₁₆
20 OD	23	22	21	23¹⁄₁₆	22¹⁄₁₆	20¹⁵⁄₁₆
24 OD	27¼	26¼	25¼	27⁵⁄₁₆	26⁵⁄₁₆	25³⁄₁₆

This schedule of dimensions conforms to the American Steel Flange Standard (B16e-1939).

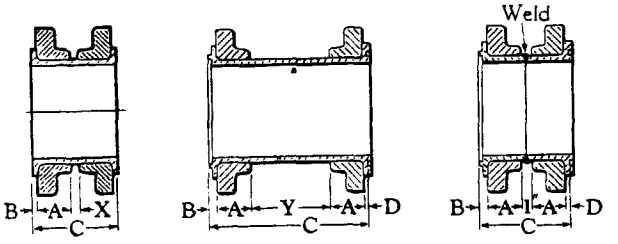
Plain Cranelaps are regularly made on lapwelded steel or genuine wrought iron pipe, using standard, extra strong, or double extra strong weights — or on seamless steel pipe, using any regular thickness. Plain Cranelaps are applicable to all pressure classes, i.e. 150-Pound and higher; the thickness of the lap is the same as the thickness of the pipe wall.

Male and female, tongue and groove, double thickness or 200% lap, and ring joint Cranelaps require the use of lapwelded or seamless steel pipe only, and of a wall thickness equal to or heavier than extra strong weight, except that the minimum lap thickness on the male for large male and female joints will be ¼-inch where the pipe wall thickness is less than ¼-inch (i.e. extra strong weight pipe sizes 2-inch and smaller). These Cranelaps, called "modified Cranelaps", are applicable to the 300-Pound and higher pressure classes only.

Dimensions of radial back Cranelaps are furnished on application. For dimensions of grooves on ring joint Cranelaps, refer to pages 450 and 451.

Description . . pages 487 to 489 *Cranelap Flanges . pages 285 to 291* *Ring Joints . . . pages 450 and 451*

Minimum Face to Face of Piping with Cranelap Joints



Sketch "A" Sketch "B" Sketch "C"

The minimum face to face dimensions of straight pipe with Cranelap joints are obtained as follows:

Sketch "A": Formula for straight pipe with plain face Cranelap joints:

$C = X + 2(A + B)$ Where $X = 16\frac{1}{2}$" on 1 to $1\frac{1}{2}$" pipe
$X = 26$" on 2" pipe
$X = 1$" on $2\frac{1}{2}$" and larger pipe

Sketch "B": Formula for straight pipe with the modified Cranelap joints—male and female, tongue and groove, ring joint, radial back, and double thickness lap:

$C = Y + (2A) + B + D$ Where $Y = 16\frac{1}{2}$" on 1 to $1\frac{1}{2}$" pipe
$Y = 26$" on 2 and $2\frac{1}{2}$" pipe
$Y = 10$" on 3" and larger pipe

Sketch "C": The minimum face to face outlined for sketch "B" can be reduced if a butt weld is located between the flanges, as illustrated in "C".

If the procedure of sketch "C" is followed, the minimum face to face of straight pipe with the modified Cranelap joints is in accordance with the formula:

$C = 1" + (2A) + B + D$

41

Flanging Processes

Welded Flanged Joints

Welded flanged joints can be furnished in the types illustrated here.

The Cranelap stub ends with Cranelap flange, also illustrated, affords an auxiliary flanged connection for welding.

Application: Any of the welded flanged joints shown at the right can be applied to straight pipe, pipe bends, the ends and nozzles of welded headers, and the flanged ends of welded assemblies. Special shop equipment assures the perfect alignment of flange faces on all Crane Welded Flanged Joints.

Welding: The shop welding of these flanged joints is performed by Crane welders working under approved procedure control.

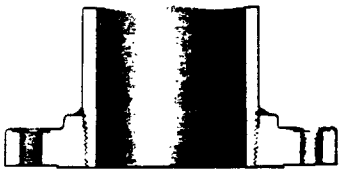
Special piping materials: These types of welded flanged joints can be furnished on many special piping materials, including numerous alloy steels, with facilities for heat-treating after fabrication.

Information and prices furnished on application.

Forged Steel Screwed Flange, Seal-Welded

A Crane Forged Steel Screwed Flange is used in this joint. The pipe and the flange are accurately threaded; the flange is made up tight on the pipe, seal-welded, and then refaced. The joint is sealed by fillet-welding the back of the flange to the pipe, thus assuring no leakage through the threads.

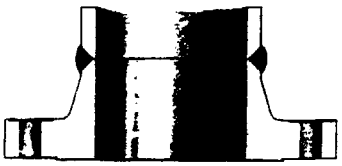
The refacing assures perfect alignment of the flange faces, and that the end of the pipe is flush with the face of the flange for a proper gasket-bearing surface to the inside of the pipe. The threads retain the function of holding the flange securely on the pipe, hence there is no shearing action.



Screwed Flange
Seal-Welded and Refaced

Forged Steel Welding Neck Flange

Crane Welding Neck Flanges are of forged steel. They are machined with a beveled end and bored to match the inside diameter of the pipe to which they are applied. A butt-weld is used to attach the welding neck flange to the pipe, which is also machine beveled.

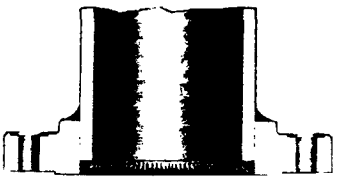


Welding Neck Flange
Butt-Welded to Pipe

Forged Steel Slip-On Welding Flange

Crane Forged Steel Slip-On Welding Flanges are bored for a snug fit on the pipe and when applied to fabricated piping are welded at the front and back through the two methods defined below and shown at the right.

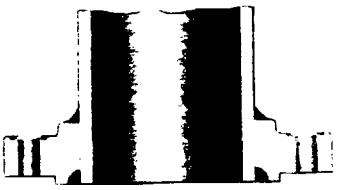
Type No. 1: Type No. 1 is Crane standard for welded flanged joints on carbon steel and genuine wrought iron piping with 150 and 300-Pound Forged Steel Slip-On Welding Flanges. Regular flanges are utilized with the end of the pipe set back from the face of the flange and the flange welded to the pipe both in front and back. Type No. 2 for this class of piping furnished on special order only.



Type No. 1
Slip-On Welding Flange
Welded Front and Back

Type No. 2: Type No. 2 is Crane standard for welded flanged joints on carbon steel and genuine wrought iron piping with 400-Pound or higher pressure class forged carbon steel flanges, and for all iron-pipe-size alloy piping where alloy flanges of all pressure-classes are used. Slip-on flanges with a special front groove for welding are used. The pipe is flush with the flange face, accomplished through refacing after welding both the front and back of the flange to the pipe.

Code limitation: When piping must comply with either the Pressure Piping Code or the A.S.M.E. Unfired Pressure Vessel Code, the use of the slip-on welding flange joint is limited to a primary service pressure rating of 300 pounds per square inch.

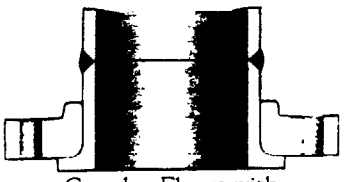


Type No. 2
Slip-On Welding Flange
Welded Front and Back
and Refaced

Cranelap Stub Ends and Cranelap Flange

The Cranelap stub end with Cranelap flange can be applied to fabricated piping. Both the stub end and the pipe are machine beveled. A butt-weld is used to complete the joint.

This type of joint has all of the advantages of the regular Cranelap joint, as described on pages 487 to 489. In most cases, piping can be fabricated with Cranelap joints applied directly, which eliminates the weld necessary for the application of the Cranelap stub end with Cranelap flange.



Cranelap Flange with
Cranelap Stub End
Butt-Welded to Pipe

41

Facings . . . pages 492 and 493

Flanges . . . pages 285 to 292 *Cranelap Stub Ends . . pages 274 to 277* *Welding Fittings . . pages 269 to 284*

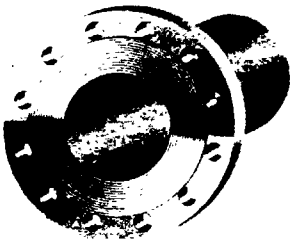
Flange Facings and Finishes

Crane Fabricated Piping includes a variety of facings and finishes for flanged joints. Shown and described on these pages are details of those regularly furnished on flanged joints in the many pressure classes. Also shown and described are other facings and finishes available on special orders.

The word "facing" refers to the type of face that is machined on flanges or lap joints. It should not be confused with the word "finish", which refers to the kind of finish that is applied to the actual contact surface of the face. For example, the "facing" on a flange machined with a ¼-inch high projection is commonly known as a "¼-inch high male face", but the "finish" on the contact surface of the male projection can be either "serrated" or "smooth".



Plain Face
Smooth Finish



1/16-inch High Raised Face
Serrated Finish



¼-inch High Male Face
Serrated Finish



Plain Face
Smooth Finish—"V" Grooved

There are many finishes in general use for flange and lap joint facings. Crane, in regular practice, employs either the serrated or smooth finish.

Serrated finish: The machining of faces with this finish is accomplished with a round nose or form tool which cuts concentric grooves. On cast iron and ferrosteel flange facings there are approximately 16 serrations to the inch and on steel flange facings, approximately 32 serrations to the inch.

Smooth finish: The machining of faces with this finish is accomplished with tools which leave an even, uniform surface, designated as "smooth".

Caution: Although not used by Crane, the term "plane face" is sometimes encountered. It usually means "smooth finish". As it is not a "facing" and is often confused with plain (or flat) face, the use of the term is misleading and should be avoided.

Iron and steel flanged joints—regular practice: Flanged joints when using 125-Pound Cast Iron or Ferrosteel Screwed Flanges are regularly furnished plain faced with smooth finish.

Serrated or special finishes can be furnished but at an extra charge.

Flanged joints when using 250-Pound Cast Iron or Ferrosteel Screwed Flanges, and 150-Pound and 300-Pound Forged Steel Screwed, Welding Neck, or Slip-On Welding Flanges are regularly furnished with a 1/16-inch high raised face having a serrated finish.

Smooth or special finishes and special facings can be furnished but at an extra charge.

Raised faces should be removed from 150-Pound Steel Flanges before bolting against 125-Pound Iron Flanges, and only a full face gasket should be used.

Flanged joints when using 400, 600, 900, 1500, and 2500-Pound Forged Steel Screwed, Welding Neck, or Slip-On Flanges are regularly furnished with a ¼-inch high large male face with serrated finish, or a 3/16-inch deep large female face with smooth finish.

Special facings, and smooth or special finishes on male faces, can be furnished but at an extra charge.

Brass flanged joints: Flanged joints when using brass flanges are regularly plain faced with smooth finish and "V" grooved. Full face gaskets should always be used when assembling all brass joints. Metallic gaskets are not recommended.

Raised faces should be removed from iron and steel flanges before bolting against brass flanges.

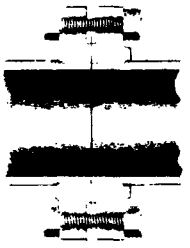
Brass Flanges page 194 *Iron Flanges . . . pages 206 to 208* *Steel Flanges . pages 285 to 292*
Templates for drilling pages 438 to 443 *Dimensions of special facings . . pages 448 to 451*

Flange Facings and Finishes (Cont.)

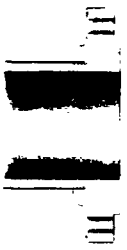
¼-inch High Double Male
Large Male and Female
Small Male and Female

Ring Joint
Large Tongue and Groove
Small Tongue and Groove

Flanged joints, when using 300, 400, 600, 900, 1500, and 2500-Pound Forged Steel Screwed, Welding Neck, or Slip-On Welding Flanges, can be furnished with ¼-inch high double male, large male and female, small male and female, large tongue and groove, small tongue and groove, and ring joint facing.



¼-inch High Double Male



Ring Joint on Screwed Flange



Ring Joint on Welding Neck Flange



Ring Joint on Slip-On Welding Flange

Flanged joints, when using 150-Pound Forged Steel Screwed, Welding Neck, or Slip-on Welding Flanges, can be furnished with ring joint facing. The ring joint face is also furnished on Cranelap joints; see page 489.

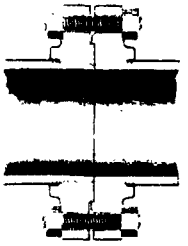
The ring joint facing should not be used with or against iron or brass valves, flanges, or fittings.

Finish: Male faces are regularly furnished with serrated finish. Female faces, tongue faces, and groove faces are regularly furnished with smooth finish.

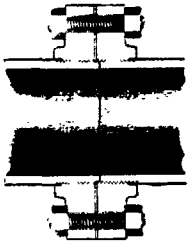
Smooth finish can be furnished on the male faces when ordered; special prices will apply.

Caution: Care should be taken in the use of small male and female joints to insure that the pipe is thick enough to permit sufficient bearing surface to prevent crushing the gasket.

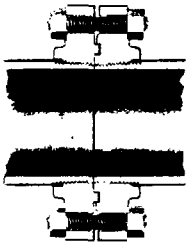
Gaskets: For best results, when corrugated copper and corrugated soft iron gaskets are used, they should be coated with Crane High Temperature Thread Lubricant. See pages 454 to 456 for gaskets and page 444 for thread lubricant.



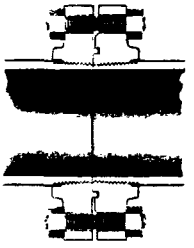
Large Male and Female



Small Male and Female



Large Tongue and Groove



Small Tongue and Groove

Cranelap Joint Facing Finishes

Regular Cranelap joint: The regular Cranelap joint with raised face is regularly furnished with a serrated finish, approximately 32 serrations per inch. Smooth finish can be furnished when specified.

Modified Cranelap joints: The modified Cranelap joint facings are finished as follows:



Cranelap Joint — Plain Face Serrated Finish

Radial back and double thickness lap Cranelap joints with raised face are regularly furnished with a serrated finish, approximately 32 serrations per inch. A smooth finish can be furnished when so specified on orders.

Large male and female, large tongue and groove, and small tongue and groove Cranelap joints are regularly furnished with a serrated finish (approximately 32 serrations per inch) on the male faces, and with smooth finish on the female, tongue, and groove faces. Smooth finish can be furnished on the male faces when specified.

Gaskets: For best results, when corrugated copper and corrugated soft iron gaskets are used, they should be coated with Crane High Temperature Thread Lubricant. See pages 454 to 456 for gaskets and page 444 for thread lubricant.

Dimensions of Cranelap Joints . . . . page 490

Crane Welded Piping

Crane Fabricated Piping includes a wide variety of shop welded product — headers, welded assemblies, receiver separators, vessels, etc.— for all current operating pressure and temperature services.

The welding of shop fabricated piping probably finds its greatest usefulness in the production of welded headers from pipe.

A few of the advantages of welded headers are: the elimination of joints; a saving in weight; a conservation of space when necessary; the location of branches or nozzles at any desired, practical intervals; continuity of insulation; and the freedom to apply any type of joint to the nozzles or connections.

Shop fabrication of welded headers is recommended. See page 480 for the "Advantages of Crane Shop Fabrication".

For information on the dimensions and design of Crane Welded Headers, see pages 498 and 499.

Welding processes: All modern methods of fusion welding are employed in the fabrication of Crane welded piping.

When orders do not specify which process should be used, Crane employs the method best adapted to the character of the work and which will produce the best results.

Codes; qualification of welders: Crane welded piping can be fabricated to conform to the requirements of the various codes. Crane welders must pass tests in accordance with the A.S.M.E. Unfired Pressure Vessel Code and the A.S.A. Code for Pressure Piping. The qualifications are for various methods of welding.

Stress relieving: Crane welded piping will be stress relieved in accordance with the codes. Welded nozzles, in both the unreinforced and reinforced types, and other welds are stress relieved when it is considered necessary, even though the codes do not stipulate that stress relief is required.

The practice of stress relief as outlined above will be followed, unless orders or inquiries specify otherwise.

Notes on Crane Welded Piping

Ends of welded piping: Welded headers and piping can be supplied with the ends plain, beveled for welding, threaded, or flanged, utilizing any of the types of flanged joints which are listed; see pages 492 and 493.

Long lengths of pipe: When designing or ordering welded headers and piping, consideration should be given to the maximum lengths of welded or seamless pipe available, see page 458

When the necessary lengths are not available, two or more pieces of pipe can be welded together or provided with intermediate flanged joints to produce the desired header or welded assembly. Any intermediate joint should be definitely located if its location is an important factor in erection.



Stress relieving a welded joint between a valve and a fabricated header.

Shipping facilities present the only practical limit to the shape or length of welded headers and assemblies. Care must be used to keep the over-all dimensions within the maximum shipping facilities and clearances between factory and destination.

Special materials: Facilities are available for welding or brazing into various types of fabricated assemblies, piping materials such as brass, copper, aluminum, and Monel.

Numerous alloy steels, including stainless steels, also can be welded. Facilities for heat-treating alloy steels after fabrication are available when required. Crane shops have welding rods and electrodes for welding alloy steels which give the deposited metals approximately the same characteristics as the parent metals.

Details on special materials on application.

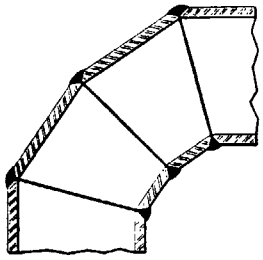
Galvanizing: Welded headers and welded piping can be furnished galvanized on the inside and outside, or galvanized on the outside only. The galvanizing is done after fabrication. Information on application.

Inquiries and Orders: Inquiries or orders for welded products should specify the quantity; the dimensions; size, weight, and kind of pipe; also if the ends are to be plain, beveled for welding, threaded, or flanged. If flanged, the kind of flange, facing, and type of joint should be specified. It is advisable to have a sketch accompany all orders or inquiries.

Crane Welded Piping (Cont.)

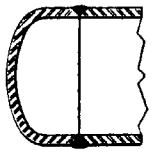
Types of Welds

There are numerous types of welds for various connections and purposes. Those in general use are as follows:


Mitre Weld


Butt Weld
For Metal Thickness
of ¾-inch or less

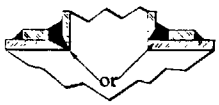

Butt Weld
For Metal Thickness
greater than ¾-inch


Welded End Closure

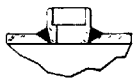

Welded Coupling
Threaded

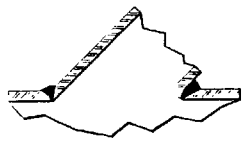


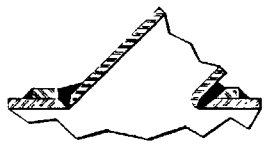
90° Nozzle Weld
Standard Type



90° Nozzle Weld
Reinforced Type


Welded Coupling
Bored for
Socket Welding


Angular Nozzle Weld
Standard Type


Angular Nozzle Weld
Reinforced Type


Welded Pad, Threaded
(Also Made
Socket Welding)

Butt welds: Two types of butt welds are furnished as illustrated — one for light sections, and one for heavy sections. All piping is machine-beveled before butt welds are applied.

Mitre weld: The mitre weld, illustrated above, may be used for fabricated piping, especially in the larger sizes, or for unusual conditions.

The use of pipe bends or welding elbows is recommended in preference to mitre welds. However, where space or design limitations require, or when suitable welding elbows are not available, mitre welding can be used. Mitre welds are made up of various combinations of segments, angles, etc., and must be designed for each condition encountered.

Welded end closure: The welded end closure regularly furnished is illustrated above. Crane Welding Caps (ellipsoidal shape) are used unless otherwise specified. For welding caps, see pages 275 and 277. Other types, such as flat head, dished head, etc. can be furnished when ordered.

Welded couplings and welded pads: Smaller sizes of screwed and socket-weld connections are furnished in two types—welded couplings and welded pads, as illustrated above.

For welded couplings, the regular practice is to use a half coupling of either the extra heavy seamless, the 3000-Pound W.O.G., or 6000-Pound W.O.G. Steel pattern. One end is beveled and the weld is made as illustrated. For welded pads, the regular practice is to use a section of steel bar stock or a forged steel pad. One end is beveled, the weld is made, and the opening is drilled and tapped or bored for socket-welding as the final operation. WeldOlets can also be supplied; see page 281. Orders and inquiries should specify type wanted.

Welded nozzles: Crane Fabricated Piping utilizes two types of welded 90° or angular nozzles — the "standard type" which is unreinforced, and the "reinforced type" which provides reinforcement of the nozzle weld. One of two types of welds is used; see illustrations above.

Reinforcing of welded nozzles will be done as required by the customer and in accordance with the A.S.M.E. Unfired Pressure Vessel Code or the A.S.A. Pressure Piping Code when these Codes must be complied with.

The ring type of reinforcement will be furnished in the absence of definite specifications on orders for fabricated piping with reinforced welded nozzles.

Other types of reinforcement can be furnished according to individual specifications, when so stipulated.


A welded header with threaded outlets.

Unit Fabrication
Piping and Valves

Piping specifications for central stations and industrial power plants have undergone many changes in recent years, especially since piping materials have been developed to meet the demands of the extremely high pressures and temperatures prevalent today.

Long, patient, and intelligent engineering research and experiment have developed new equipment and alloys capable of handling pressures and temperatures which would have seemed fantastic but little more than a decade ago. It follows that as service demands become more severe, piping materials themselves must and do meet the challenge of more exacting design, materials, and construction.

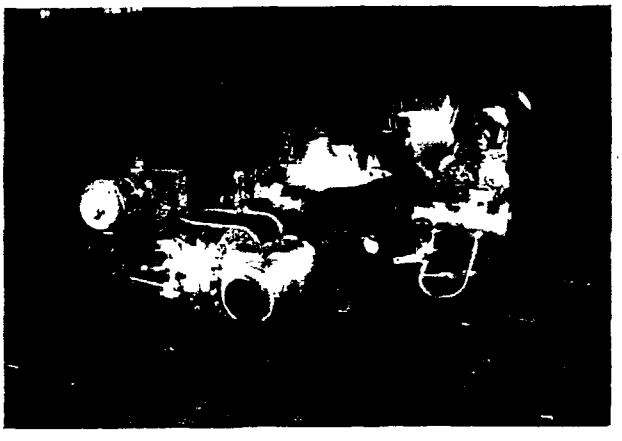
The present trend in power plant design is to make the main steam headers large in diameter and relatively short in length. Stop valves for boiler, turbine, and auxiliary leads can be grouped closely on such a header. Feed water headers and auxiliary or service assemblies follow this trend.

Among the many innovations contributing to the efficiency of modern piping materials, welding has played an important part. That, in turn, has pointed the way to shop fabrication of headers, assemblies, and even complex piping units. These can be delivered complete to the job, thereby saving considerable time in installation costs, as well as assuring compliance with the strictest intent of the design and dependable performance when placed in operation.

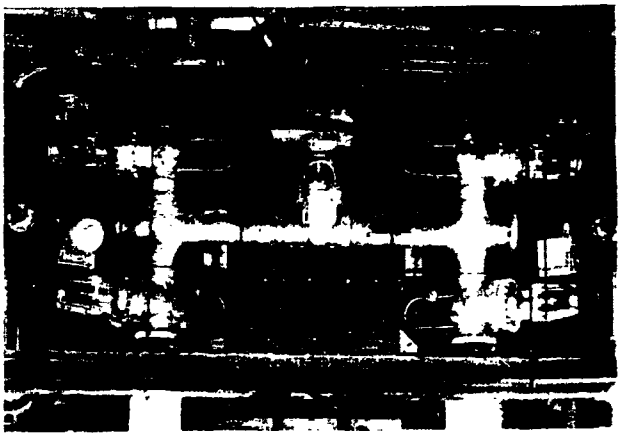
Where installations suggest that welding end valves and headers are preferred, it is becoming common practice to have the header with its valves and other piping welded into convenient assemblies. Suitable flanged or beveled end connections can be provided so the assemblies may be connected to adjacent flanged or welded piping lines.

There are many advantages in having piping units fabricated in the shop, as portrayed on pages 479 to 483, 494 and 495.

A secondary but important consideration is that a modern fabricating shop has the facilities needed to care for all possible emergencies and unusual requirements. Unavoidable last minute changes or additions, the replacement of a component part of an assembly which occasionally fails under test, and re-alignment after fabrication, are but a few of the contingencies encountered and overcome daily in the shop fabrication of complete assemblies.







These photos of an 8-inch assembly for the steam distribution system of a central station, show two of the steps required in unit fabrication. The third photo shows the assembly installed and operating at 550 pounds pressure and 825° F. temperature. The total weight of the completed assembly was 12,500 pounds.

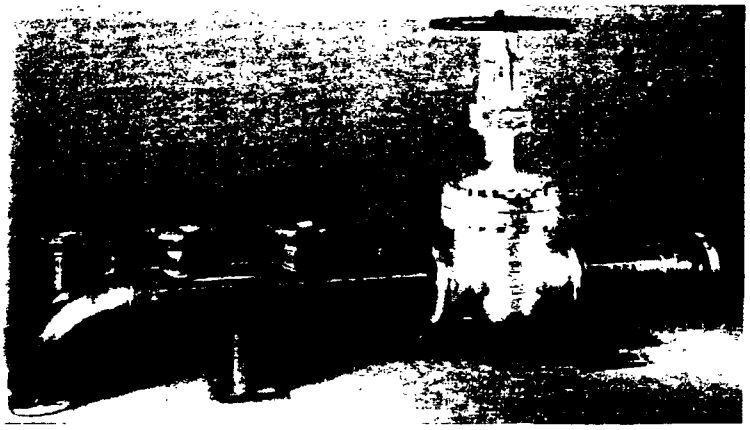
Unit Fabrication
Piping and Valves (Cont.)

It is generally agreed among engineers that headers and major piping assemblies, such as those illustrated, are the heart of the main steam, boiler feed, and auxiliary lines in high-pressure high-temperature power plants

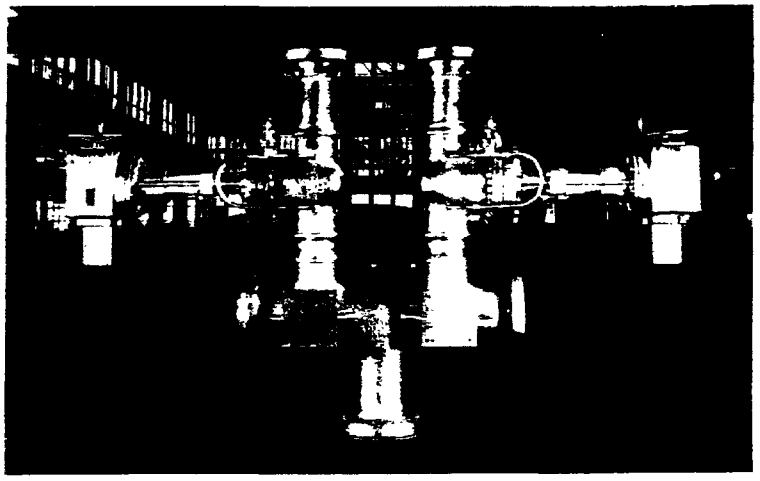
Some of the illustrations on these pages show cast carbon-moly steel headers. These are gaining in favor where the required length permits their use. This design permits the application of liberal radii for nozzle outlets, thus providing better flow characteristics. Velocities have been speeded up to a point where the effect of cavitation at the outlet nozzles of a header may reach serious proportions. This is minimized through the careful nozzle design possible in a cast header.

In large header structures involving many outlets, the problem of reinforcing is overcome through the exacting design of a casting, and uniform results can be predicted from the final annealing operation.

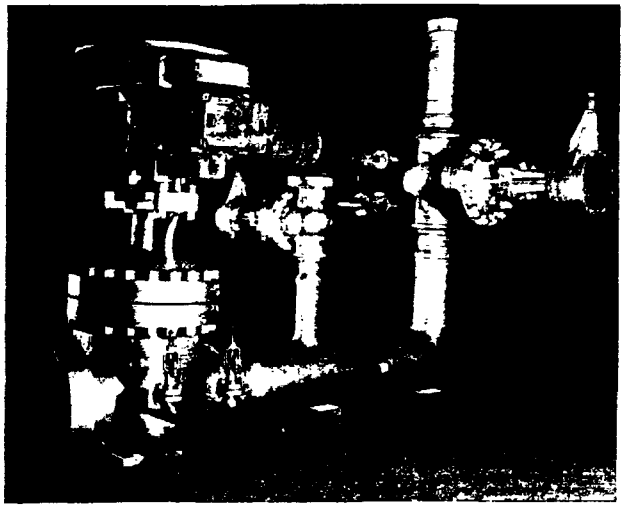
While most of the illustrations show assemblies for higher pressures and temperatures, the plan of pre-fabricated assemblies is also applicable to lower pressure jobs.



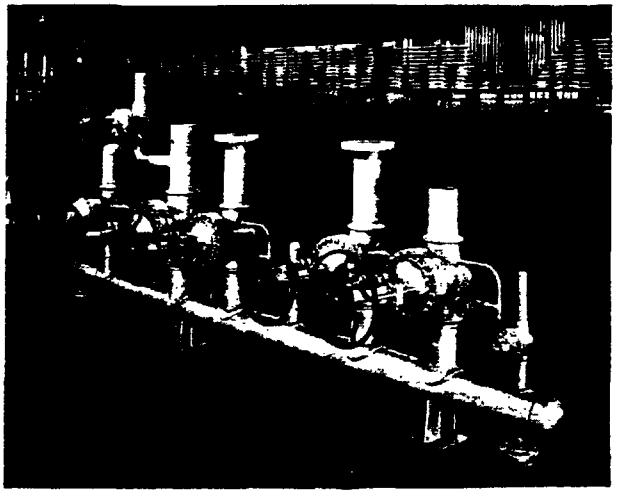
Unit fabrication of 600-Pound header and valve.



A 900-Pound cast header, complete with valves.

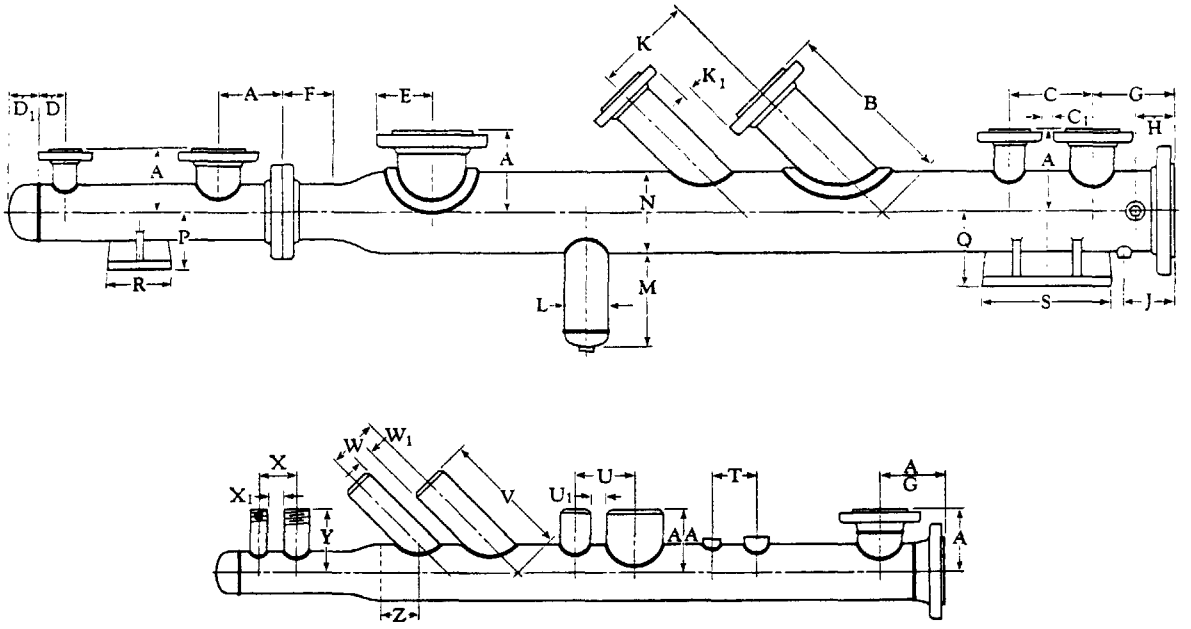


1500-Pound shop fabricated valve and cast header assembly.



10-inch main steam header for central station installation.

Dimensions of Crane Welded Headers



Design recommendations: It is impossible to outline in complete detail fixed recommendations for the dimensions of welded headers, because the specific requirements often necessitate the use of special or unusual dimensional design. However, for the major portion of ordinary requirements, it is possible to keep within the limitations of standard practice.

To this end, the composite header sketches shown above and the data following are presented as a guide for designing and for determining the dimensions of welded headers.

Caution: In the data following, reference is made, in many cases, to recommended minimum dimensions. The principles of good header design preclude the use of these minimum dimensions, and consequent close clearances, except when necessary.

As an example, refer to dimension "C" (center to center of adjacent flanged end nozzles) in the sketch above and in the data section following, and note that the recommended minimum should be used only when close nesting of the branch outlet piping is required, or when the space for the header length is limited. Obviously, the use of the minimum dimension "C" is not desirable when greater spacing of adjacent nozzles can be effected.

Recommended minima: While the recommended minimum dimensions appearing in the following data are accurate for general purposes, slight variations are possible. For specific problems of this nature, full information will be furnished upon receipt of inquiries, which preferably should be accompanied by a sketch.

Dimensions "A" and "B": The center to face dimension of flanged end welded nozzles should be the same as the corresponding dimensions of flanged fittings of similar pressure rating and of similar type.

Dimensions "C"-"C_1" and "K"-"K_1": The recommended minimum center to center dimension of adjacent flanged end welded nozzles should be one-half the diameter of one outlet flange, plus one-half the diameter of the other outlet flange, plus one inch (1"). This will provide sufficient clearance for welding the nozzles to the header and also for bolting up the adjacent flanged joints.

If the nozzle welds are reinforced, certain types of reinforcement may require more than one inch of clearance between adjacent flanges of nozzles. However, if ring reinforcement is used, this qualification does not apply, as the one inch clearance between adjacent flanges (dimensions "C_1" and "K_1") provides sufficient clearance for the application of welded reinforcing rings.

Dimensions "D" and "E": The dimension "D" (center of welded nozzle to center of the butt weld of an end closure) and the dimension "E" (center of welded nozzle to the beginning of a swedged reduction in the diameter of the header) should not be less than one-half the diameter of the flange on the welded nozzle.

Dimension "D_1" For dimensions of the welding caps used for end closures, see page 280. See pages 274 to 277 for description of caps.

Dimensions of welding cap end closures for pressures greater than those shown on pages 274 to 277 will be furnished on application.

Dimension "F": The minimum lengths of tangents on swedged or reduced ends should be the same as the minimum tangents used on pipe bends. See column "C" in the table on page 485 and the notes relating to tangents on page 484.

Dimensions of Crane Welded Headers (Cont.)

Dimension "G": When the diameter of the welded nozzle is smaller than the diameter of the header, it is possible, in some instances, to make the dimension from center of nozzle to face of header flange less than the normal dimension ("A"), which is the corresponding flanged fitting dimension.

Dimension "G" should not be less than one-half the diameter of the outlet flange, plus the length through the hub of the header flange (including welding neck type), plus any additional space, if necessary, for the insertion of bolts.

Dimension "H": The pipe connection for flow meter purposes should be located according to the requirement of the flow meter manufacturer. However, clearance for the hub of the flange is necessary.

Dimension "J": Welded coupling nozzles or welded pads for a drain or other purposes should be so located that dimension "J" provides ample clearance for the hub of the header flange, and also for the insertion or removal of the bolts for the header flange when piping is connected to the welded coupling nozzle or pad.

Dimensions "L" and "M": The diameter of welded drip pockets ("L") should be approximately one-half to two-thirds of the diameter of the header ("N"). The length of welded drip pockets ("M") should be, as a recommended minimum, approximately two to three times the diameter ("L"). It is recommended that the drain connection be not less than 1-inch, also that the size should be based on the service requirement.

For low pressure saturated steam lines, drip pockets should be larger than those used on high pressure superheated steam lines, because more condensate will be present in the low pressure saturated steam lines than in the high pressure superheated steam. Drip pockets should not be located immediately opposite and below a vertical branch outlet of a header, because the flow from the header through the vertical branch will produce a syphonic action and render the drip pocket partially or even entirely ineffective, especially when a high velocity of flow is employed.

Dimensions "P" and "Q": The fabrication of headers by welding readily permits variations in the location, design, and dimensions of supports and anchorage bases.

In the absence of any special requirement, it is recommended that the dimension "P" (center of header to face of base support) and the dimension "Q" (center of header to face of anchorage base) be the same as the corresponding dimensions of base fittings of similar pressure rating and of similar type.

These recommended dimensions provide clearance for insulation.

Dimensions "R" and "S": The dimensions of the support bases ("R") should be the same as the corresponding dimensions of base fittings of similar pressure rating and type.

The dimensions of anchorage bases ("S") should be larger than those of support bases and should be developed to suit the conditions.

When bases are to be drilled for bolts, the size and the location of the holes should be specified. When an anchorage base is used, it should be bolted securely; however, the supporting base should then be free, in order not to interfere with the longitudinal movement of the header when expanding or contracting.

Dimension "T": The minimum center to center dimension of adjacent welded coupling nozzles or welded pads ("T") is governed by the pipe sizes of these connections. Adequate space should be provided for the installation of any valves, unions, etc., in the connected piping.

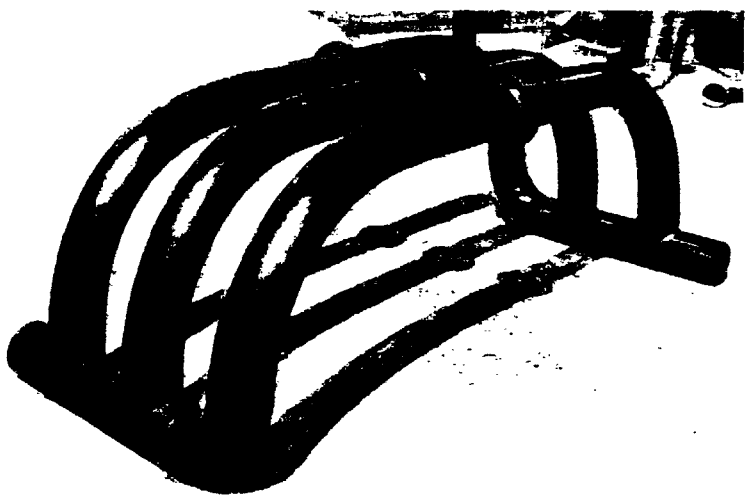
Dimensions "AA", "V", and "Y": It is recommended that the center to end dimension of beveled end welded nozzles ("AA" and "V") and threaded end welded nozzles ("Y") be the same as the center to face dimensions of corresponding flanged fittings of similar pressure rating and type.

When necessary, it is possible to reduce dimensions "AA", "V", and "Y" below the standard recommended above, but in such a case care should be used to have these dimensions of adequate length for proper butt-welding or screwing-up of the branch piping to the ends of the nozzles in the header.

Dimensions "U"-"U_1", "W"-"W_1", and "X"-"X_1": The minimum center to center dimension of adjacent beveled end or threaded end welded nozzles is governed by the pipe sizes of these nozzles. Adequate space should be provided for the installation of any valves, unions, flanges, etc. in the piping connected to the nozzles.

It is also necessary that the dimensions "U_1", "W_1", and "X_1" be of sufficient length to provide adequate space for the welding of the nozzles to the header.

Dimension "Z": The dimension "Z" can be determined by the same formula used for dimension "E", i. e., the same as one-half the flange diameter on a 90° welded nozzle.



A Crane fabricated header, welded and flanged.

Pipe Coils

Pipe coils can be obtained in varied designs and sizes, dependent upon the space available for installing, and other factors. They provide a practical, efficient, and economical means for the transfer of heat from one fluid to another.

Crane fabricating shops, located for nation-wide service, are equipped to produce the complicated types of pipe coils as well as the simple or standardized types.

Materials: Carbon steel pipe, seamless or welded, of standard or extra strong weights, predominate the pipe coil field, although other tubular materials are available. Seamless pipe, rather than butt-welded or lap-welded, is recommended, to overcome any possible leakage in service.

Testing, stress-relieving and heat-treating: Crane regularly tests all pipe coils either hydrostatically, or on air, before shipment. Special tests will be made if indicated in the order. Facilities for stress-relieving or heat-treating coils made from carbon, or alloy steels, or other materials, are available. Details will be furnished on application.

Dimensional tolerances: Commercial pipe coils are subject to certain manufacturing tolerances in dimensions. Additional information on this subject will be furnished on request.

Galvanizing: Pipe coils can be furnished galvanized on the outside only. It is possible, however, in limited instances, to galvanize on the inside as well.

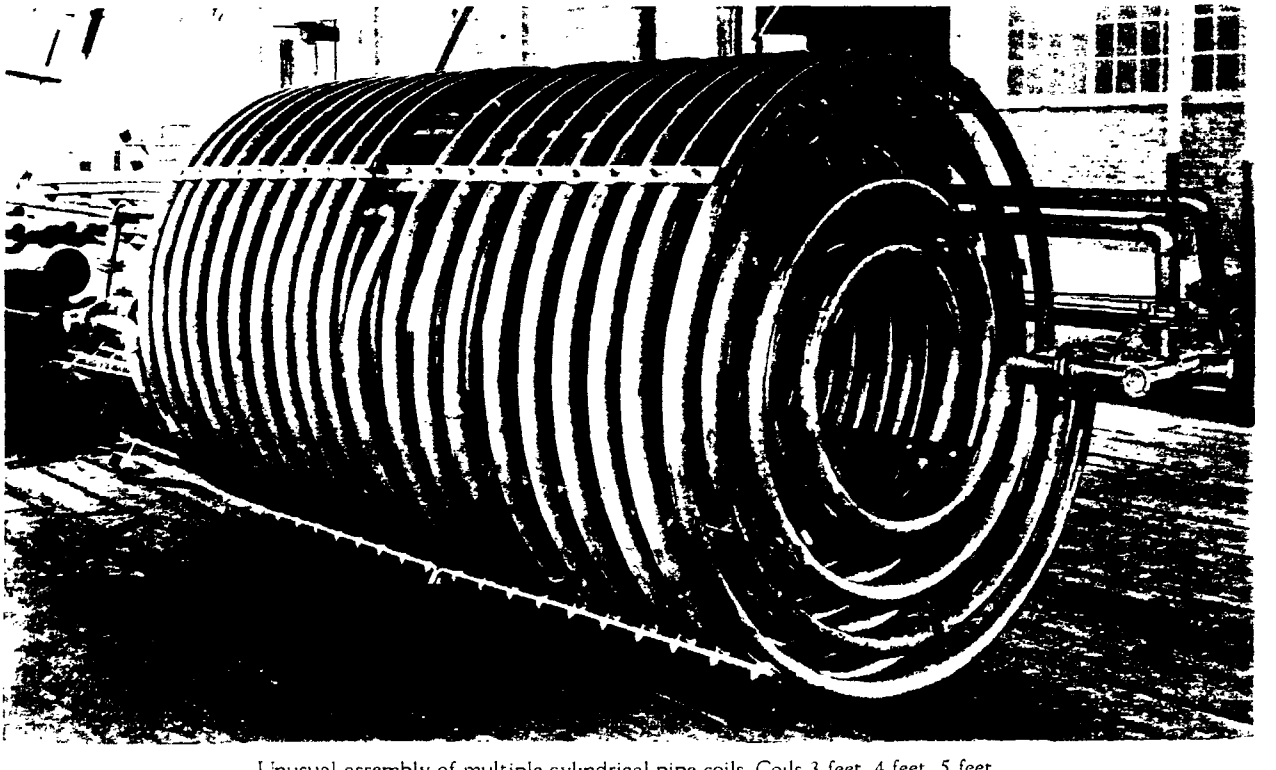
Painting: Unless specified in detail on the order, all coils are shipped unpainted.

Straps and supports: Straps will be furnished for all types of pipe coils if the over-all size is large enough to warrant support for maintaining their shape in shipment. These straps can be used as supports in installation.

Welded headers: To conserve space, save weight, and eliminate many joints, welded headers are recommended for connecting the inlets and outlets of two or more pipe coils used in a battery. For further information on Crane Welded Headers, refer to pages 498 and 499.

On the following pages are illustrations of pipe coils more commonly used.

For additional information on common types available, dimensional tolerances, straps, supports and engineering data, request a copy of Circular No. 318 from the nearest Crane branch.



Unusual assembly of multiple cylindrical pipe coils. Coils 3 feet, 4 feet, 5 feet, and 6 feet in diameter. Notice the fabricated header on this coil, specially designed to provide flanged connections. Fabricated in the Birmingham Shop.

Pipe Coils (Cont.)

Cylindrical

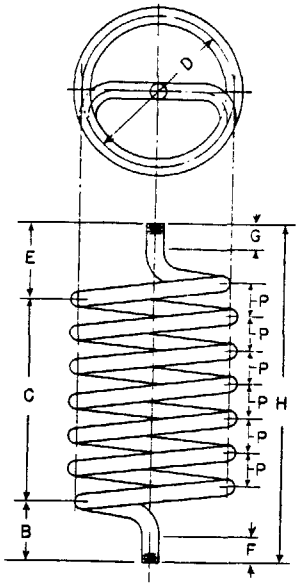


Figure No. C-1

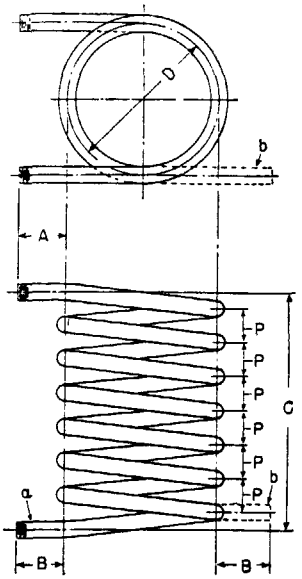


Figure No. C-6
Shown by solid lines.

Figure No. C-7
Outlet shown by dotted lines.

Double Cylindrical

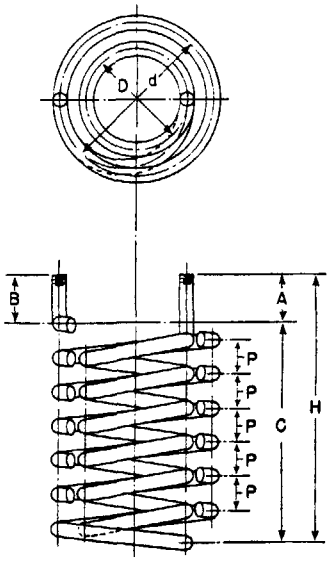


Figure No. DC-1
As shown

Triple Cylindrical Pipe Coils can also be furnished

Flat Spiral

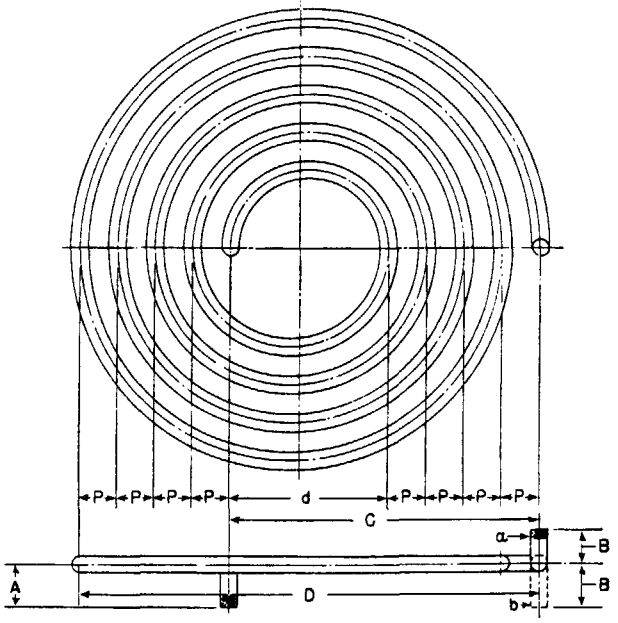


Figure No. FS-1
Shown by solid lines

Figure No. FS-2
Outlet shown by dotted lines

Inlets and outlets: Inlets and outlets are identified by markings "a" and "b."

The inlet or outlet locations may be in positions other than shown in these illustrations. If required in other positions, provide those details in a sketch.

Tangents: The illustration of Figure No. C-1 shows how required lengths of tangents may be specified by inserting dimensions "F" and "G." If a specific length of tangent must be maintained, include that information in detail.

Minimum dimensions..... page 503

Pipe Coils (Cont.)

Flat Type

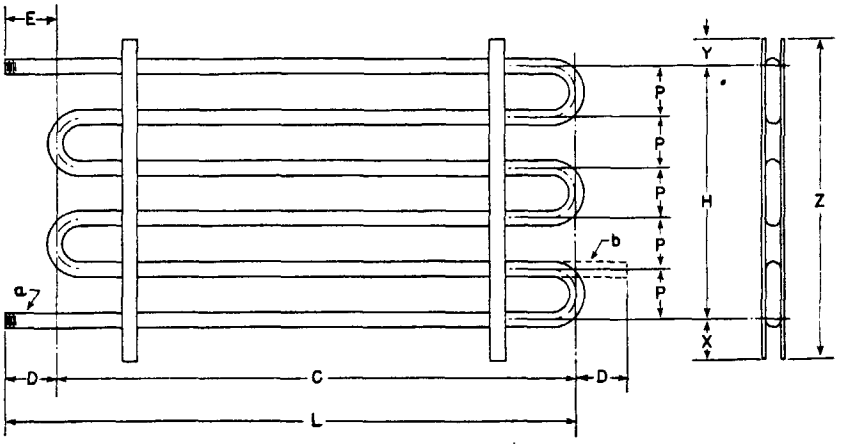


Figure No. F-3
Shown by solid lines

Figure No. F-4
Outlet shown by dotted lines

Oval Type

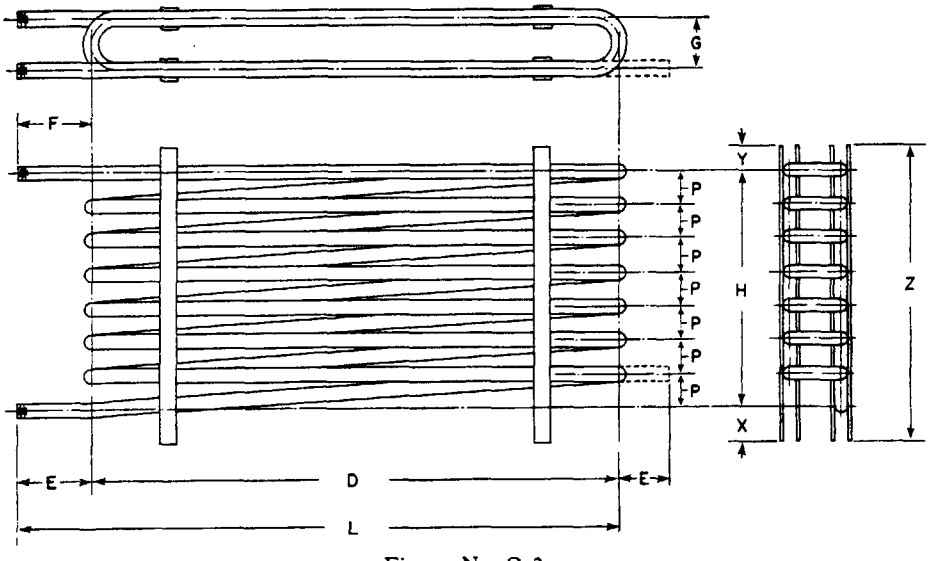


Figure No. O-3
Shown by solid lines

Figure No. O-4
Outlet shown by dotted lines

Inlets and outlets: Inlets and outlets are identified by markings "a" and "b."

The inlet or outlet locations may be in positions other than shown in these illustrations. If required in other positions, provide those details in a sketch.

Tangents: If a specific length of tangent must be maintained for the inlet and outlet of the pipe coils shown above, include that information in detail.

Welding return bends can be used in the fabrication of flat or oval pipe coils. For sizes and centers of welding return bends, refer to pages 274 to 277.

41

Pipe Coils (Cont.)

Box Type

The inlet or outlet locations may be in positions other than shown in the illustration. If required in other positions, provide those details in a sketch.

Welding return bends can be used in the fabrication of these box pipe coils. For sizes and centers of welding return bends, refer to pages 274 to 277, inclusive.

Minimum dimensions are shown below.

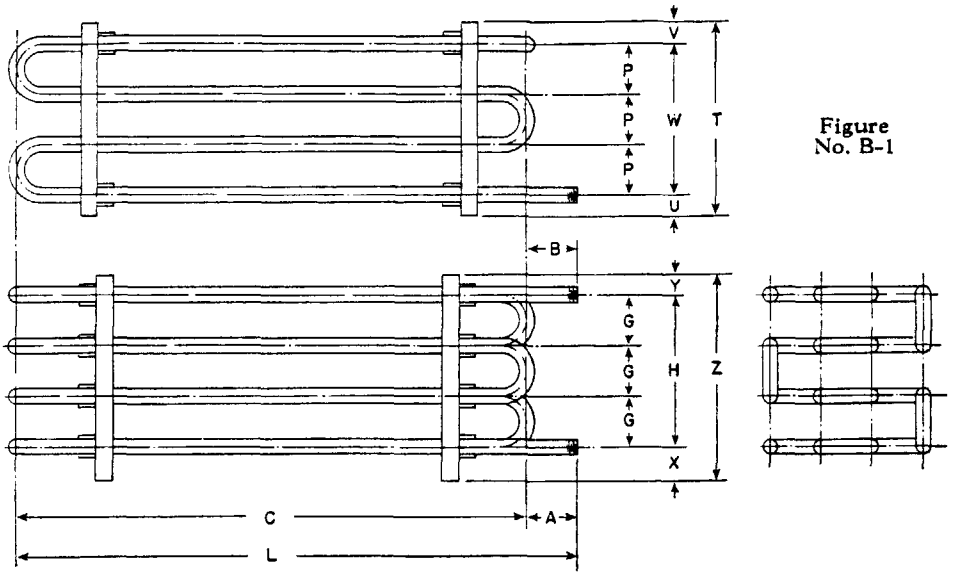


Figure No. B-1

Minimum Dimensions of Pipe Coils

The following table shows two sets of dimensions which can be used in the fabrication of pipe coils. Both are classed as minimum schedules of dimensions.

When it is necessary to resort to a compact design, the "Recommended Minimum Center to Center" dimensions are suggested. For unusually compact designs, the "Shortest Center to Center" dimensions can be used. Both should be avoided whenever greater centers can be employed; refer to the cautionary note below.

For pipe coils bent on short center to center dimensions, the use of seamless pipe is recommended.

"Center to Center" has reference to dimension "D" (diameter) for cylindrical pipe coils, to dimension "P" for flat pipe coils, dimension "G" for oval pipe coils, and dimensions "P" and "G" for box pipe coils.

Type of Pipe Coils	Size of Pipe Inches	Steel Pipe				Genuine Wrought Iron Pipe			
		Recommended Minimum Center to Center Dimensions—Inches		Shortest Center to Center Dimensions—Inches		Recommended Minimum Center to Center Dimensions—Inches		Shortest Center to Center Dimensions—Inches	
		Standard	Extra Strong	Standard	Extra Strong	Standard	Extra Strong	Standard	Extra Strong
For Cylindrical Pipe Coils	½	5	5	3½	3	8	6	6	4
	¾	7½	7	5	4½	10	9	8	6
	1	10	9	7	6	14	12	10	8
	1¼	13	12	9	8	18	16	12	10
	1½	18	15	10	9	24	20	15	12
	2	24	20	14	12	30	26	20	16
For Flat, Oval, and Box Pipe Coils	½	3	2½	3	2	5	4	5	4
	¾	3½	3	3½	2½	6	6	6	5
	1	4	3½	4	3	10	8	8	6
	1¼	5	4	4½	3½	12	10	10	8
	1½	6	5	5	4	15	12	12	10
	2	8	7	6	6	20	16	16	12

Information on smaller and larger sizes of pipe, and on other piping materials, will be furnished on application.

Cautionary Note Regarding the Use of Recommended Minimum or Shortest Center to Center Dimensions

The center to center dimensions and bending radii of pipe coils preferably should exceed the recommended minimum shown above.

By bending to close centers the outside pipe walls are subject to some flattening and thinning, both of which increase as the bending centers are reduced. This is particularly true of the larger sizes, 1½-inch and 2-inch.

In some instances it is possible to obtain shorter center to center dimensions than listed. Detailed information will be furnished upon receipt of specific inquiry.

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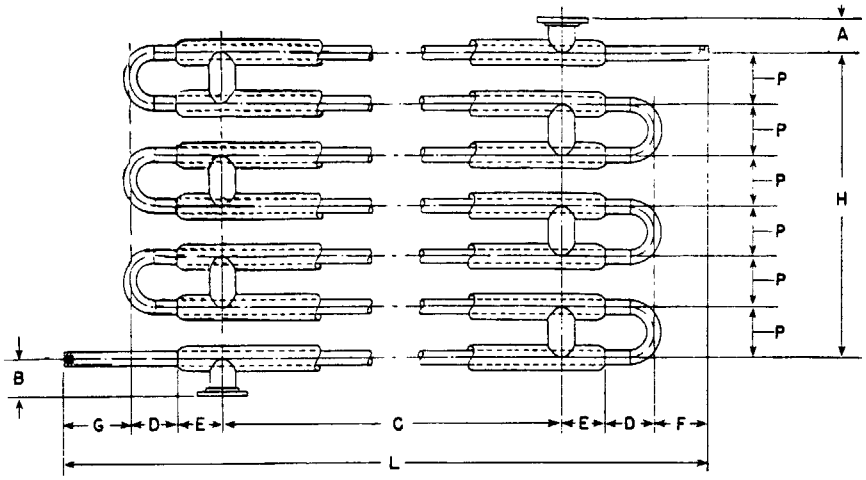
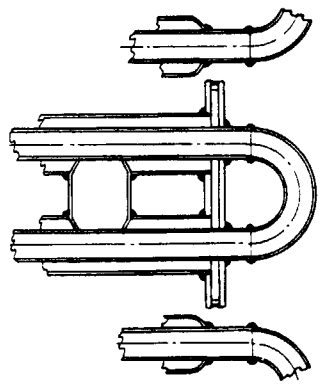
Welded Double Pipe Heat Exchangers





Crane shops can fabricate heat exchangers of the type illustrated above. They are formed of two sets of piping, one placed inside of the other, utilizing swedging and welding to complete the assembly.

Application: This type of heat exchanger has a wide range of application in various installations, to serve as a medium for heat transfer between liquids, gases, etc. The usual arrangement is to provide counter flows or directions of travel in the inside of the smaller or inner piping and the annular space between the inner and outer piping.

Pipe sizes: The sizes commonly used are 2 x 1¼, 2½ x 1¼, 3 x 2, and 4 x 3-inch. Other sizes can be made; information will be furnished upon receipt of specific inquiries.

Length and height: These double pipe heat exchangers are regularly made in any length up to 20 feet long. Lengths over 20 feet can be fabricated on special orders.

The usual practice limits the height to 12 pipes; however, these heat exchangers can be any number of pipes high, the only limitation being shipping facilities.

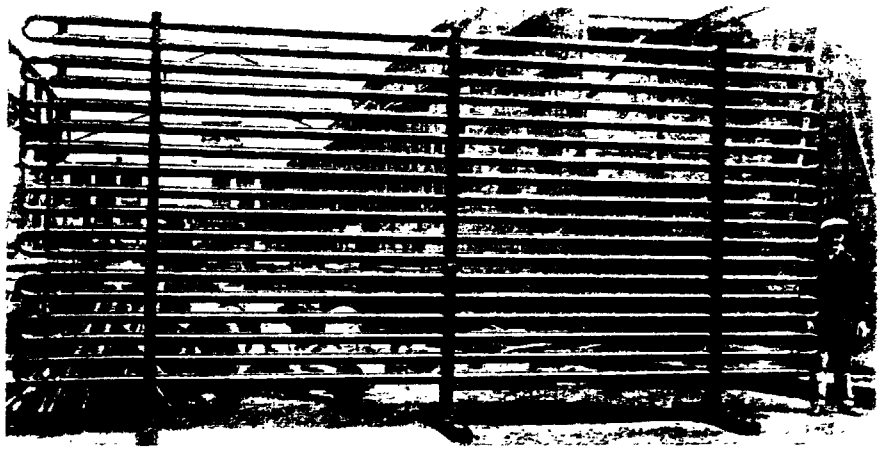
Headers for multiple stands: When two or more stands of double pipe heat exchangers are used in a battery, welded piping headers for connecting the inlets and outlets are recommended.

Note: For information about sizes and centers of welding return bends, see pages 274 to 277.

Special expansion joint: The enlarged detail above shows a design of welded expansion joint which can be adapted to double pipe heat exchangers as an alternate construction. It is suggested for installations involving unusual temperature differentials, when provision for taking care of moderate expansive movement of the connected piping appears desirable.

Inquiries and orders: Inquiries or orders should specify the quantity; size, weight, and kind of pipe; service, pressure, and temperature; over-all length; number of pipes; number of stands; center to center dimensions of stands when headers are wanted; and whether or not valves and any additional connections are wanted on the inlets and outlets.

Prices: Prices will be quoted on application.



Double Pipe Heat Exchanger fabricated by welding—made in the Chicago Shop of Crane

Engineering Data

Assembly and Maintenance of Flanged Joints ..... page 508
Crane Bolting ..... pages 506 and 507
Discharge of Water Through Pipes, Orifices, and Valves ..... pages 509 to 511
Resistance of Valves and Fittings to Flow of Fluids ..... pages 512 and 513

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Selecting Size of Crane Stop-Check Valves ..... page 563

Crane service extends beyond product manufacture. Through years of research, experimenting, and testing, Crane Engineers have accumulated a wealth of engineering data to assist in solving the complicated problems sometimes associated with piping systems.

A small portion of that data is shown in this section of the catalog. Users confronted with unusual piping problems are invited to avail themselves of Crane's complete service or to refer to the several Crane technical publications for additional information.

For greater convenience, certain data of an engineering nature have been included in other sections of this catalog with products to which they definitely pertain. Refer to the pages indicated below:

Formula for Determining Size of Steam or Oil Separators ..... page 340
Normal Engagement Between Male and Female Threads ..... page 474
American and British Standard Pipe Threads ..... pages 472 to 474
Railing Pipe Threads ..... page 198
Expansion of Wrought Iron, Steel, Brass, or Copper Pipe ..... page 345
Commercial Wrought Steel Pipe Data ..... pages 470 and 471

Crane Bolting



Machine Bolt
Square Head
With Hexagon Nut



Bolt-Stud
Threaded Entire Length
With Two Hexagon Nuts



Stud
Threaded Oversize on One End
Other End Threaded for Nut

Definitions

Bolt: A bolt is threaded on one end only, the other end being upset into the form of a head.

Bolt-Stud: A bolt-stud is threaded either on both ends, or full length to the standard diameter for nut assembly on each end.

Stud: A stud is threaded on both ends, one end being oversize in diameter to fit tightly (wrench fit) in a tapped hole, the other being to the standard diameter for a nut assembly.

Materials

Crane furnishes bolts, studs, and bolt-studs of the following materials:

Machine Bolts for use at temperatures up to 500° F. are made from steel complying with A.S.T.M. Specification A 107, open-hearth, free-cutting grade, having the following physical properties:

	Minimum
Tensile Strength, lbs. per sq. in.	60,000
Yield Point, lbs. per sq. in.	35,000
Elongation in 2", per cent	25
Reduction of Area, per cent	50

These bolts are furnished with "Regular" unfinished square heads in accordance with A.S.A. B18.2.

All machine bolts are threaded in accordance with A.S.A. B1.1 Coarse Thread Series, Class 2 fit.

Nuts regularly furnished with machine bolts are made of free-cutting or resulfurized nut stock conforming to A.S.T.M. Specification A 107.

Nuts are made to American Standard Unfinished "Heavy" Hexagon Dimensions, A.S.A. B18.2.

All nuts are tapped in accordance with A.S.A. B1.1 Coarse Thread Series, Class 2 fit.

Studs and Bolt-Studs for use at temperatures up to 500° F. are made from cold rolled steel complying with A.S.T.M. Spec. A 108, open-hearth free-cutting grade, having the following physical properties:

	Minimum
Tensile Strength, lbs. per sq. in.	70,000
Yield Point, lbs. per sq. in.	60,000
Elongation in 2", per cent	18
Reduction of Area, per cent	45

Cold roll steel studs and bolt-studs are threaded in accordance with A.S.A. B1.1 Coarse Thread Series, Class 2 fit (nut ends only).

Nuts regularly furnished are cold made of material in accordance with A.S.T.M. Spec. A 107.

Nuts are semi-finished in accordance with the American Standard "Heavy" Hexagon Dimensions, A.S.A. B18.2.

All nuts are tapped in accordance with A.S.A. B1.1 Coarse Thread Series, Class 2 fit.

Alloy Steel Studs and Bolt-Studs are made of Crane Triplex or Templex Steel. Crane Triplex Steel has been used with uniformly satisfactory results in thousands of steel valve and fitting installations, many of which—particularly in oil refineries—have been operating under extreme pressures and temperatures. Templex Steel, a recent Crane development in bolting materials, is superior to Triplex Steel in creep resistance; on temperatures over 850° F., especially where joints are made up for permanent, long-time service, as in steam power plants, Crane Templex Steel will be found ideal.

Crane Triplex Steel complies with the requirements of A.S.T.M. Specification A 193, Grades BC and B 7 bolting.

Crane Templex Steel complies with the requirements of A.S.T.M. Specification A 193, Grades BC and B 14 bolting.

Both steels have the following physical properties:

	Minimum
Tensile Strength, lbs. per sq. in.	125,000
Yield Point, lbs. per sq. in.	105,000
Elongation in 2", per cent	16
Reduction of Area, per cent	50

Crane Alloy Steel Bolt-Studs, threaded their entire length, and accompanying nuts are threaded in accordance with the American Standard for Screw Threads for High Strength Bolting (ASA B1.4), sizes 1-inch and smaller in diameter with the Coarse-Thread Series, and 1⅛-inch and larger in diameter with the 8-Pitch-Thread Series.

Nuts regularly furnished with alloy steel bolt-studs are medium carbon, oil-quenched, semi-finished, made to the American Standard "Heavy" Hexagon Nut Dimensions, A.S.A. B18.2.

Nuts for alloy steel bolt-studs comply with the requirements of A.S.T.M. Specification A 194, Class 2 H.

Torque Required to Produce Bolt Stress

The torque or turning effort required to produce a certain stress in bolting is dependent upon a number of conditions, some of which are:

1. Diameter of bolt.
2. Type and number of threads on bolt.
3. Material of bolt.
4. Condition of nut bearing surfaces.
5. Lubrication of bolt threads and nut bearing surfaces.

Crane has conducted many tests to determine the relation between torque and bolt stress from which the tables given below were prepared. The values given in these tables are based upon steel bolting well lubricated with a heavy graphite and oil mixture. It was found that a non-lubricated bolt has an efficiency of about 50 per cent of a well lubricated bolt and also that different lubricants produce results varying between the limits of 50 and 100 per cent of the tabulated stress figures.

Crane High Temperature Thread Lubricant

The graphite and oil mixture will give satisfactory results; however, for high temperature service Crane High Temperature Thread Lubricant should be used so that bolt-studs can be more readily followed up or disassembled after being subjected to heat. See page 444 for description of Crane High Temperature Thread Lubricant.

Data for Use with Machine Bolts and Cold Rolled Steel Bolt-Studs

Load in Pounds on Bolts and Bolt-Studs when Torque Loads Are Applied

Nominal Diameter of Bolt	No. of Threads per Inch	Diameter at Root of Thread	Area at Root of Thread	Stress					
				7,500 Lbs. per Sq. In.		15,000 Lbs. per Sq. In.		30,000 Lbs. per Sq. In.	
				Torque Ft. Lbs.	Compression, Lbs.	Torque Ft. Lbs.	Compression, Lbs.	Torque Ft. Lbs.	Compression, Lbs.
1/4"	20	.185	.027	1	203	2	405	4	810
5/16	18	.240	.045	2	388	4	675	8	1350
3/8	16	.294	.068	3	510	6	1020	12	2040
7/16	14	.345	.093	5	698	10	1395	20	2790
1/2	13	.400	.126	8	945	15	1890	30	3780
9/16	12	.454	.162	12	1215	23	2430	45	4860
5/8	11	.507	.202	15	1515	30	3030	60	6060
3/4	10	.620	.302	25	2265	50	4530	100	9060
7/8	9	.731	.419	40	3143	80	6285	160	12570
1	8	.838	.551	62	4133	123	8265	245	16530
1 1/8	7	.939	.693	98	5190	195	10380	390	20760
1 1/4	7	1.064	.890	137	6675	273	13350	545	26700
1 3/8	6	1.158	1.054	183	7905	365	15810	730	31620
1 1/2	6	1.283	1.294	219	9705	437	19410	875	38820
1 5/8	5 1/2	1.389	1.515	300	11363	600	22725	1200	45450
1 3/4	5	1.490	1.744	390	13080	775	26160	1550	52320
1 7/8	5	1.615	2.049	525	15368	1050	30735	2100	61470
2	4 1/2	1.711	2.300	563	17250	1125	34500	2250	69000

Data for Use with Alloy Steel Bolt-Studs

Load in Pounds on Bolt-Studs when Torque Loads Are Applied

Nominal Diameter of Stud	No. of Threads per Inch	Diameter at Root of Thread	Area at Root of Thread	Stress					
				30,000 Lbs. per Sq. In.		45,000 Lbs. per Sq. In.		60,000 Lbs. per Sq. In.	
				Torque Ft. Lbs.	Compression, Lbs.	Torque Ft. Lbs.	Compression, Lbs.	Torque Ft. Lbs.	Compression, Lbs.
1/4"	20	.185	.027	4	810	6	1215	8	1620
5/16	18	.240	.045	8	1350	12	2025	16	2700
3/8	16	.294	.068	12	2040	18	3060	24	4080
7/16	14	.345	.093	20	2790	30	4185	40	5580
1/2	13	.400	.126	30	3780	45	5670	60	7560
9/16	12	.454	.162	45	4860	68	7290	90	9720
5/8	11	.507	.202	60	6060	90	9090	120	12120
3/4	10	.620	.302	100	9060	150	13590	200	18120
7/8	9	.731	.419	160	12570	240	18855	320	25140
1	8	.838	.551	245	16530	368	24795	490	33060
1 1/8	8	.963	.728	355	21840	533	32760	710	43680
1 1/4	8	1.088	.929	500	27870	750	41805	1000	55740
1 3/8	8	1.213	1.155	680	34650	1020	51975	1360	69300
1 1/2	8	1.338	1.405	800	42150	1200	63225	1600	84300
1 5/8	8	1.463	1.680	1100	50400	1650	75600	2200	100800
1 3/4	8	1.588	1.980	1500	59400	2250	89100	3000	118800
1 7/8	8	1.713	2.304	2000	69120	3000	103680	4000	138240
2	8	1.838	2.652	2200	79560	3300	119340	4400	159120
2 1/4	8	2.088	3.423	3180	102690	4770	154035	6360	205380
2 1/2	8	2.338	4.292	4400	128760	6600	193140	8800	257520
2 3/4	8	2.588	5.259	5920	157770	8880	236655	11840	315540
3	8	2.838	6.324	7720	189720	11580	284580	15440	379440

Assembly and Maintenance of Flanged Joints

As the temperatures and pressures used in the piping industry have increased, the problem of maintaining tight flanged joints has progressively become more severe. Many types of joints have been used; various types of gaskets have been installed in these joints; and different kinds of bolting materials have been recommended — all with a varying amount of success, depending upon the operating conditions. Even with all of these variations in design, certain precautions must be taken to maintain tight flanged joints.

When a flanged joint is assembled, each of the component parts is subjected to tensile or compressive stresses of varying magnitude. Under service conditions, especially where high temperatures are involved, a change in the magnitude of these stresses occurs and a lowering of the bolt stress results.

To compensate for this reduction in bolt stress, the following recommendations are made with regard to the assembly and maintenance of flanged joints.

Assembly: Initial bolt stresses to be applied in the assembly of flanged joints should afford a reasonable factor of safety with reference to the yield point of the bolting material. And yet the initial bolt stress must be high enough to insure a tight joint.

An extensive survey of field erected flanged joints has indicated that the following initial stresses are usually applied when alloy steel bolt-studs are pulled up manually. Experience has shown that these stresses are satisfactory for American Standard Steel Flanges and will comply with the requirements as set forth in the preceding paragraph.

Table I

Size of Alloy Steel Bolt-Stud (Note 1)	Average Stress Applied Manually Lbs. per Sq. Inch (Note 2)	Approximate Torque to Obtain Stress, Ft. Lbs. (Note 3)	Elongation in Inches, per Inch of Effective Length (Note 4)
¾	52,000	175	.00173
⅞	48,000	255	.00160
1	45,000	370	.00150
1⅛	42,500	500	.00142
1¼	40,000	665	.00133
1⅜	38,000	860	.00127
1½	36,500	975	.00122
1⅝	35,000	1285	.00117
1¾	34,000	1700	.00113
1⅞	33,000	2200	.00110
2	32,000	2350	.00107

Notes: (1) Coarse thread series, 1" and smaller; 8 pitch thread series, 1⅛" and larger. (2) Average stress applied by maintenance men in assembly, using a lever and wrench or by sledging. (3) Based upon well-lubricated* threads. (4) Based on a modulus of elasticity of 30,000,000. The effective length of bolt-stud equals the distance from center of one nut to center of the other.

The values given in Table I have been graduated according to size — however, if it is possible to apply higher torques, it is recommended that the initial bolt stress be approximately 45,000 pounds per square inch.

The initial bolt stress can be applied by either of two methods: (1) By pulling up the well-lubricated* bolt-studs with the proper torque, or (2) by pulling up the bolt-studs to produce the elongation necessary for the desired bolt stress. When the second method is used the total desired elongation of the bolt-stud should be ascertained by multiplying the value given in the table for elongation in inches per inch by the effective length (distance from center of one nut to center of the other). Figures 1 and 2, respectively, show the design of an instrument which can be used in measuring bolt-stud elongation and the preparation of the ends of a bolt-stud for accurate measurement.

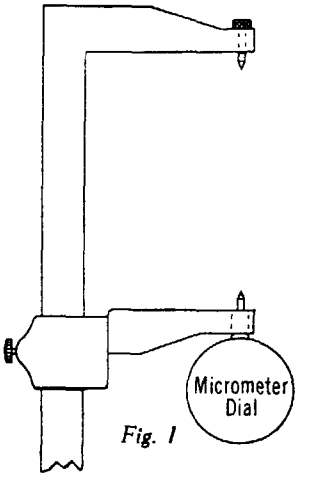


Fig. 1

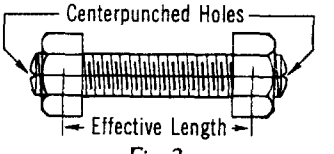


Fig. 2

Maintenance: ***When should bolt-studs be pulled up after being in service?*** It is recommended that the bolting in all flanged joints installed on temperatures above 500° F. be pulled up after the first shutdown. On high temperature service where creep may be expected to occur, it is recommended that the bolting be pulled up at least once during the first 200 hours of service, regardless of whether the line has been shut down or not. Bolt stress should be checked periodically during the life of the installation.

How should the bolt elongation be checked and the bolt-studs pulled up? As a general rule, it is only necessary to check the elongation in two or three diametrically opposite bolt-studs, using the average of the values obtained as the elongation for the remainder. If the bolt elongation is to be determined while the joint is in service, one bolt should be checked and pulled up before another is loosened. Measurements should be taken immediately after releasing the load before the bolt temperature decreases. The following procedure should be used in checking bolt elongation:

(a) Determine the length of the bolt in the assembled joint.
(b) Release the load on the bolt by loosening the nut and re-measure the length.
(c) Subtract second reading from first.
(d) Divide this value by the effective length of the bolt. (Effective length equals distance from center of one nut to center of the other.)

If the residual elongation is less than 70% of the values given in Table I, the bolts should be pulled up so that the final elongation approximates the figures shown.

*Crane High-Temperature Thread Lubricant or equal. see page 444.

For Pressure-Seal Bonnet Valves, see pages 209 to 220.

Discharge of Water
Through Pipes, Orifices, and Valves

Table of Nomenclature

A = Area of opening, square feet.
C = Experimental coefficient.
D = Inside diameter of pipe, feet.
f = Coefficient of friction.
g = 32.2 feet per second^2
h_1, h_2, h_3 = Individual head losses, feet of water.
H = Effective head pressure, feet of water.
L = Length of pipe line, feet.
Q = Flow of water, gallons per minute.
V = Velocity of water, feet per second.

Frequently it is necessary to determine the quantity of water which will be discharged through a valve or orifice, or through a certain length of pipe. This problem is one which occurs often in hydraulic work, particularly with reference to the flow of water through long pipe lines from a high level to a lower one.

The quantity of water which is discharged into the atmosphere through a pipe, orifice, or valve is dependent upon several variable factors which include flow pressure, size of pipe, type of valve or orifice, condition of pipe wall surface, length of pipe line, etc. The discharge of water into the atmosphere in terms of head loss follows the general formula:

$$H = C\frac{V^2}{2g} \qquad \textit{Formula No. 1.}$$

Where the value of "C" is usually determined by experiment.

Discharge of Water Through Pipes

In the case of water flowing through pipes, the quantity discharged is dependent upon three major resistance factors:

A. Entrance loss
B. Loss of head due to friction
C. Loss of head due to velocity

The loss of head at entrance depends upon the condition of the pipe end. A well rounded connection will cause the entrance loss to be decreased appreciably, while a square non-projecting pipe will give a "C" value of approximately .5 in Formula No. 1. This latter condition is realized in the majority of installations and therefore, the formula for entrance effect is as follows:

$$h_1 = .5\frac{V^2}{2g} \qquad \textit{Formula No. 2.}$$

The loss of head due to friction is mainly dependent upon the length and condition of the pipe line and may be expressed as

$$h_2 = \frac{f \times L}{D} \times \frac{V^2}{2g} \qquad \textit{Formula No. 3.}$$

In this equation, the friction factor, "f", must be determined from experimental results. For rough approximations, the value of "f" may be assumed as .015 for brass tubes, .02 for steel pipe, and .04 for cast iron pipe.

The third factor, the loss of head due to velocity, may be expressed by the following formula:

$$h_3 = \frac{V^2}{2g} \qquad \textit{Formula No. 4.}$$

The total loss of head is the sum of the individual losses and may be expressed as follows:

$$H = h_1 + h_2 + h_3 = \left(1.5 + \frac{f \times L}{D}\right)\frac{V^2}{2g}$$

As $Q = VA \times 450$

It follows that $Q = 450A\sqrt{\dfrac{2gH}{1.5 + \dfrac{f \times L}{D}}}$ *Formula No. 5.*

Example: How much water will an 8" steel pipe line (7.981 inside diameter) 3000 feet long discharge per minute at a point which is 300 feet below the inlet?

Given: $D = \dfrac{7.981}{12} = .665$ feet
$A = .3474$ square feet
$H = 300$ feet
$2g = 64.4$ feet per second^2
$f = .02$ (assumed)
$L = 3000$ feet

Then: $Q = 450 \times .3474\sqrt{\dfrac{64.4 \times 300}{1.5 + \dfrac{.02 \times 3000}{.665}}}$

$Q = 2268$ gallons per minute

Discharge of Water Through Orifices

The coefficient "C" for orifices is dependent upon the condition of the orifice edges, i.e., an orifice having well rounded edges has a "C" value of approximately 1.23, while one having sharp edges gives a "C" value of approximately 2.69.

Discharge of Water Through Globe Valves

The discharge of water through globe valves under a given flow pressure depends primarily upon the type of valve considered. Crane has conducted tests on various types of globe valves in sizes up to and including 2½" and has determined that the flow through a globe valve is, roughly, one-half of the flow through a short pipe of the same size.

For additional data, see pages 510 and 511.

Discharge of Water (Cont.)

Through Pipes, Orifices, and Valves

The chart on the opposite page gives the discharge of water through pipe sizes from $\frac{3}{8}$" to 10", in lengths from 1 foot to 200 feet; through orifices in sizes up to 10"; and through valves in sizes up to $2\frac{1}{2}$" based upon the formulas or tests described previously. For sizes, lengths, or pressures not given on the chart, the respective formulas or ratios may be used.

Note: In all cases, the pressure used to determine the flow through pipes, orifices, or valves, should be the effective head pressure under flow conditions, not the static pressure in the line before flow commences. This statement applies particularly to lines supplied by pumps, etc.

Application of Chart

Example No. 1

What quantity of water will be discharged through 75 feet of 5" standard pipe under a discharge gauge pressure of 50 pounds per square inch?

Enter the upper portion of the chart (page 511) at the intersection of the horizontal line for 75 feet of pipe and the line for the 5" pipe size. Proceed downward to the intersection with the diagonal for 50 pounds gauge pressure and then continue horizontally to the right where the quantity discharged is given as 2600 gallons per minute on the right hand ordinate.

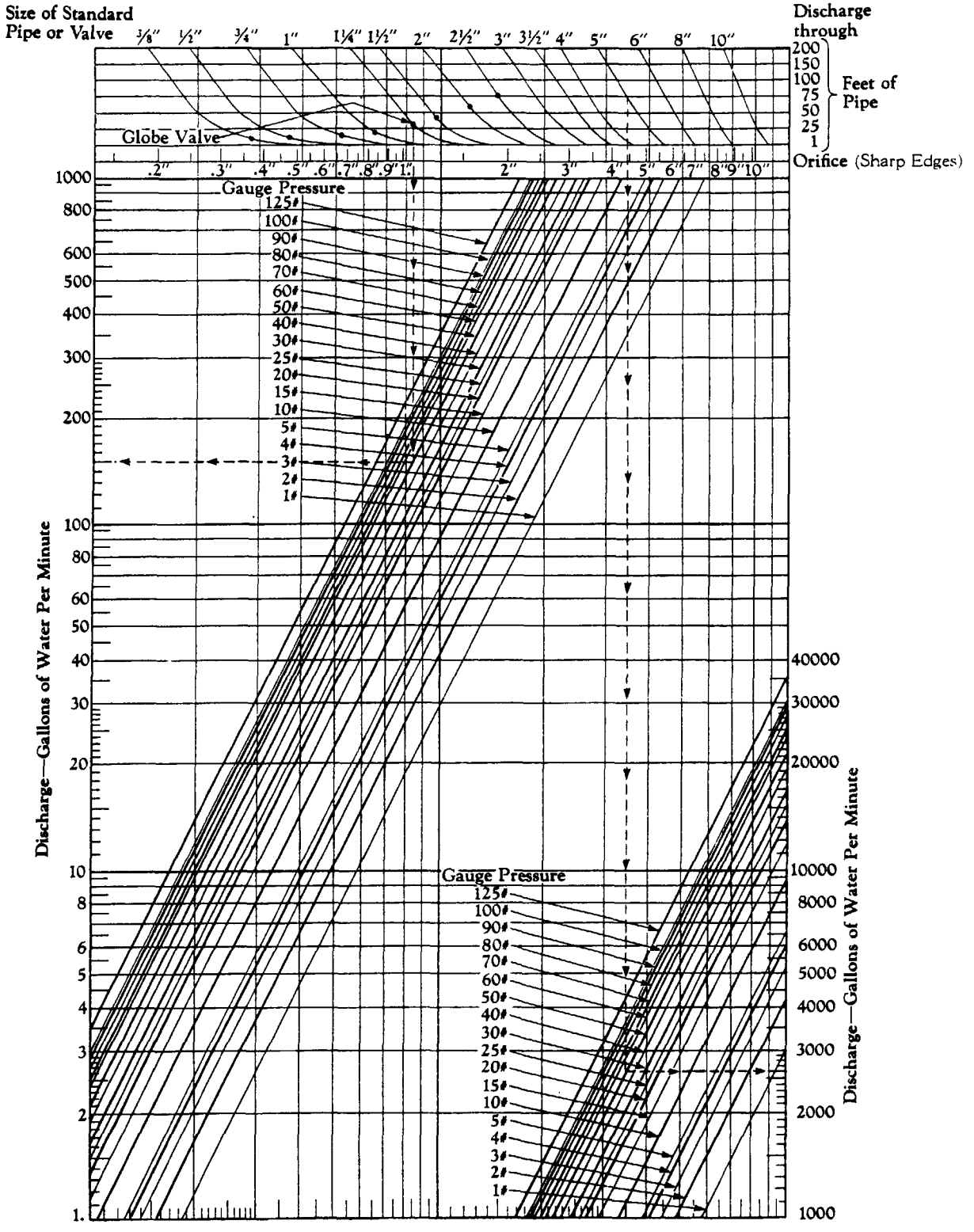
Example No. 2

A $1\frac{1}{4}$" globe valve is discharging water into the atmosphere under a discharge gauge pressure of 50 pounds per square inch. What quantity is discharged in gallons per minute?

Enter the upper portion of the chart (opposite page) at the black dot on the line for $1\frac{1}{4}$" valve size. Proceed downward to the intersection with the diagonal for 50 pounds gauge pressure and then continue horizontally to the left where the quantity discharged is given as 150 gallons per minute on the left hand ordinate.

Discharge of Water (Cont.)

Through Smooth Pipes, Orifices, and Valves



Resistance of Valves and Fittings to Flow of Fluids

When the flow of a fluid in a pipe line is altered by some obstruction such as a valve or fitting, the velocity is changed, turbulence is magnified, and a drop in pressure results. This pressure drop may be insignificant in long lines where it is very small in comparison to the total drop, but when the line is short, the pressure drop through valves and fittings becomes a major item in the total pressure drop value.

The most widely used data on the subject of the resistance of valves and fittings to the flow of water and steam is the information given in Dean Foster's paper on "Effect of Fittings on Flow of Fluids Through Pipe Lines" (published in Vol. 42, 1920, of the *Transactions of the American Society of Mechanical Engineers*). Later tests conducted by others have indicated that the values given by Foster are low for globe valves, angle valves, etc., and that data are needed to establish the correct information to use.

It has been the tendency, and probably is the most practical way, to present the friction values in terms of an equivalent length of the same size of pipe; i. e., the pressure drop caused by a 2-inch elbow is equivalent to approximately the pressure drop caused by five or six feet of 2-inch pipe under the same conditions of flow.

In this way, water and steam can be treated comparatively and a relation can be established between the relative friction values of water and steam. Foster has stated that the equivalent length of pipe for steam flow is about .8 of that established for the flow of water.

Realizing the need for definite data covering this subject, Crane has conducted pressure drop tests on valves and fittings on both water and steam. These tests were made on 2-inch and 6-inch sizes and conducted under conditions which were thoroughly investigated previous to the tests.

Resistance in Terms of Equivalent Pipe Length

From data given in the tests conducted by Crane and also from information gathered from authentic sources, the chart shown on the opposite page has been prepared. The chart gives the equivalent length of pipe to produce the same pressure drop as a valve or fitting. This additional pipe length should be added to the length of the line in order to determine the total pressure drop.

It has been shown by previous investigators that the drop in pressure through valves, fittings, etc., is some constant multiplied by the velocity head,

$$\frac{V^2}{2g}.$$

Therefore: $H_1 = k\frac{V^2}{2g}$ where

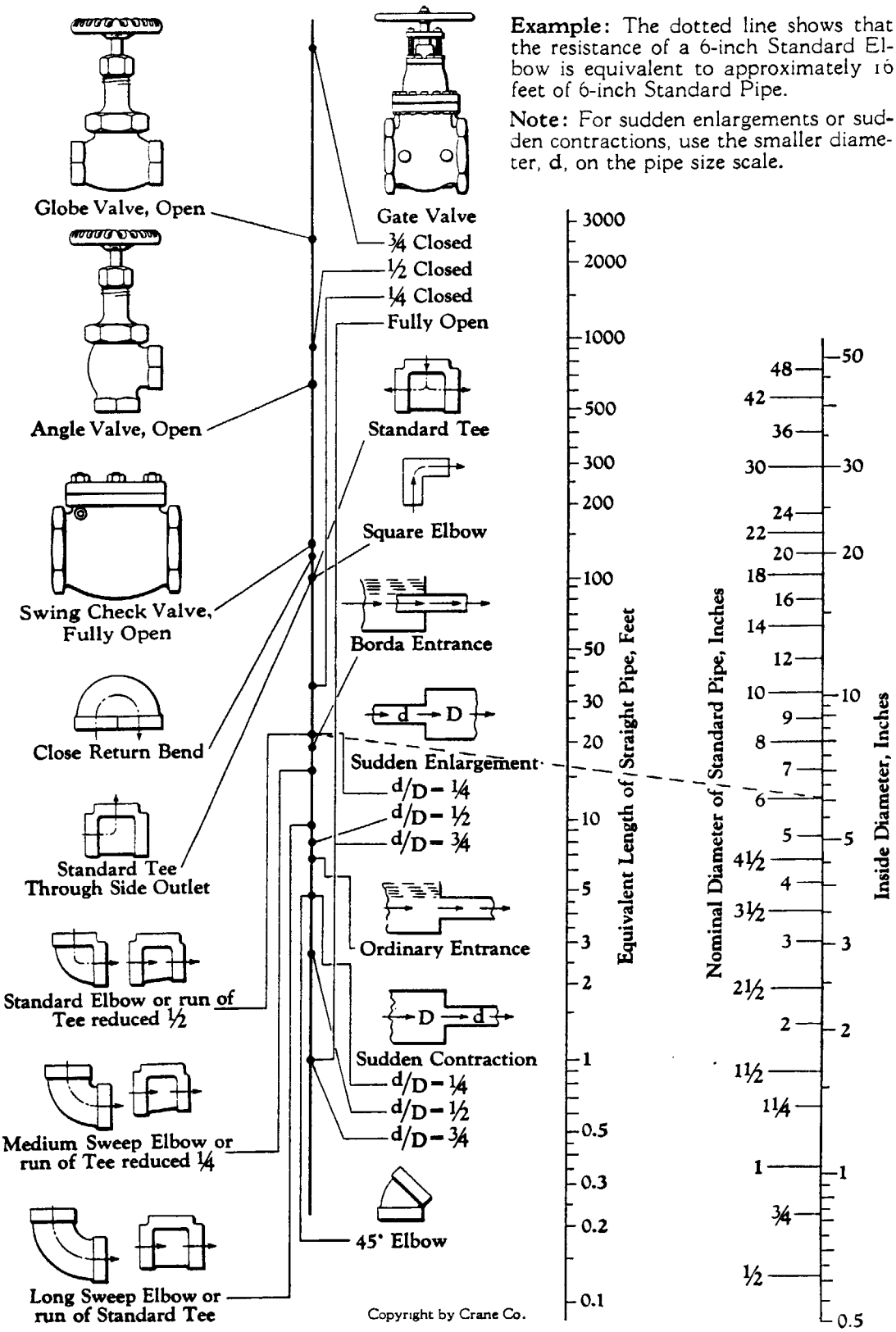
H_1 = Loss of head in feet
k = Coefficient (Values given in table below)
V = Velocity of water, feet per second
$2g$ = 64.4

Representative "K" Values for Various Valves and Fittings

Type	"K"	Authority
Globe valve (fully open)	10.0	Crane tests
Angle valve (fully open)	5.0	Crane tests
Swing check valve (fully open)	2.5	Crane tests
Close return bend	2.2	
Standard tee	1.8	Giesecke & Badgett
Standard elbow	.9	Giesecke & Badgett
Medium sweep elbow	.75	Crane tests
Long sweep elbow	.60	Bulletin No. 2712—University of Texas
45° elbow	.42	Bulletin No. 2712—University of Texas
Gate valve (fully open)	.19	
¼ closed	1.15	University of Wisconsin tests* and Crane tests
½ closed	5.6	
¾ closed	24.0	
Borda entrance	.83	"Hydraulics" Daugherty
Sudden enlargement:		
d_1/d_2 = ¼	.92	"Hydraulics" Daugherty
d_1/d_2 = ½	.56	"Hydraulics" Daugherty
d_1/d_2 = ¾	.19	"Hydraulics" Daugherty
Ordinary entrance	5	"Hydraulics" Daugherty
Sudden contraction:		
d_2/d_1 = ¼	.42	"Hydraulics" Daugherty
d_2/d_1 = ½	.33	"Hydraulics" Daugherty
d_2/d_1 = ¾	.19	"Hydraulics" Daugherty

*University of Wisconsin Experimental Station Bulletin Vol 9, No. 1, 1922

Resistance of Valves and Fittings to Flow of Fluids



Example: The dotted line shows that the resistance of a 6-inch Standard Elbow is equivalent to approximately 16 feet of 6-inch Standard Pipe.

Note: For sudden enlargements or sudden contractions, use the smaller diameter, d, on the pipe size scale.

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Pressure Drop of Water Through Schedule 40 Steel Pipe

Pressure Drop of Water per 100 Feet of Schedule 40 Steel Pipe

Discharge Gallons per Minute	1/8" Velocity Feet per Second	1/8" Pressure Drop Pounds per Sq In.	1/4" Velocity Feet per Second	1/4" Pressure Drop Pounds per Sq. In.	3/8" Velocity Feet per Second	3/8" Pressure Drop Pounds per Sq In.	1/2" Velocity Feet per Second	1/2" Pressure Drop Pounds per Sq. In.	3/4" Velocity Feet per Second	3/4" Pressure Drop Pounds per Sq In	1" Velocity Feet per Second	1" Pressure Drop Pounds per Sq In.	1¼" Velocity Feet per Second	1¼" Pressure Drop Pounds per Sq In.	1½" Velocity Feet per Second	1½" Pressure Drop Pounds per Sq. In.
.2	1.13	1.52	.62	.420												
.3	1.69	4.20	.92	.925	.50	.199	.32	.065								
.4	2.26	7.70	1.23	1.61	.67	.346	.42	.111								
.5	2.82	11.20	1.54	2.41	.84	.527	.53	.169	.30	.045						
.6	3.38	15.75	1.85	3.32	1.01	.747	.63	.238	.36	.064	1"		1¼"		1½"	
.8	4.52	27.40	2.46	5.77	1.34	1.30	.84	.407	.48	.102						
1			3.08	8.80	1.68	1.98	1.06	.605	.60	.152	.37	.049				
2			6.16	33.60	3.37	7.17	2.11	2.18	1.20	.552	.74	.170	.43	.045		
3					5.05	15.30	3.16	4.67	1.80	1.18	1.12	.353	.64	.094	.47	.044
4	2"				6.73	25.70	4.22	7.60	2.40	1.97	1.49	.594	.86	.155	.63	.074
5							5.27	11.15	3.60	2.90	1.86	.902	1.07	.236	.79	.112
6	.57	.046	2½"				.842	27.60	4.20	4.05	2.24	1.23	1.28	.330	.95	.153
8	.76	.075							4.80	6.97	2.98	2.11	1.72	.552	1.26	.263
10	.96	.114	.67	.048	3"				6.01	10.52	3.72	3.08	2.14	.834	1.57	.386
15	1.43	.233	1.00	.099			3½"		9.02	22.00	5.60	6.46	3.21	1.76	2.36	.813
20	1.91	.386	1.34	.164	.87	.059					7.44	11.05	4.29	2.91	3.15	1.35
25	2.39	.581	1.68	.248	1.08	.087	.81	.042	4"				5.36	4.37	3.94	2.02
30	2.87	.804	2.01	.343	1.30	.121	.97	.060					6.43	6.29	4.72	2.91
35	3.35	1.10	2.35	.449	1.52	.158	1.14	.079	.88	.402			7.51	8.25	5.51	3.82
40	3.82	1.37	2.68	.588	1.74	.206	1.30	.100	1.01	.053					6.30	4.78
45	4.30	1.74	3.00	.714	1.95	.251	1.46	.121	1.13	.067					7.08	6.06
50	4.78	2.06	3.35	.882	2.17	.310	1.62	.144	1.26	.080	5"				7.87	7.47
60	5.74	2.96	4.02	1.22	2.60	.429	1.95	.207	1.51	.110						
70	6.69	3.86	4.69	1.53	3.04	.584	2.27	.271	1.76	.150	1.12	.048				
80	7.65	5.03	5.37	2.17	3.48	.762	2.59	.353	2.01	.187	1.28	.063	6"			
90	8.60	6.36	6.04	2.61	3.91	.922	2.92	.446	2.26	.237	1.44	.080				
100	9.56	7.51	6.71	3.23	4.34	1.14	3.24	.527	2.52	.281	1.60	.095	1.11	.039		
125			8.38	4.82	5.42	1.71	4.05	.786	3.15	.438	2.00	.148	1.39	.056		
150			10.06	6.04	6.51	2.35	4.86	1.13	3.78	.602	2.41	.204	1.67	.078		
175			11.73	9.00	7.59	3.20	5.67	1.47	4.41	.820	2.81	.278	1.94	.106	8"	
200					8.68	3.97	6.48	1.92	5.04	1.02	3.21	.346	2.22	.132		
225					9.77	5.02	7.29	2.31	5.67	1.29	3.61	.437	2.50	.166	1.44	.044
250					10.85	6.19	8.10	2.85	6.30	1.59	4.01	.514	2.78	.205	1.60	.055
275					11.94	7.50	8.91	3.44	6.93	1.83	4.41	.622	3.06	.236	1.76	.063
300					13.02	8.47	9.72	4.09	7.56	2.18	4.81	.741	3.33	.280	1.92	.075
325							10.53	4.55	8.18	2.55	5.21	.825	3.61	.329	2.08	.088
350							11.35	5.27	8.82	2.97	5.61	.957	3.89	.362	2.24	.097
375							12.17	6.07	9.45	3.23	6.01	1.10	4.16	.416	2.40	.111
400							12.97	6.89	10.08	3.67	6.41	1.25	4.44	.472	2.56	.127
425	10"						13.78	7.78	10.70	4.15	6.82	1.41	4.72	.534	2.72	.143
450							14.59	8.73	11.33	4.65	7.22	1.50	5.00	.596	2.88	.160
475	1.93	.030							11.96	5.17	7.62	1.67	5.27	.666	3.04	.169
500	2.04	.063							12.59	5.73	8.02	1.85	5.55	.739	3.20	.187
550	2.24	.070							13.84	6.93	8.82	2.24	6.11	.894	3.53	.226
600	2.44	.086	12"						15.10	8.25	9.62	2.67	6.66	1.06	3.85	.270
650	2.65	.101									10.42	3.13	7.21	1.18	4.17	.316
700	2.85	.118	2.01	.048							11.22	3.63	7.77	1.37	4.49	.369
750	3.05	.135	2.15	.055	14"						12.02	4.16	8.32	1.57	4.81	.421
800	3.26	.154	2.29	.062							12.82	4.47	8.88	1.78	5.13	.479
850	3.46	.174	2.44	.070	2.02	.043					13.62	5.05	9.44	2.02	5.45	.511
900	3.66	.194	2.58	.079	2.14	.048					14.42	5.66	10.00	2.26	5.77	.573
950	3.87	.223	2.72	.088	2.25	.053					15.22	6.31	10.55	2.37	6.09	.638
1,000	4.07	.240	2.87	.098	2.38	.059	16"				16.02	7.00	11.10	2.63	6.41	.708
1,100	4.48	.274	3.16	.118	2.61	.068					17.63	8.46	12.22	3.18	7.05	.856
1,200	4.88	.327	3.45	.140	2.85	.081	2.18	.040					13.32	3.78	7.69	1.03
1,300	5.29	.383	3.73	.156	3.09	.095	2.36	.047					14.43	4.44	8.33	1.13
1,400	5.70	.444	4.02	.180	3.32	.110	2.54	.054					15.54	5.15	8.97	1.30
1,500	6.10	.511	4.30	.207	3.55	.119	2.73	.062	18"				16.65	5.55	9.62	1.50
1,600	6.51	.546	4.59	.236	3.80	.135	2.91	.071					17.76	6.31	10.26	1.70
1,800	7.32	.691	5.16	.298	4.27	.171	3.27	.085	2.58	.048			19.98	7.98	11.54	2.16
2,000	8.13	.854	5.73	.347	4.74	.211	3.63	.105	2.88	.056	20"		22.20	9.85	12.83	2.50
2,500	10.18	1.25	7.17	.541	5.92	.309	4.54	.163	3.59	.088					16.03	3.90
3,000	12.21	1.80	8.60	.731	7.12	.445	5.45	.221	4.31	.127	3.45	.073	24"		19.24	5.24
3,500	14.25	2.29	10.03	.995	8.32	.618	6.35	.300	5.03	.152	4.03	.094			22.43	7.14
4,000	16.28	2.99	11.48	1.30	9.49	.792	7.25	.392	5.74	.212	4.61	.122	3.19	.051	25.65	9.33
4,500	18.31	3.78	12.90	1.54	10.67	.936	8.17	.497	6.47	.250	5.19	.155	3.59	.060		
5,000	20.35	4.67	14.34	1.89	11.84	1.16	9.08	.572	7.17	.308	5.76	.178	3.99	.074		
6,000	24.42	6.72	17.21	2.73	14.32	1.54	10.88	.824	8.62	.445	6.92	.257	4.80	.100		
7,000	28.50	8.51	20.08	3.72	16.60	2.10	12.69	1.22	10.04	.606	8.06	.350	5.68	.136		
8,000			22.95	4.51	18.98	2.74	14.52	1.36	11.43	.734	9.23	.457	6.38	.178		
9,000			25.80	5.70	21.35	3.47	16.32	1.72	12.92	.920	10.37	.536	7.19	.225		
10,000			28.63	7.04	23.75	4.29	18.16	2.12	14.37	1.15	11.53	.663	7.96	.278		
12,000			34.38	9.36	28.50	6.18	21.80	3.09	17.23	1.65	13.83	.954	9.57	.371		
14,000					33.20	8.40	25.42	4.16	20.10	2.07	16.14	1.20	11.18	.505		
16,000							29.05	5.44	22.96	2.71	18.43	1.57	12.77	.660		

Pressure Drop of Air Through Schedule 40 Steel Pipe

Cubic Feet per Minute of Free Air At Atmospheric Pressure and Temperature of 60° F.	Equivalent Cubic Feet per Minute of Compressed Air At 100 Pounds Gauge Pressure and Temperature of 60° F.	Pressure Drop of Air Per 100 Feet of Schedule 40 Steel Pipe In Pounds per Square Inch at 100 Pounds Gauge Air Inlet Pressure								
		1/8"	1/4"	3/8"	1/2"					
1	.128	.394	.087	.019						
2	.256	1.51	.311	.068	.021					
3	.384	3.16	.675	.148	.046	3/4"				
4	.513	5.47	1.19	.256	.078					
5	.641	8.60	1.80	.396	.118	.030	1"			
6	.769		2.56	.556	.165	.042				
8	1.025		4.50	.962	.276	.070	.020			
10	1.282		6.85	1.42	.407	.100	.031	1¼"		
15	1.922			2.93	.890	.211	.063		1½"	
20	2.563			5.03	1.53	.361	.105	.028		
25	3.204			7.85	2.31	.546	.158	.043	.020	
30	3.845				3.22	.785	.227	.060	.027	
35	4.486				4.21	1.03	.297	.075	.035	
40	5.126				5.52	1.35	.388	.105	.046	2"
45	5.767				6.72	1.64	.492	.129	.056	
50	6.408				8.27	2.02	.580	.154	.069	.020
60	7.690	2½"				2.92	.835	.221	.099	.028
70	8.971					3.82	1.14	.290	.134	.037
80	10.25	.020				4.98	1.43	.375	.168	.048
90	11.53	.025				6.07	1.81	.476	.213	.058
100	12.82	.031	3"			7.47	2.14	.587	.253	.068
125	16.02	.046					3.34	.887	.397	.108
150	19.22	.067	.023				4.82	1.22	.542	.155
175	22.43	.088	.031	3½"			6.28	1.66	.738	.201
200	25.36	.110	.038				8.02	2.03	.900	.257
225	28.84	.137	.049	.023				2.63	1.17	.333
250	32.04	.169	.057	.029				3.24	1.44	.392
275	35.24	.204	.069	.033				3.76	1.66	.475
300	38.45	.243	.082	.040	4"			4.47	1.98	.565
325	41.65	.272	.096	.047				5.27	2.31	.662
350	44.86	.316	.112	.052	.027			5.77	2.68	.767
375	48.06	.362	.128	.059	.032			6.65	3.08	.840
400	51.26	.413	.140	.068	.036			7.55	3.51	.955
425	54.47	.466	.157	.076	.041			8.55	3.76	1.08
450	57.67	.507	.176	.086	.045				4.22	1.14
475	60.88	.552	.197	.095	.051				4.70	1.28
500	64.08	.611	.218	.100	.056				5.20	1.41
550	70.49	.740	.263	.122	.064				5.95	1.71
600	76.90	.880	.298	.144	.077	5"			7.10	2.03
650	83.30	.980	.350	.169	.090					2.38
700	89.71	1.04	.405	.185	.099	.034				2.77
750	96.12	1.31	.441	.213	.113	.039				3.18
800	102.5	1.49	.500	.242	.129	.044				3.42
850	108.9	1.68	.565	.273	.146	.047	6"			3.87
900	115.3	1.88	.633	.306	.154	.053				4.32
950	121.8	1.98	.707	.341	.172	.059	.023			4.82
1000	128.2	2.19	.782	.357	.190	.065	.026			5.33
1100	141.0	2.65	.895	.432	.231	.079	.031			6.10
1200	153.8	3.16	1.07	.515	.275	.094	.035			7.27
1300	166.6	3.70	1.25	.603	.322	.110	.042			8.52
1400	179.4	4.30	1.45	.700	.376	.127	.048			
1500	192.2	4.65	1.66	.803	.428	.139	.055	8"		
1600	205.1	5.27	1.92	.915	.487	.158	.063			
1800	230.7	6.67	2.40	1.11	.580	.199	.080	.021		
2000	256.3	8.25	2.79	1.35	.717	.246	.093	.025	10"	
2500	320.4		4.35	2.11	1.12	.385	.145	.037		
3000	384.5		6.27	3.02	1.51	.522	.208	.053	.017	
3500	448.6		8.52	4.11	2.06	.710	.265	.071	.023	
4000	512.6			5.37	2.69	.927	.347	.088	.030	12"
4500	576.7			6.40	3.41	1.10	.438	.111	.036	
5000	640.8			7.90	4.20	1.36	.540	.137	.044	.020
6000	769.0				5.63	1.94	.726	.197	.063	.026
7000	897.1				7.70	2.48	.990	.268	.086	.036
8000	1025					3.24	1.29	.324	.113	.047
9000	1153					4.10	1.52	.410	.142	.059
10000	1282					5.05	1.87	.505	.164	.074
11000	1410					6.13	2.27	.574	.199	.089
12000	1538					6.77	2.70	.683	.237	.099
13000	1666					7.95	3.17	.802	.278	.115
14000	1794					9.20	3.67	.928	.299	.134
15000	1922						4.22	1.07	.343	.154
16000	2051						4.78	1.21	.390	.162
18000	2307						5.60	1.53	.493	.205
20000	2563						6.92	1.89	.610	.253
22000	2820						8.37	2.29	.737	.307
24000	3076							2.52	.827	.365
26000	3332							2.96	1.03	.428
28000	3588							3.44	1.11	.498
30000	3845							3.61	1.27	.572

For lengths of pipe other than 100 feet, the pressure drop is proportional to the length. Thus, for 50 feet of pipe, the pressure drop is approximately one-half the value given in the table; for 300 feet, three times the given value, etc.

For inlet pressures other than 100 pounds gauge, the pressure drop is inversely proportional to the absolute pressure. Thus, for 100 feet of Schedule 40 steel pipe, multiply the values given in the table by the ratio:

$$\frac{100 + 14.7}{P_1 + 14.7}$$

Where P_1 is the gauge pressure under consideration.

The equivalent cubic feet per minute of compressed air at any pressure is inversely proportional to the absolute pressure. To determine, multiply the value of the cubic feet per minute of free air at atmospheric pressure by the ratio:

$$\frac{14.7}{14.7 + P_1}$$

Where P_1 is the gauge pressure under consideration.

Simplified Steam Flow Formula for Pressure Drop, Rate of Flow, and Pipe Size

The Fanning formula for the flow of steam can be written in the form:

$$\Delta P_{100} = C_1 C_2 C_3 \overline{V}$$

C_1 = discharge factor—obtain from chart below.
C_2 = size factor—obtain from table on opposite page.
C_3 = viscosity factor—obtain from chart on opposite page.
ΔP_{100} = pressure drop per 100 feet of pipe, in pounds per square inch.
$\overline{V}$ = average specific volume of steam—obtain from steam tables, pages 538 to 545.

Example 1: Find the pressure drop in 100 feet of 8-inch Standard (Schedule 40) pipe if the steam pressure and temperature are 360 pounds per square inch absolute and 500° Fahrenheit, respectively. The discharge is 240,000 pounds per hour.

Solution: From the tables and figures, the following values are found: $C_1 = 26.7$, $C_2 = 0.263$, $C_3 = 0.996$, and $\overline{V} = 1.45$. If we put these values in the steam flow formula and solve for ΔP_{100}, we find: $\Delta P_{100} = 10.14$ pounds per square inch per 100 feet.

Example 2: Find the rate of flow, in pounds per hour, in a 4-inch Schedule 40 pipe if the pressure drop is 8 pounds per square inch per 100 feet. Saturated steam at 150 pounds absolute pressure is flowing in the pipe.

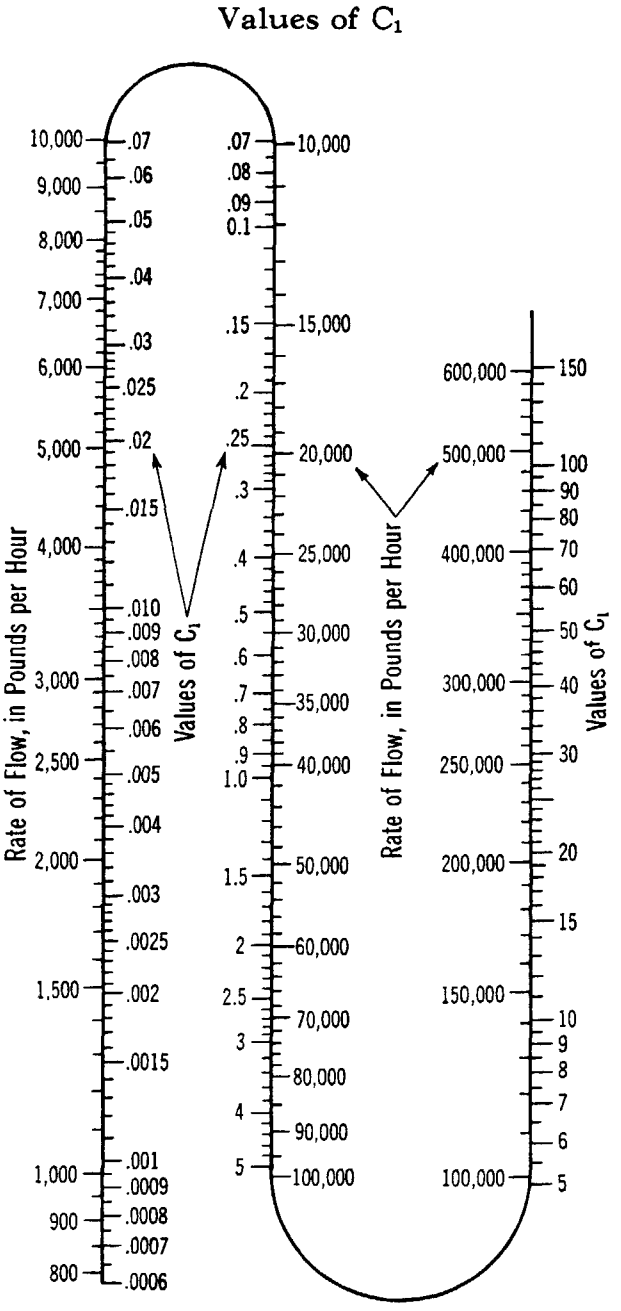
Solution: From the given conditions and the tables and figures we find $\Delta P_{100} = 8.0$, $C_2 = 7.73$, $C_3 = 0.972$, and $\overline{V} = 3.0$. If we substitute these values into the steam flow formula and solve for C_1, we get $C_1 = 0.355$. By referring to the chart at the right, the discharge for this value of C_1 is found to be 23,600 pounds per hour.

Example 3: Find the smallest size of Schedule 40 (Standard) pipe that can be used for a process requiring 20,000 pounds of saturated steam per hour, if the initial steam pressure is 100 psi absolute and the maximum allowable pressure drop is 10 pounds per square inch per 100 feet of pipe.

Solution: From the given conditions and the tables and figures:

$\Delta P_{100} = 10$, $C_1 = 257$, $C_3 = 96$, and $\overline{V} = 4.432$.

Substituting these values in the steam flow formula, and solving for C_2, it is found that $C_2 = 9.2$. From the table, 4-inch Schedule 40 pipe is the smallest size that will provide a value of C_2 less than the calculated value. The actual pressure drop per 100 feet of 4-inch Schedule 40 pipe may now be calculated as 8.5 psi by solving the steam flow formula using the table value of 7.73 for C_2.



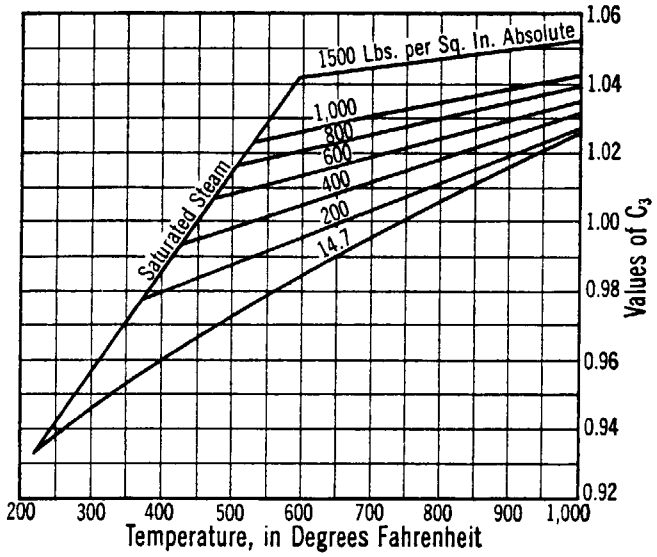
Simplified Steam Flow Formula for Pressure Drop, Rate of Flow, and Pipe Size

(Continued)

Values of C_2

Nominal Pipe Size Inches	Schedule Number of Pipe	Internal Diameter of Pipe Inches	Value of C_2	Nominal Pipe Size Inches	Schedule Number of Pipe	Internal Diameter of Pipe Inches	Value of C_2
1	40	1.049	6420.	6	40	6.065	1.00
	80	0.957	10050.		80	5.761	1.28
	160	0.815	21950.		120	5.501	1.62
1¼	40	1.380	1687.		160	5.189	2.16
	80	1.278	2455.	8	30	8.071	0.249
	160	1.160	3935.		40	7.981	0.263
1½	40	1.610	755.		60	7.813	0.291
	80	1.500	1067.		80	7.625	0.328
	160	1.338	1860.		100	7.439	0.369
2	40	2.067	213.		120	7.189	0.435
	80	1.939	291.		160	6.813	0.568
	160	1.689	570.	10	30	10.136	0.0819
2½	40	2.469	80.1		40	10.020	0.0866
	80	2.323	121.		60	9.750	0.0980
	160	2.125	188.		80	9.564	0.109
3	40	3.068	31.2		100	9.314	0.1235
	80	2.900	40.9		120	9.064	0.141
	160	2.626	66.7		140	8.750	0.168
3½	40	3.548	15.0		160	8.500	0.193
	80	3.364	19.5	12	30	12.090	0.0344
4	40	4.026	7.73		40	11.938	0.0366
	80	3.826	9.91		60	11.626	0.0420
	120	3.626	12.8		80	11.376	0.0467
	160	3.438	17.5		100	11.064	0.0534
5	40	5.047	2.57		120	10.750	0.0615
	80	4.813	3.18		140	10.500	0.0690
	120	4.563	4.22		160	10.126	0.0823
	160	4.313	5.52				

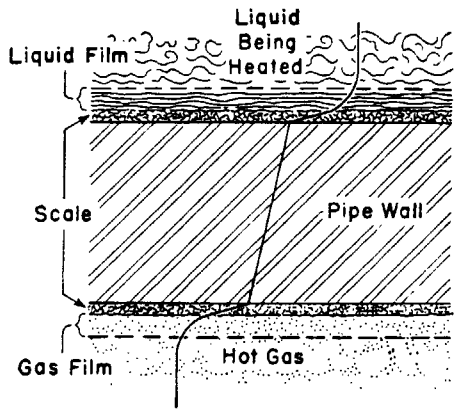
Values of C_3



Theory of Heat Transfer Through Pipe Walls

The conduction of heat through a pipe wall is shown diagrammatically in the illustration at the right. It shows the transfer of heat from a hot gas (such as steam) to a liquid (such as water).

The heat is conducted first from the hot gas through the gas film, then through the corrosion scale on the pipe wall due to the gas, through the pipe wall itself, then through the corrosion scale on the pipe wall due to the liquid, and finally through the liquid film to the liquid.



The general formula for the transfer of heat through pipes is given as

$$Q = U\ A\ T \qquad \textit{Formula 1}$$

Where: Q = Total heat to be transmitted in Btu per hour.
U = Over-all coefficient of heat transfer in Btu per hour per square feet per degree F.
A = Amount of heating surface in the pipe coil expressed in square feet.
T = The logarithmic mean temperature difference between the hot and cold fluids in degrees F.

Determination of Q

The total heat to be transmitted "Q" is determined by multiplying the weight of the fluid per unit of time (pounds per hour), the specific heat of the fluid at the average fluid temperature, and the fluid change in temperature in degrees F. If the fluid alters its phase, that is, if the fluid changes from a liquid to a gas or from a gas to a liquid, then the heat of vaporization must be considered in this calculation. If the fluid is to give up heat through radiation, emission, or surface convection, such heat losses also must be considered.

Determination of A

Since "A" is the unknown to be solved, Formula 1 becomes $A = \frac{Q}{UT}$. The number of square feet of heating surface, "A", can be converted readily into the number of feet of pipe of any particular size and wall thickness by dividing the value of "A" by the external surface area in square feet per foot as given in the table of Pipe Data, pages 470 and 471.

Determination of T

A true average temperature difference between the hot and cold fluids "T" is called the logarithmic mean temperature difference and is determined by the following formula:

$$T = \frac{GTD - LTD}{Log\ \frac{GTD}{LTD}} \qquad \textit{Formula 2}$$

Where:
GTD = Greatest temperature difference between the fluids.
LTD = Least temperature difference between the fluids.

(See pages 560 and 561 for table of Common Logarithms).

Determination of U

The over-all coefficient of heat transfer "U" is dependent upon a large number of variables, including the conductivity and thickness of the metal in the pipe wall, the fluid velocity, specific heat, conductivity, density and viscosity, and the oxidation or scaling effect of the fluid on the pipe wall, as well as other physical characteristics such as the quantity of entrapped gases in the fluid, etc. The value of "U" may, therefore, be determined accurately only by experiment.

Generally accepted approximations of over-all heat transfer coefficients are listed in the table on the opposite page.

If a scale of rust or oxide builds up on either the inner or outer pipe walls, the value of "U" will be greatly reduced. In some cases, therefore, the substitution of a copper or alloy pipe coil for steel pipe will greatly improve the over-all rate of heat transfer, not because of the change in conductivity of the metal but because the pipe surface stays bright and practically rust free.

Selection of a value for "U" should be based upon a consideration of the conditions under which the coil will be operated. The maximum values should be used only when the velocity of the cooling and the cooled fluids is high and when corrosion or scaling of the pipe is negligible. The coefficients given in the column headed "Free Convections" are those obtained with pipe coils and pipe immersed in liquids under normally static conditions. The column headed "Forced Convections" covers pipe coils and pipe immersed in liquids that are agitated either by mechanical means or by a continuous flow of the fluid through the vessel.

Design of Pipe Coils for Heat Transfer

The following practical hints and recommendations are presented to aid the designer of pipe coils for heat transfer.

1. "Overdesign" rather than "underdesign". It is a simple matter to cut down the conductivity of a pipe coil but more difficult to increase it.

2. Have adequate means for removal of condensate.

3. Remove entrapped gases from liquids.

4. It is important that pressure drop be considered in designing a pipe coil, to determine the limitations on length of a given pipe size. If excessively long lines are used, they may not be capable of transmitting the required quantity of fluid at the available initial pressure. Keeping this limitation in mind, it is desirable to use fluid velocities as high as possible, so that the resistance to heat transfer due to the film is lowered.

Data for calculating the pressure drop in steam lines is given on page 516, water lines on page 514, and air lines on page 515. In a coil using smooth pipe bends, the actual pipe length should be converted to an equivalent pipe length, for purposes of calculating pressure drop on the basis of the chart on page 522 showing the resistance of 90° bends. If other fittings such as return bends or elbows are used, equivalent length may be based on data shown on page 513.

For steam condensing in a pipe coil, the quantity of steam passing through the coil varies from total input at the inlet to zero pounds per hour at the outlet, and the amount of condensate varies from zero pounds per hour at the inlet to total weight per hour at the outlet. Obviously, the total pressure drop in the coil will be equal to the sum of the losses due to the flow of the steam and the water. However, due to the high ratio of the specific volumes of the two fluids, the percentage of pipe cross-section that is occupied by the water is negligible and the pressure drop due to the flow of condensate may therefore be neglected in the calculation of practical problems. The pressure drop due to the flow of steam will be high near the inlet, and will decrease approximately as the square of the velocity as the steam passes through the coil. From this relationship, combined with the effect of increased specific volume of the steam due to pressure drop, it can be shown that the average velocity of the steam in the coil is approximately three-fourths of the maximum or initial velocity, and for the purpose of calculating pressure drop, the same ratio may be used to determine the average quantity of steam flowing within the coil.

5. Give careful consideration to the installation of those accessories which are necessary adjuncts for the successful use of pipe coils, such as pressure and temperature indicators and regulators, safety and relief valves, traps, vent valves, and sediment separators.

6. The shape and dimensions of the vessel determine the dimensional limits and design of the pipe coil which is to be installed. The illustrations of pipe coils given on pages 500 to 503 will aid in the selection of the most applicable design.

The sample problem on the page following shows the procedure for determining the pipe size and lineal feet of pipe required in a pipe coil containing steam at a given pressure and specified allowable pressure drop, to raise the temperature of a given quantity of water per unit of time a specified amount.

(Continued on the next page)

Ordinary Ranges of U*[1]

Over-all Coefficients "U" Expressed in Btu per Hour per Square Foot per Degree F.
(See preceding page for explanation—"Determination of U")

Fluid Giving Up Heat	Fluid Receiving Heat	State of Controlling Resistance		Typical Fluid	Typical Apparatus
		Free Convections *U*	Forced Convections *U*		
Liquid	Liquid	25-60	150-300	Water	Liquid Heat Exchangers, etc.
		5-10	20-50	Oil	
	Gas	1-3	2-10	Water to Air	Hot Water Radiators, Cooling Tower Surfaces
	Boiling Liquid	20-60	50-150	Water	Brine Coolers
		5-20	25-60	Oil	
Gas	Liquid	1-3	2-10	Air to Water	Air Coolers, Economizers
	Gas	0.6-2	2-6	Gas to Steam	Steam Superheaters
	Boiling Liquid	1-3	2-10	Gas to Boiling Water	Steam Boilers
Condensing Vapor	Liquid	50-200	150-800	Steam to Water	Condensers, Feed Water Heaters
		10-30	20-60	Steam to Oil	
	Gas	1-2	2-10	Steam to Air	Steam Pipes in Air, Air Heaters
	Boiling Liquid	300-800		Steam to Water	Vacuum Evaporators
		50-150		Steam to Oil	

*Under special conditions higher or lower values may be realized.

[1]W. H. McAdams, "Heat Transmission" (McGraw-Hill Book Co., Inc.) from data given by A. P. Colburn (Copyright 1942).

Design of Pipe Coils for Heat Transfer (Cont.)

Sample Problem

1000 gallons of hot water per hour is required. The water is to be heated from 50° to 180° F. with 25 lb. gauge steam in a single cylindrical steel pipe coil (Standard or Schedule 40 pipe) immersed in water. The coil is to be 3'-0" center to center in diameter. The pressure drop through the coil shall not exceed 5 psi. *Determine the size of pipe from which the coil should be made and the number of turns required in the coil.*

Solution

Refer to the steam tables, pages 538 to 541, and determine the properties of the steam, as follows:

Average pressure $= \frac{25 + (25 - 5)}{2} = 22.5$ psi

Average specific volume = 11.29 cu. ft./lb.

Latent Heat of Steam at avg. press. = 936 BTU/lb.

Temp. of 25 lb. steam = 267° F.

Temp. of 20 lb. steam = 259° F. (minimum allowable downstream pressure)

Fluid change in temp. = 180° F. − 50° F. = 130° F.

Refer to table of thermal properties of water, page 521 and determine the weight per gallon of 180° F. water equals 8.098 pounds.

Determination of Q

$Q = 8.098 \times 1000 \times 130$
$= 1{,}053{,}000$ BTU/hr. required.

Determination of U

From the conditions given, water flows through the heat exchanger at the rate of 1000 GPH, giving continuous flow. Therefore, a value of "U" will be selected from the column headed "Forced Convections." The velocity of the water as it passes the coil will obviously be low, and since steel pipe is used, some rusting may be expected. The minimum value of "U" for forced convections, i. e., $U = 150$, is therefore used.

Determination of T (*Use Formula 2*)

$GTD = 267 - 50 = 217°$ F.

$LTD = 259 - 180 = 79°$ F.

$$T = \frac{217 - 79}{2.3 \log \frac{217}{79}} = \frac{138}{2.3 \log 2.75} =$$

$$\frac{138}{2.3 \times .4393} = 136°\text{ F.}$$

Determination of A (*Use Formula 1*)

$$A = \frac{1{,}053{,}000}{150 \times 136} = 51.5 \text{ sq. ft.}$$

Determination of Pipe Size and Length of Pipe

Refer to the table of Pipe Data, pages 470 and 471, to determine the inside diameter and external area per foot of the probable pipe sizes.

Size	Inside Diameter	External Surface (Square Feet per Foot)
1¼	1.380	.435
1½	1.610	497
2	2.067	.622

Calculate the length of pipe required to give the required area of heating surface:

$$(1\tfrac{1}{4}'') = \frac{51.5}{.435} = 118 \text{ feet}$$

$$(1\tfrac{1}{2}'') = \frac{51.5}{.497} = 104 \text{ feet}$$

$$(2'') = \frac{51.5}{.622} = 83 \text{ feet}$$

To determine the equivalent length of the coil for purposes of calculating pressure drop, calculate the relative radius R/D by dividing the radius of the coil by the ID of the pipe, and refer to the Chart for resistance of 90° bends to determine the total resistance and resistance due to the length of the bends

Size	R/D	Pipe Diameter	
		Total Resistance	Resistance Due to Length
1¼	13.0	37	21
1½	11.2	32	18
2	8.7	26	14

The equivalent length of the circular coil, then, is equal to the lineal length of the pipe times the ratio of the total resistance to the resistance due to length.

Equivalent Length:

$$(1\tfrac{1}{4}'') = \frac{37}{21} \times 118 = 208 \text{ feet of straight pipe}$$

$$(1\tfrac{1}{2}'') = \frac{32}{18} \times 104 = 185 \text{ feet of straight pipe}$$

$$(2'') = \frac{26}{14} \times 83 = 154 \text{ feet of straight pipe}$$

Amount of steam that must be condensed to provide

$$1{,}053{,}000 \text{ BTU} = \frac{1{,}053{,}000}{936} = 1130 \text{ lbs./hr.}$$

For the purpose of calculating pressure drop, the average quantity of steam flowing within the coil may be assumed as, $= .75 \times 1130 = 850$ pounds per hour. Refer to pages 516 and 517 to determine pressure drops as follows:

Size	C_1	C_2	C_3	ΔP_{100}
1¼	.0007	1687	.95	12.67
1½	.0007	755	.95	5.67
2	.0007	213	.95	1.6

By inspection, the conditions of the problem i. e., 5 psi maximum pressure drop, cannot be met with either 1¼" or 1½" pipe, and 2" pipe must be used.

Total pressure drop in the 2" coil will be:

$\frac{154}{100} \times 1.6$, or 2.46 psi

Number of coils required will be:

$\frac{83}{\pi D} = 8.8$, or 9 coils.

Thermal Properties of Water

Temperature of Water Degrees Fahr.	Saturation Pressure Pounds per Square Inch Absolute	Specific Volume Cubic Feet per Pound	Density Pounds per Cubic Foot	Weight Pounds per Gallon	Specific Heat	Specific Gravity
32	.08854	.01602	62.42	8.345	1.0093	1.001
40	.12170	.01602	62.42	8.345	1.0048	1.001
50	.17811	.01603	62.38	8.340	1.0015	1.000
60	.2563	.01604	62.34	8.334	.9995	1.000
70	.3631	.01606	62.27	8.325	.9982	.998
80	.5069	.01608	62.19	8.314	.9975	.997
90	.6982	.01610	62.11	8.303	.9971	.996
100	.9492	.01613	62.00	8.289	.9970	.994
110	1.2748	.01617	61.84	8.267	.9971	.991
120	1.6924	.01620	61.73	8.253	.9974	.990
130	2.2225	.01625	61.54	8.227	.9978	.987
140	2.8886	.01629	61.39	8.207	.9984	.984
150	3.718	.01634	61.20	8.182	.9990	.981
160	4.741	.01639	61.01	8.156	.9998	.978
170	5.992	.01645	60.79	8.127	1.0007	.975
180	7.510	.01651	60.57	8.098	1.0017	.971
190	9.339	.01657	60.35	8.068	1.0028	.968
200	11.526	.01663	60.13	8.039	1.0039	.964
210	14.123	.01670	59.88	8.005	1.0052	.960
212	14.696	.01672	59.81	7.996	1.0055	.959
220	17.186	.01677	59.63	7.972	1.0068	.956
240	24.969	.01692	59.10	7.901	1.0104	.947
260	35.429	.01709	58.51	7.822	1.0148	.938
280	49.203	.01726	57.94	7.746	1.020	.929
300	67.013	.01745	57.31	7.662	1.026	.919
350	134.63	.01799	55.59	7.432	1.044	.891
400	247.31	.01864	53.65	7.172	1.067	.860
450	422.6	.0194	51.55	6.892	1.095	.826
500	680.8	.0204	49.02	6.553	1.130	.786
550	1045.2	.0218	45.87	6.132	1.200	.735
600	1542.9	.0236	42.37	5.664	1.362	.679
700	3093.7	.0369	27.10	3.623		.434

Weight per Gallon based on 7.48 Gallons per Cubic Foot.

Weight of Air at Various Pressures and Temperatures[1]

Temp. of Air	Gauge Pressure, in Pounds per Square Inch (Based on an Atmospheric Pressure of 14.7 Pounds per Square Inch Absolute at Sea Level)																				
	0	5	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	175	200	225	250	300
Deg. Fahr.	Weight (Density), in Pounds per Cubic Foot																					
−20	.0900	.1205	.1515	.2125	.2744	.3360	.3970	.4580	.5190	.5800	.6410	.702	.7635	.825	.886	.948	1.010	1.165	1.318	1.465	1.625	1.930
−10	.0882	.1184	.1485	.2090	.2685	.3283	.3880	.4478	.5076	.5674	.6272	.687	.747	.807	.868	.928	.989	1.139	1.288	1.438	1.588	1.890
0	.0864	.1160	.1455	.2040	.2630	.3215	.3800	.4385	.4970	.5555	.6140	.672	.731	.790	.849	.908	.968	1.114	1.260	1.406	1.553	1.850
10	.0846	.1136	.1425	.1995	.2568	.3145	.3720	.4292	.4863	.5433	.6006	.658	.716	.774	.832	.889	.947	1.090	1.233	1.376	1.520	1.810
20	.0828	.1112	.1395	.1955	.2516	.3071	.3645	.4205	.4770	.5330	.5890	.645	.701	.757	.813	.869	.927	1.067	1.208	1.348	1.489	1.770
30	.0811	.1088	.1366	.1916	.2465	.3015	.3570	.4121	.4672	.5221	.5771	.632	.687	.742	.797	.852	.908	1.046	1.184	1.322	1.460	1.735
40	.0795	.1067	.1338	.1876	.2415	.2954	.3503	.4038	.4576	.5114	.5652	.619	.673	.727	.781	.835	.890	1.025	1.161	1.296	1.431	1.701
50	.0780	.1045	.1310	.1839	.2367	.2905	.3432	.3960	.4487	.5014	.5541	.607	.660	.713	.766	.819	.873	1.006	1.139	1.271	1.403	1.668
60	.0764	.1025	.1283	.1803	.2323	.2840	.3362	.3882	.4402	.4927	.5447	.596	.649	.700	.752	.804	.856	.988	1.116	1.245	1.376	1.636
70	.0750	.1005	.1260	.1770	.2280	.2791	.3302	.3808	.4316	.4824	.5332	.584	.635	.686	.737	.788	.839	.967	1.095	1.223	1.350	1.604
80	.0736	.0988	.1239	.1738	.2237	.2739	.3242	.3738	.4234	.4729	.5224	.572	.622	.673	.723	.774	.824	.949	1.074	1.199	1.325	1.573
90	.0723	.0970	.1218	.1707	.2195	.2688	.3182	.3670	.4154	.4639	.5122	.561	.611	.660	.709	.759	.809	.932	1.054	1.177	1.300	1.544
100	.0710	.0954	.1197	.1676	.2155	.2638	.3122	.3602	.4079	.4555	.5033	.551	.599	.648	.696	.745	.794	.914	1.035	1.155	1.276	1.517
110	.0698	.0937	.1176	.1645	.2115	.2593	.3070	.3542	.4011	.4481	.4950	.542	.589	.637	.685	.732	.780	.899	1.017	1.135	1.254	1.491
120	.0686	.0921	.1155	.1618	.2080	.2549	.3018	.3481	.3944	.4403	.4866	.533	.579	.626	.673	.720	.767	.884	1.001	1.118	1.234	1.465
130	.0674	.0905	.1135	.1590	.2045	.2505	.2966	.3446	.3924	.4296	.4770	.524	.570	.616	.662	.708	.754	.869	.984	1.099	1.214	1.440
140	.0663	.0889	.1115	.1565	.2015	.2465	.2915	.3364	.3813	.4262	.4711	.516	.561	.606	.651	.696	.742	.855	.968	1.081	1.194	1.416
150	.0652	.0874	.1096	.1541	.1985	.2425	.2865	.3308	.3751	.4193	.4636	.508	.552	.596	.640	.685	.730	.841	.953	1.064	1.175	1.392
175	.0626	.0840	.1054	.1482	.1910	.2335	.2755	.3181	.3607	.4033	.4450	.488	.531	.573	.616	.658	.701	.808	.914	1.021	1.128	1.337
200	.0603	.0809	.1014	.1427	.1840	.2248	.2655	.3054	.3473	.3882	.4291	.470	.511	.552	.592	.633	.674	.776	.879	.982	1.084	1.287
225	.0581	.0779	.0976	.1373	.1770	.2163	.2555	.2949	.3344	.3738	.4129	.452	.491	.531	.570	.609	.649	.747	.846	.944	1.043	1.240
250	.0560	.0751	.0941	.1323	.1705	.2085	.2466	.2845	.3223	.3602	.3981	.436	.474	.513	.551	.589	.627	.722	.817	.912	1.007	1.197
275	.0541	.0726	.0910	.1278	.1645	.2011	.2378	.2745	.3111	.3478	.3844	.421	.458	.494	.531	.568	.605	.697	.789	.881	.972	1.155
300	.0523	.0707	.0881	.1237	.1592	.1945	.2300	.2654	.3008	.3362	.3716	.407	.442	.478	.513	.549	.585	.673	.762	.852	.940	1.118
350	.0491	.0658	.0825	.1160	.1495	.1828	.2160	.2492	.2824	.3156	.3488	.382	.415	.449	.482	.516	.549	.632	.715	.799	.883	1.048
400	.0463	.0621	.0779	.1090	.1405	.1720	.2035	.2348	.2661	.2974	.3287	.360	.391	.423	.454	.486	.517	.596	.674	.753	.831	.987
450	.0437	.0586	.0735	.1033	.1330	.1628	.1925	.2220	.2515	.2810	.3105	.340	.369	.399	.429	.458	.488	.562	.637	.711	.786	.934
500	.0414	.0555	.0696	.0978	.1260	.1540	.1820	.2100	.2380	.2660	.2940	.322	.351	.379	.407	.435	.463	.534	.604	.675	.746	.885
550	.0394	.0528	.0661	.0930	.1198	.1464	.1730	.1996	.2262	.2528	.2794	.306	.333	.359	.386	.413	.440	.507	.573	.641	.709	.841
600	.0376	.0504	.0631	.0885	.1140	.1395	.1650	.1904	.2158	.2412	.2668	.292	.317	.343	.368	.393	.419	.483	.547	.611	.675	.801

[1]Reprinted from "Compressed Air Data" Fifth Edition. Courtesy of Ingersoll-Rand Company.

Pressure Drop in Bends and Elbows

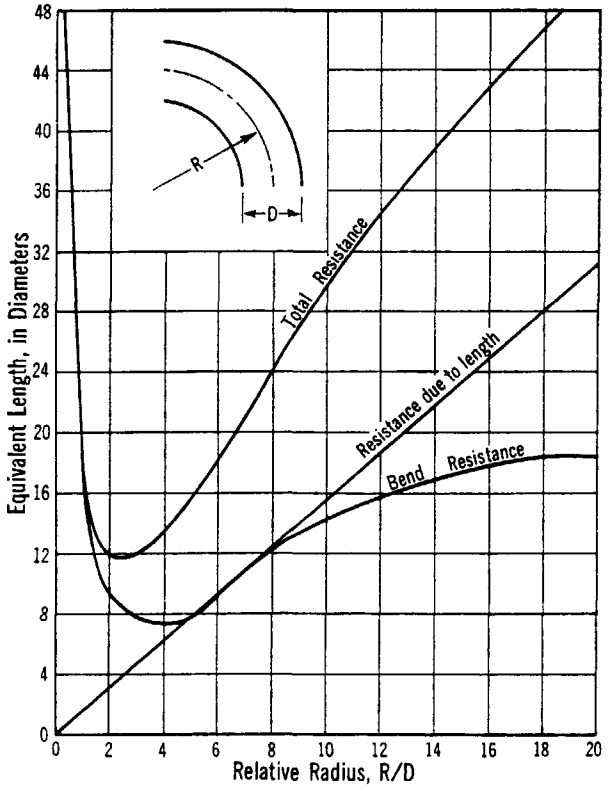
Resistance of Bends to Flow

The relationship between the equivalent length of pipe bends and the ratio of the radius of the bend axis to the internal diameter, i.e. R/D, is not well defined and considerable variation is found in the results based on the work of various investigators. The chart below, showing the resistance of 90° bends in terms of equivalent length of straight pipe, represents average flow conditions and is based on the work of K. H. Biej, in his paper on "Pressure Losses for Fluid Flow in 90° Pipe Bends," Journal of Research of the National Bureau of Standards, Vol. 21, July, 1938.

The chart showing the Resistance of Miter Bends to the Flow of Fluids represents average flow conditions and is based on resistance coefficients for Miter Bends determined by H. Kirchbach, "Loss of Energy in Miter Bends," Transactions of the Munich Hydraulic Institute, Bulletin No. 3, American Society of Mechanical Engineers, New York, 1935.

Resistance of Elbows to Flow

For the common 90° cast or malleable iron screwed elbow, the total resistance is roughly equivalent to 30 diameters of straight pipe. Flanged elbows offer approximately 25% less resistance than screwed elbows.



Resistance of 90° Bends
(Biej)

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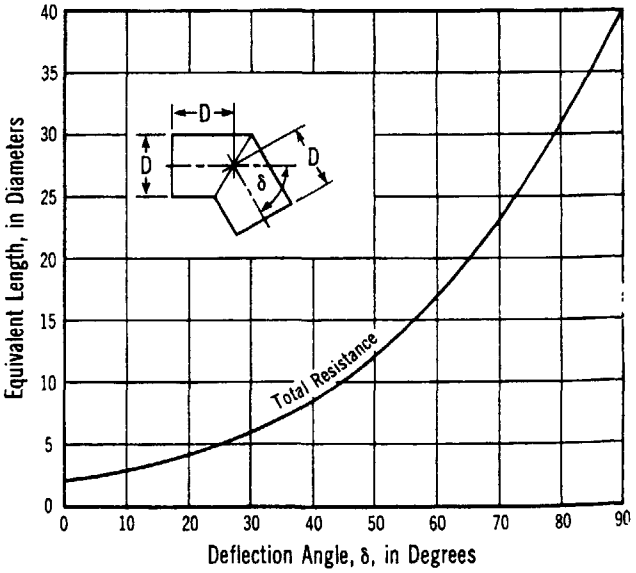


Resistance of Miter Bends
to the Flow of Fluids (Kirchbach)

Excerpts from the Code for Pressure Piping

Shown on this and the following page are excerpts from the Code for Pressure Piping, American Standard B31. 1-1942, with 1944 Supplement No. 1 and 1947 Supplement No. 2. The excerpts cover the Scope and Classification of the five piping sections and set forth limitations of threaded end pipe.

Section 1, Power Piping Systems

"**101 Scope.** Section 1 of this Code covers the design, manufacture, test and installation of power piping systems, as defined below, for steam generating plants, central heating plants, and industrial plants.

102 Classification. (a) Power piping systems and the component parts of such piping including, for example, the pipe, flanges, bolting, gaskets, valves, and fittings, shall be understood to embrace all steam, water, and oil piping (not including oil piping covered by Section 3 of this code) within or forming a part of the above-mentioned plants. Gas, air, refrigerating piping, central and district heating steam or hot water distribution piping away from the plant, building heating piping when the pressure does not exceed 15 p.s.i. gage, roof and floor drains, plumbing, sprinkler systems, piping for hydraulic pressure tools or equipment, sewers, and industrial process piping for fluids not mentioned above, are excluded.

(b) Valves, fittings, and piping for boilers, as prescribed in the A.S.M.E. Code for Power Boilers are within the scope of this code except that provisions of the A.S.M.E. Code for Power Boilers shall govern insofar as they exceed corresponding requirements of this code.

(c) Economizers, heaters, tanks, and other pressure vessels are outside the scope of this code, but connecting piping shall conform to the requirements herein specified.

122 Thickness of Pipe. (f) Steel.....pipe lighter than Schedule 40.....shall not be threaded. The value of P in formula 1 (pipe design formula)..... shall not be taken at less than 100 psi gage for any conditions or material.

(g) (1) While the thickness given by ..... (the pipe design formula).... is theoretically ample to take care of both bursting pressure and material removed in the threading, it is mandatory that where steel pipe is threaded and used for steam pressures of 250 psi and over, or for piping under pressure in excess of 100 psi with water temperature of 220° F and over, it shall be seamless of a quality at least equal to A.S.T.M. Specifications A-106 or A-53 and of a weight at least equal to Schedule 80. .... in order to furnish added mechanical strength."

Section 2, Gas and Air Piping Systems

"**201 Scope.** This section covers the design, manufacture, installation, and tests of piping systems and the component parts of such piping including, for example, the pipe, flanges, bolting, gaskets, valves, and fittings, intended for conveying air, fuel gas, illuminating gas, and other substantially non-corrosive gases.

202 Classification. (a) This section includes city gas distribution systems, cross-country transportation systems, piping in gas manufacturing plants, in gas or air compressing stations, and in processive plants.

(b) This section does not contemplate gas or air temperatures above 450°F. The requirements of Section 3 of this code for temperatures above 450°F. shall apply to all gas or air piping systems where the temperature exceeds 450°F.

(c) This section *does not* apply to:

(1) Air piping under pressures 30 psi and below,
(2) Equipment or apparatus, or pipe connections which are a part of apparatus,
(3) Piping lined with fire brick or other refractory material used for conveying hot gases,
(4) Piping used for conveying refinery process gas in oil refineries or gasoline recovery plants, and for sewer gas; or ducts for waste gases and ventilation.
(5) Casing, tubing, and pipe when used in gas or oil wells, and material gas and oil field producing and gathering systems outside the boundaries of city or villages. The gathering system is defined as a piping system which carries gas from wells to a common point in the producing field where the transportation systems begin,
(6) Residential and commercial building gas piping systems.

220 Thickness of Pipe. Div. 1. (d)..... The value of P allowed.....shall not exceed two-thirds of the mill test pressure for service temperatures not in excess of 100°F and five-ninths of the mill test pressure for a service temperature of 450°F, P values for intermediate temperatures to be obtained by interpolation.

(e) Threaded pipe thinner than listed in any of the specifications for threaded pipe enumerated..... (in the code) shall not be used.

(f) The value of P shall not be taken at less than 180 psi for pipe diameters up to and including 24 in., and 100 psi for pipe diameters greater than 24 in....."

Section 3, Oil Piping Systems Including Oil Vapor, Refinery Gas, and Gasoline Recovery Plants

"**301 Scope.** Section 3 of this Code covers mandatory requirements and recommended practices for the design, manufacture, test, and installation of oil piping systems and the component parts of such piping including, for example, the pipe, flanges, bolting, gaskets, valves, and fittings, used in the production, transmission, and refining of petroleum. It is not intended to include casing, tubing or pipe used in gas or oil wells."

(continued on the next page)

Excerpts from the Code for Pressure Piping

(Section 3—*continued from the preceding page*)

"**302 Classification.** (a) The requirements specified herein shall apply particularly to oil piping, refinery gas piping, and piping for gasoline recovery plants. They may also be used for corresponding pressure and temperature conditions for all piping other than oil; such as steam, air, water, gas, etc., used in the distribution systems and process areas of the plants devoted principally to the processing and handling of oils, but they shall not be used for steam piping in such plants within the limits of the boiler house or boiler plant areas, nor for boiler feed water piping between feed pumps and boilers; piping for these services and in these locations shall conform to the requirements of Section 1.

The requirements do not apply to heater coils, economizers, or pipe exchangers except surface coolers or exchangers ordinarily known as condenser box coils; nor to the design of piping for conveying fluids such as acids or caustics (or solutions thereof), or other special fluids of a dangerous nature.

(b) This section of the code includes piping, valves, and fittings up to the connections of drums, pressure vessels, and apparatus, and up to the tube sheets of furnaces, interstage piping between compressors or duplex pumping equipment, etc., but does not include (1) The connections themselves, which are ordinarily furnished with and as a part of the equipment; (2) piping exposed to flame in furnaces; (3) internal piping or its parts integral with the equipment or apparatus.

(c) Oil lines are classified according to pressure and temperature. Oil vapor lines shall follow the same classifications and specifications as oil lines. (Refinery gas lines are dealt with specifically.)

325 Thickness of Pipe. (e) For pipes both inside and outside of refinery limits it is recommended that no pipe lighter than A.P.I. standard threaded line pipe (see A.P.I. Standard 5 L) shall be threaded (where two or more standard weights of pipe are obtainable the heavier or heaviest is referred to in this case).

(f) Regardless of the actual pressure, the minimum thickness of the pipe used shall not be less than that determined by.....(the pipe design formula)....., and in addition shall not be less than the thickness required for mechanical strength as determined by the best engineering data available. For temperatures above 750°F, only seamless steel pipe or a high temperature resisting seamless alloy pipe is permitted where....."

Section 4, District Heating Piping Systems

"**401 Scope.** (a) This section covers the design, manufacture, test, and installation of district heating and central heating piping systems and the component parts of such piping including, for example, the pipe, flanges, bolting, gaskets, valves, and fittings (away from the plant) for the distribution of steam or hot water, for pressures not exceeding 600 psi or temperatures in excess of 750°F.

(b) Piping in the district heating and central heating generating plants is covered by Section 1 of this Code. Piping for pressures in excess of 600 psi, or temperatures in excess of 750°F, shall conform to requirements of Section 1.

402 Classification. (a) District and central heating piping systems shall include all distributing piping for steam or hot water produced in district heating and central heating plants whether the piping is installed underground or elsewhere and distributed at pressures in excess of 15 p.s.i. gage.

(b) This section shall not apply to equipment, apparatus, or pipe connections which are a part of apparatus, nor does it apply to low pressure heating piping within buildings, roof, and floor drains, or plumbing and sewers. This section shall not apply to heating systems aboard ship.

(c) Outdoor steam or hot water distribution piping on the premises of an industrial establishment shall conform to the requirements of this section. Such distribution piping constructed within the buildings of such establishment shall conform to Section 1 of this code.

423 Thickness of Pipe. (f) Steel.....pipe lighter than Schedule 40.....shall not be threaded. In .....(the pipe design formula).....the value P shall be taken at not less than 100 psi gage for any conditions or material.

(g) (1) While the thickness given by ..... (the pipe design formula).....is theoretically ample to take care of both bursting pressure and material removed in the threading, it is mandatory that where steel pipe is threaded and used for steam pressures of 250 psi and over, or for piping under pressure in excess of 100 psi with water temperature of 220° F and over, it shall be seamless of a quality at least equal to A.S.T.M. Specifications A-106 or A-53 and of a weight at least equal to Schedule 80..... in order to furnish added mechanical strength."

Section 5, Refrigeration Piping Systems

"**501 Scope.** Section 5 of this Code covers the design, manufacture, installation, and tests of piping systems and the component parts of such piping including, for example, the pipe, flanges, bolting, gaskets, valves, and fittings for refrigerants and brines, as defined below.

503 Classification. (a) Refrigeration piping shall be understood to comprise all refrigerant and brine piping, wheresoever used and whether erected on the premises or factory assembled. It does not include shell apparatus, compressors, nor pumps, but does include all connecting refrigerant or brine piping, starting at the first joint adjacent to such apparatus. Requirements apply to both refrigerant and brine piping unless specifically restricted by the wording to one or the other class.

(b) Water piping in connection with refrigerating systems shall be designed in accordance with the provisions for Service Water and Condensing Water Systems in Section 1 of this code,.....

519 Specific Minimum Thickness Requirements for Refrigerant Pipe and Tubing. (a) Standard weight (Schedule 40) steel.....pipe may be used for design working pressures not exceeding 250 psi, provided lap welded or seamless pipe is used for sizes larger than 2" (iron pipe size) and extra heavy (Schedule 80) pipe is used for liquid lines for 1½" (iron pipe size) and smaller."

Welded and Seamless Steel Pipe

Calculating Working Pressure, Stress, or Wall Thickness

Based on the Code for Pressure Piping

It is the generally accepted practice among designers today, when computing thickness of pipe for a given service condition, to use formulas provided by the Code for Pressure Piping, the A.S.M.E. Boiler Construction Code, or other applicable codes.

Of these codes, the Code for Pressure Piping, American Standard B31 1-1942, with 1944 Supplement No. 1 and 1947 Supplement No. 2, serves the widest general purpose. It presents minimum safety requirements for the design, manufacture, and erection of pressure piping systems, and is divided into five major sections, as follows:

Section 1.....covering Power Piping
Section 2.....covering Gas and Air Piping
Section 3.....covering Oil Piping
Section 4.....covering District Heating Piping
Section 5.....covering Refrigeration Piping

Pipe Design Formula

The Code for Pressure Piping includes the following formulas for determining pipe wall thickness:

$$t = \frac{PD}{2S + .8P} + c, \text{ for Sections 1, 4, and 5}$$

$$\text{and: } t = \frac{PD}{2S} + c, \text{ for Sections 2 and 3.}$$

Where: *t = minimum pipe wall thickness for inspection, in inches
P = maximum internal working pressure, in lbs. per sq. in. (gauge)
D = outside diameter of pipe, in inches
S = allowable stress in material, in lbs. per sq. in.
c = allowance for threading, mechanical strength, and for corrosion, in inches

*Since all pipe furnished by the mill is subject to a 12½% variation in wall thickness, the thickness calculated by the above formula should be multiplied by 8/7 to obtain the nominal wall thickness.

The value of P shall not be taken at less than allowed by the various Sections of the Code.

Table 1
"c" Values for Steel Pipe, Code for Pressure Piping

Nominal Pipe Size Inches	Plain End			**Threaded
	Sections 1, 4, & 5	Section 3	Section 2	Sections 1, 3, 4, & 5
⅛	0.05"	0.00"	Depend	0.05"
¼ and ⅜	0.05	0.00	on	0.05
½ and ¾	0.05	0.05	corrosive	0.0571
1	0.05	0.05	condi-	0.0696
1¼ to 2	0.065	0.05	tions.	0.0696
Larger than 2	0.065	0.05	See Code.	0.1000

**Values are for American Standard Pipe Threads for nominal pipe sizes of ½-inch and larger.

Simplified Method for Calculating Working Pressure, Stress, or Wall Thickness

Although the formulas given above enable the determination of pipe wall thicknesses, their extensive use for practical purposes involves many laborious calculations. By establishing the ratio of the working pressure to the allowable stress as a coefficient, Crane engineers have developed an exceedingly easy, simple, and accurate method for figuring not only the pipe wall thickness but also the stress in the pipe or the working pressure of the pipe, based on the Code for Pressure Piping. Three typical problems and complete data for making calculations are shown on the following two pages.

* * * * * * * * * * * * * * * * *

Coefficients for calculating; P/S values: The coefficients for calculating, which are the values of the ratio of the working pressure to allowable stress (P/S) are shown in Table 3, page 527. This table covers various thicknesses and sizes of steel pipe, including not only all scheduled pipe shown in the American Standard for Wrought-Iron and Wrought-Steel Pipe (A.S.A. B36.10) but also other thicknesses which are at present commercially available.

The table has been based upon the design formulas given in the Code for Pressure Piping, the formulas being rearranged in the following manner in order to calculate these values:

$$P/S = \frac{2\,(.875T - c)}{D - .8\,(.875T - c)} \text{ for Sections 1, 4, and 5.}$$

$$\text{and: } P/S = \frac{2(.875T - c)}{D} \quad \text{for Section 3}$$

Where: T = nominal wall thickness, in inches

The P/S values vary for the different sections of the Code due to the fact that the formulas and the value of "c" are not the same in all sections. The use of any particular value, therefore, depends upon the service for which the pipe is to be used.

Allowable stress for pipe: Each section of the Code for Pressure Piping tabulates the allowable stress, "S", for piping materials at various temperatures. Table 2, page 526, shows these allowable stresses for steel pipe made in accordance with A.S.T.M. Specifications A 53 and A 106, and for carbon molybdenum steel pipe made in accordance with A.S.T.M. Specification A 206.

The allowable stresses for Section 2 of the Code for Pressure Piping have not been included in Table 2, because information for solution of the pipe design formula must be obtained from the Code since "c" values for Section 2 depend upon corrosive conditions.

Calculated pressure-temperature ratings: For the convenience of users, Crane engineers have also calculated the actual pressure-temperature ratings for Standard and Extra Strong Grade A Seamless Steel Pipe for the Power Piping and the Oil Piping (Within Refinery Limits) Sections of the Code for Pressure Piping. See pages 282 and 283. As explained above, other ratings, stresses, or pipe wall thicknesses can be easily calculated from the data shown on the following two pages.

Working Pressure, Stress, or Thickness Calculated Quickly and Accurately

Determining Working Pressure

Multiply P/S value by allowable stress. Determination of maximum allowable working pressure when material, thickness, and temperature are known.

What is the maximum allowable working pressure at 100° F. for 1" Schedule 40, Grade A seamless steel plain end pipe per A.S.T.M. Specification A 106 to comply with Section 1 of the Code for Pressure Piping?

The P/S value for 1" Schedule 40 pipe for Section 1 is .105; see Table 3. The allowable stress for Grade A pipe at 100° F. for Section 1 is 12,240 pounds; see Table 2. Multiply these values to obtain the maximum working pressure, thus:

Working pressure = .105 x 12240 = 1285 lbs. per sq. in

Determining Stress

Divide working pressure by P/S value. Determination of stress in pipe when the material, the working pressure, and the thickness are known.

What is the stress in 4" Schedule 80, Grade A seamless steel plain end pipe per A.S.T.M. Spec. A 106 when the working pressure is 1000 pounds per square inch and the temperature is 550° F.? The stress should not exceed that allowed at 550° F. by Section 1 of the Code for Pressure Piping.

The P/S value for 4" Schedule 80 pipe for Section 1 is .107; see Table 3. Divide the known working pressure by the P/S value, thus:

$$\text{Stress} = \frac{1000}{.107} = 9346 \text{ lbs. per sq. in.}$$

The allowable stress for this Grade A seamless steel pipe at 550° F. per Section 1 is 10,080 pounds per square inch; see Table 2. Since the calculated stress is less than the allowable, the pipe is satisfactory for the service conditions.

Determining Pipe Wall Thickness

Divide working pressure by allowable stress to get P/S value.

Refer to Table 3 for equivalent.

Determination of pipe wall thickness when the material, working pressure, and temperature are known.

What thickness of 12" Grade B seamless steel plain end pipe per A.S.T.M. Specification A 106 can be used for 950 pounds per square inch oil working pressure at 450° F.? This pipe is to comply with Section 3 (Within Refinery Limits) of the Code for Pressure Piping.

The allowable stress for 12" Grade B pipe at 450° F. for Section 3 is 17,200 pounds; see Table 2. Divide the known working pressure by the allowable stress, thus:

$$\text{P/S value} = \frac{950}{17200} = .055$$

Compare this P/S value with those of the established thicknesses of 12" pipe to find its equivalent or the next heavier weight; see Table 3. In the column for Section 3, it will be found that 12" pipe with a .500" thickness has a P/S value of .061. Since the calculated value is .055 and the next lighter weight pipe (.406" thickness) has a lower P/S value (.048), pipe .500" thick should be used.

Table 2—Allowable Stresses for Steel Pipe (psi) From Code for Pressure Piping

Temperature Degrees Fahr.	Seamless: Grade A *†‡ ASTM A 106	Seamless: Grade B †‡ ASTM A 106	Seamless: Carbon Molybdenum ASTM A 206	Lap-Weld ‡ ASTM A 53 or A 106	Butt-Weld ‡ ASTM A 53
Section 1, Power Piping or Section 4, District Heating					
100	12240	15300		9600	6875
150	12000	15000		9400	6750
200	11760	14700		9200	6625
250	11520	14400		9000	6500
300	11280	14100		8775	6350
350	11040	13800		8550	6200
400	10800	13400		8350	6050
450	10560	13200		8150	5950
500	10320	12900		7950	5800
550	10080	12600		7750	5650
600	9840	12300		7550	5550
650	9600	12000	11000	7300	5400
700	9250	11400	11000	6800	5100
750	8700	10400	11000	6250	4700
800	8000	9100	10750		
850	6850	7400	10500		
900	5600	5600	10000		
950	3800	3800	8000		
1000	2000	2000	5000		
Section 3, Oil Piping					
Outside of Refinery Limits					
100	25500	29750		15950	15300
Within Refinery Limits					
100	18000	21000	18000	11250	10800
150	17450	20450	17650	11000	10500
200	16900	19900	17350	10750	10200
250	16350	19350	17000	10500	9900
300	15800	18800	16700	10250	9600
350	15300	18250	16350	10000	9300
400	14700	17700	16050	9700	9000
450	14150	17200	15700	9450	8700
500	13600	16600	15400	9200	8400
550	13100	16100	15050	8950	8100
600	12550	15550	14750	8700	7800
650	12000	15000	14400	8450	7500
700	11550	14250	14100	8200	7200
750	10900	13000	13800	7850	6700
800	10000	11400	13500		
850	8550	9250	13150		
900	7000	7000	12250		
950	4750	4750	10000		
1000	2500	2500	6250		
1050			3000		
1100			1500		
Section 5, Refrigeration Piping					
....	12000	15000		9000	6800

*Silicon killed, 0.10 to 0.25 per cent silicon.

†Within the following temperature limitations, the values are also applicable to Seamless Pipe per ASTM Specification A 53:
For Section 1 or 4, Grade A Pipe not exceeding 650° F.
Grade B Pipe not exceeding 700° F.
For Section 3, Grade A or B Pipe not exceeding 750° F.

‡For Section 3 only, values are also applicable to A.P.I. 5L.

For allowable stresses for steel pipe for Section 2, Division 1, Gas and Air Piping, see Code for Pressure Piping.

Table 3—P/S Values for Steel Pipe; Coefficients, Based on Code for Pressure Piping

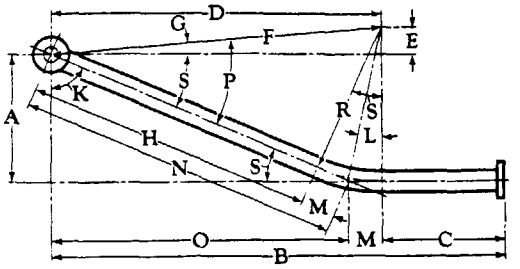
Nominal Pipe Size	O.D. of Pipe Inches	[1]Nominal Wall Thickness Inches	[2]Values for P/S: Plain End Pipe Sec. 1, 4, or 5	Plain End Pipe Sec. 3	[3]Thd'd. Pipe Sec. 1, 4, or 5	Thd'd. Pipe Sec. 3
1/8"	.405	.068 (40) s	.048	.294	.048	.047
		.095 (80) x	.175	.410	.175	.164
1/4	.540	.088 (40) s	.104	.285	.104	.100
		.119 (80) x	.218	.386	.218	.200
3/8	.675	.091 (40) s	.091	.236	.091	.088
		.126 (80) x	.192	.327	.192	.179
1/2	.840	.109 (40) s	.113	.108	.095	.091
		.147 (80) x	.202	.187	.183	.170
		.187 (160)	.303	.271	.282	.254
		.294 xx	.615	.493	.589	.477
3/4	1.050	.113 (40) s	.097	.093	.082	.080
		.154 (80) x	.173	.161	.157	.148
		.218 (160)	.300	.268	.283	.255
		.308 xx	.502	.418	.482	.405
1	1.315	.133 (40) s	.105	.101	.073	.071
		.179 (80) x	.173	.162	.140	.132
		.250 (160)	.286	.257	.249	.227
		.358 xx	.477	.400	.435	.371
1 1/4	1.660	.140 (40) s	.071	.087	.065	.064
		.191 (80) x	.129	.141	.123	.118
		.250 (160)	.200	.203	.194	.180
		.382 xx	.373	.342	.365	.319
1 1/2	1.900	.145 (40) s	.067	.081	.062	.060
		.200 (80) x	.121	.132	.116	.111
		.281 (160)	.206	.206	.200	.186
		.400 xx	.341	.316	.335	.295
2	2.375	.154 (40) s	.060	.071	.056	.055
		.218 (80) x	.111	.119	.106	.102
		.343 (160)	.215	.211	.210	.194
		.436 xx	.298	.279	.293	.263
2 1/2	2.875	.203 (40) s	.081	.089	.055	.054
		.276 (80) x	.129	.133	.102	.098
		.375 (160)	.198	.193	.169	.159
		.552 xx	.329	.301	.298	.266
3	3.500	.216 (40) s	.073	.079	.052	.051
		.300 (80) x	.118	.121	.096	.093
		.437 (160)	.196	.190	.172	.161
		.600 xx	.294	.271	.269	.243
3 1/2	4.000	.226 (40) s	.068	.074	.050	.049
		.318 (80) x	.111	.114	.092	.089
4	4.500	.237 (40) s	.065	.070	.049	.048
		.337 (80) x	.107	.109	.090	.087
		.437 (120)	.149	.148	.132	.126
		.531 (160)	.191	.184	.173	.162
		.674 xx	.257	.240	.238	.218
5	5.563	.258 (40) s	.059	.063	.046	.045
		.375 (80) x	.098	.100	.085	.082
		.500 (120)	.142	.139	.128	.121
		.625 (160)	.186	.179	.172	.161
		.750 xx	.232	.218	.217	.200
6	6.625	.280 (40) s	.056	.059	.045	.044
		.432 (80) x	.098	.099	.087	.084
		.562 (120)	.136	.133	.124	.118
		.718 (160)	.182	.175	.170	.159
		.864 xx	.228	.213	.215	.198
8	8.625	.250 (20)	.036	.039	.028	.028
		.277 (30)	.042	.045	.033	.033
		.322 (40) s	.051	.054	.043	.042
		.406 (60)	.069	.071	.061	.059
		.500 (80) x	.089	.090	.081	.078
		.593 (100)	.110	.109	.101	.097
		.718 (120)	.138	.134	.129	.122
		.812 (140)	.159	.153	.150	.142
		.875 xx	.174	.166	.165	.154
		.906 (160)	.181	.172	.172	.161
10"	10.75	.250 (20)	.029	.031	.022	.022
		.307 (30)	.038	.041	.032	.031
		.365 (40) s	.048	.050	.041	.041
		.500 (60) x	.071	.072	.064	.063
		.593 (80)	.087	.087	.080	.078
		.718 (100)	.109	.108	.102	.098
		.843 (120)	.132	.128	.125	.119
		1.000 (140)	.160	.153	.153	.144
		1.125 (160)	.184	.174	.176	.165
12	12.75	.250 (20)	.024	.026	.019	.019
		.330 (30)	.036	.037	.030	.030
		.375 s	.042	.044	.036	.036
		.406 (40)	.046	.048	.041	.040
		.500 x	.060	.061	.054	.053
		.562 (60)	.069	.069	.063	.061
		.687 (80)	.087	.086	.081	.079
		.843 (100)	.110	.108	.104	.100
		1.000 (120)	.134	.129	.128	.122
		1.125 (140)	.153	.147	.147	.139
		1.312 (160)	.182	.172	.176	.164
14 OD	14.00	.250 (10)	.022	.024	.017	.017
		.312 (20)	.030	.032	.025	.025
		.375 (30) s	.038	.040	.033	.033
		.437 (40)	.046	.047	.041	.040
		.500 x	.054	.055	.049	.048
		.593 (60)	.067	.067	.061	.060
		.750 (80)	.087	.087	.082	.079
		.937 (100)	.113	.110	.107	.103
		1.093 (120)	.134	.129	.129	.122
		1.250 (140)	.156	.149	.151	.142
		1.406 (160)	.178	.169	.173	.161
16 OD	16.00	.250 (10)	.019	.021	.015	.015
		.312 (20)	.026	.028	.022	.022
		.375 (30) s	.033	.035	.029	.029
		.500 (40) x	.047	.048	.043	.042
		.656 (60)	.065	.066	.061	.059
		.843 (80)	.087	.086	.082	.080
		1.031 (100)	.109	.107	.104	.100
		1.218 (120)	.132	.127	.127	.121
		1.437 (140)	.158	.151	.154	.145
		1.593 (160)	.178	.168	.173	.162
18 OD	18.00	.250 (10)	.017	.019	.013	.013
		.312 (20)	.023	.025	.019	.019
		.375 s	.030	.031	.026	.025
		.437 (30)	.036	.037	.032	.031
		.500 x	.042	.043	.038	.038
		.562 (40)	.048	.049	.044	.044
		.750 (60)	.067	.067	.063	.062
		.937 (80)	.087	.086	.083	.080
		1.156 (100)	.110	.107	.106	.101
		1.375 (120)	.133	.128	.129	.123
		1.562 (140)	.154	.146	.149	.141
		1.781 (160)	.178	.168	.173	.162
20 OD	20.00	.250 (10)	.015	.017	.012	.012
		.375 (20) s	.027	.028	.023	.023
		.500 (30) x	.038	.038	.034	.034
		.593 (40)	.046	.047	.043	.042
		.812 (60)	.066	.066	.063	.061
		1.031 (80)	.087	.085	.083	.080
		1.281 (100)	.110	.107	.106	.102
		1.500 (120)	.131	.126	.127	.121
		1.750 (140)	.156	.148	.152	.143
		1.968 (160)	.177	.167	.173	.162
24 OD	24.00	.250 (10)	.013	.014	.010	.010
		.375 (20) s	.022	.023	.019	.019
		.500 x	.031	.032	.028	.028
		.562 (30)	.036	.037	.033	.033
		.687 (40)	.045	.046	.042	.042
		.968 (60)	.067	.066	.064	.062
		1.218 (80)	.086	.085	.083	.080
		1.531 (100)	.111	.107	.108	.103
		1.812 (120)	.133	.128	.130	.124
		2.062 (140)	.154	.146	.151	.142
		2.343 (160)	.177	.166	.174	.162

[1] Figures in parentheses indicate A.S.A. B-36 Schedule Numbers. Letters "s", "x", and "xx" indicate Standard, Extra Strong, and Double Extra Strong Pipe.

[2] P/S Values for Section 2 are not listed because the "c" values (page 525) vary, depending upon corrosive conditions.

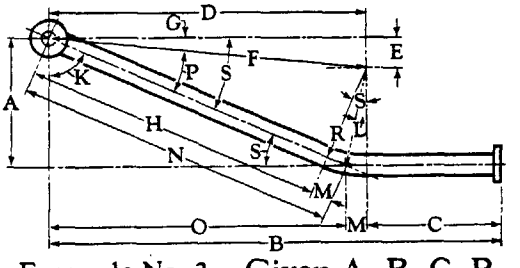
[3] See pages 523 and 524 for limitations of threaded ends.

Calculation of Pipe Bends



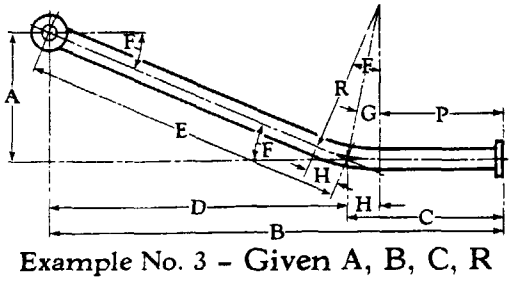
Example No. 1 - Given A, B, C, R

$D = B - C$
$E = R - A$
$F = \sqrt{D^2 + E^2}$
$\frac{E}{F} = \sin \angle G$
$H = \sqrt{F^2 - R^2}$
$\frac{R}{F} = \sin \angle P$
$\angle S = \angle P - \angle G$
$\angle K = 90° - \angle S$
$\angle L = \frac{1}{2} \angle S$
$M = \tan \angle L \times R$
$N = H + M$
$O = B - C - M$



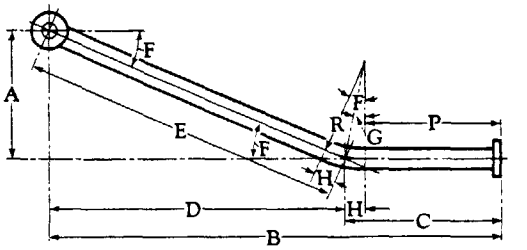
Example No. 2 - Given A, B, C, R

$D = B - C$
$E = A - R$
$F = \sqrt{D^2 + E^2}$
$\frac{E}{F} = \sin \angle G$
$H = \sqrt{F^2 - R^2}$
$\frac{R}{F} = \sin \angle P$
$\angle S = \angle P + \angle G$
$\angle K = 90° - \angle S$
$\angle L = \frac{1}{2} \angle S$
$M = \tan \angle L \times R$
$N = H + M$
$O = B - C - M$



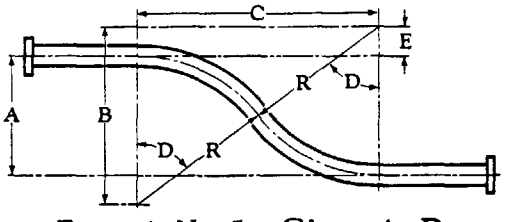
Example No. 3 - Given A, B, C, R

$D = B - C$
$E = \sqrt{A^2 + D^2}$
$\frac{A}{E} = \sin \angle F$
$\angle G = \frac{1}{2} \angle F$
$H = \tan \angle G \times R$
$P = C - H$



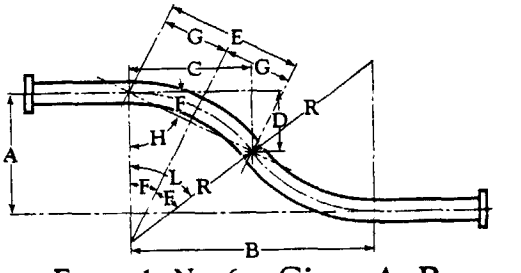
Example No. 4 - Given A, B, C, R

$D = B - C$
$E = \sqrt{A^2 + D^2}$
$\frac{A}{E} = \sin \angle F$
$\angle G = \frac{1}{2} \angle F$
$H = \tan \angle G \times R$
$P = C - H$



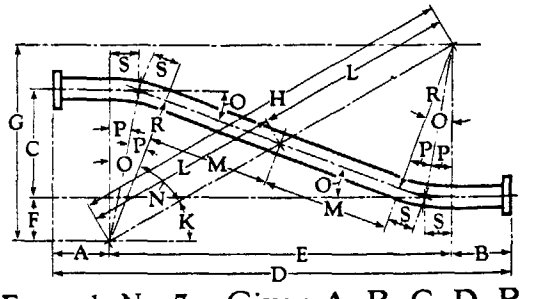
Example No. 5 - Given A, R

$B = 2R - A$
$C = \sqrt{(2R)^2 - B^2}$
$\frac{C}{2R} = \sin \angle D$



Example No. 6 - Given A, B

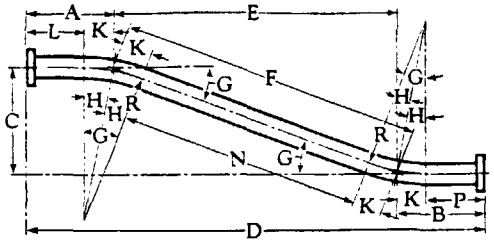
$C = \frac{1}{2} B$
$D = \frac{1}{2} A$
$E = \sqrt{C^2 + D^2}$
$\frac{D}{E} = \sin \angle F$
$G = \frac{1}{2} E$
$\angle H = 90° - \angle F$
$R = \frac{A^2 + B^2}{4A}$
$L = 2F$



Example No. 7 - Given A, B, C, D, R

$E = D - A - B$
$F = R - C$
$G = R + F$
$H = \sqrt{E^2 + G^2}$
$G/H = \sin \angle K$
$L = \frac{1}{2} H$
$M = \sqrt{L^2 - R^2}$
$M/L = \sin \angle N$
$\angle O = 90° - \angle K - \angle N$
$\angle P = \frac{1}{2} \angle O$
$S = \tan \angle P \times R$

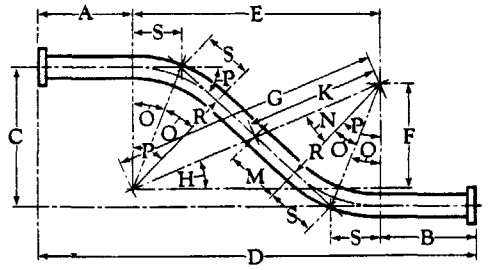
Calculation of Pipe Bends (Cont.)



Example No. 8 - Given A, B, C, D, R

$E = D - A - B$
$F = \sqrt{E^2 + C^2}$
$\frac{C}{F} = \sin \angle G$

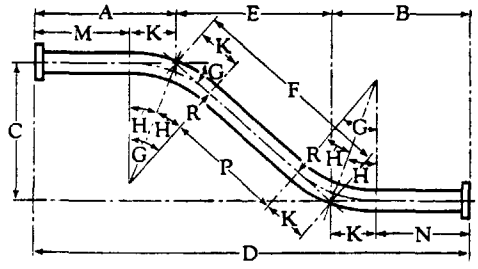
$\angle H = \frac{1}{2} \angle G$
$K = \tan \angle H \times R$
$L = A - K$
$P = B - K$
$N = F - 2K$



Example No. 9 - Given A, B, C, D, R

$E = D - A - B$
$F = 2R - C$
$G = \sqrt{E^2 + F^2}$
$\frac{F}{E} = \tan \angle H$
$K = \frac{1}{2} G$

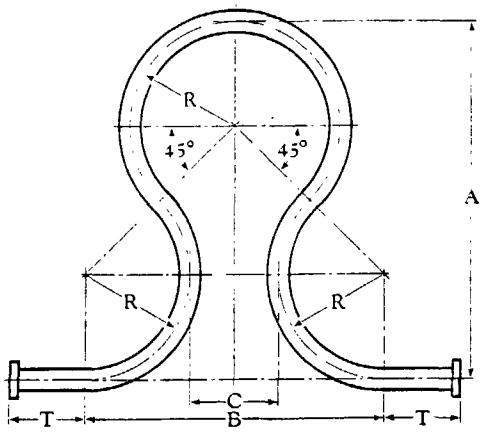
$M = \sqrt{K^2 - R^2}$
$\frac{M}{K} = \sin \angle N$
$\angle P = 90° - \angle H - \angle N$
$\angle O = \frac{1}{2} \angle P$
$S = \tan \angle O \times R$



Example No. 10 - Given A, B, C, D, R

$E = D - A - B$
$F = \sqrt{C^2 + E^2}$
$\frac{C}{F} = \sin \angle G$

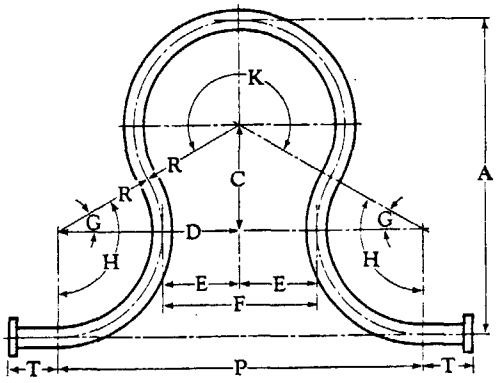
$\angle H = \frac{1}{2} \angle G$
$K = \tan \angle H \times R$
$M = A - K$
$N = B - K$
$P = F - 2K$



Example No. 11 - Given R and 45° Angles

$A = 3.414 \times R$
$B = 2.828 \times R$
$C = 0.828 \times R$

T = Tangent
Length of Pipe in Bend = $9.425 \times R + 2T$

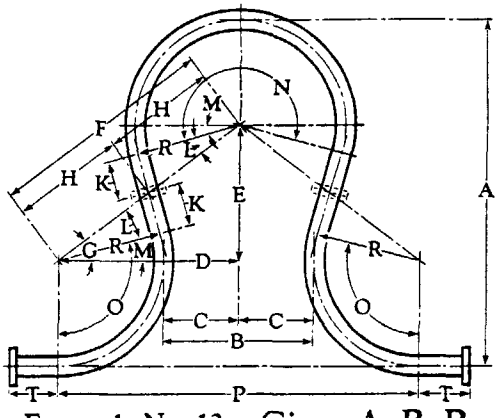


Example No. 12 - Given A, R

$C = A - 2R$
$D = \sqrt{(2R)^2 - C^2}$

$P = 2D$
$E = D - R$
$F = 2E$

$C/2R = \sin \angle G$
$\angle H = 90° + \angle G$
$\angle K = 180° + 2 \angle G$



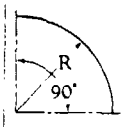
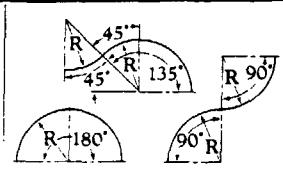
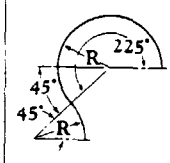
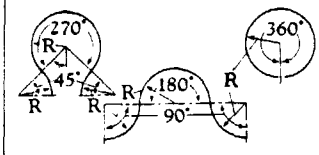
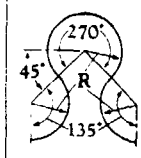
Example No. 13 - Given A, B, R

$C = \frac{1}{2} B$
$D = R + C$
$E = A - 2R$
$F = \sqrt{D^2 + E^2}$

$E/F = \sin \angle G$
$H = \frac{1}{2} F$
$K = \sqrt{H^2 - R^2}$
$K/H = \sin \angle L$

$\angle M = \angle G - \angle L$
$\angle N = 180° + 2 \angle M$
$\angle O = 90° + \angle M$
$P = 2D$

Length of Pipe in Bends

Radius of Pipe Bends						
Inches	Feet	90° Bends	180° Bends	270° Bends	360° Bends	540° Bends
1		1½"	3"	4¾"	6¼"	9½"
2		3	6¼	9½	12½	18¾
3	¼	4¾	9½	14¼	18¾	28¼
4		6¼	12½	18¾	25¼	37¾
5		7¾	15¾	23½	31½	47¼
6	½	9½	18¾	28¼	37¾	56½
7		11	22	33	44	66
8		12½	25¼	37¾	50¼	75½
9	¾	14¼	28¼	42½	56½	84¾
10		15¾	31½	47¼	62¾	94¼
11		17¼	34½	51¾	69	103¾
12	1	18¾	37¾	56½	75½	113
12.5		19¾	39¼	59	78½	117¾
14		22	44	66	88	132
15	1¼	23½	47	70¾	94¼	141¼
16		25¼	50¼	75½	100½	150¾
17.5		27½	55	82½	110	165
18	1½	28¼	56½	84¾	113	169¾
20		31½	62¾	94¼	125¾	188½
21	1¾	33	66	99	132	198
24	2	37¾	75½	113	150¾	226¼
25		39¼	78½	117¾	157	235½
30	2½	47¼	94¼	141¼	188½	282¾
32		50¼	100½	150¾	201	301½
36	3	56½	113	169½	226¼	339¼
40		62¾	125¾	188½	251¼	377
48	4	75½	150¾	226¼	301½	452½
50		78½	157	235½	314¼	471¼
56		88	176	264	351¾	527¾
60	5	94¼	188½	282¾	377	565½
64		100½	201	301½	402	603¼
70		110	220	329¾	439¾	659¾
72	6	113	226¼	339¼	452½	678½
80		125¾	251¼	377	502¾	754
84	7	132	263¾	395¾	527¾	791½
90	7½	141¼	282¾	424	565½	848¼
96	8	150¾	301½	452½	603	904¾
100		157	314¼	471¼	628¼	942½
108	9	169½	339¼	509	678½	1017¾
120	10	188½	377	565½	754	1131
132	11	207¼	414¾	622	829½	1244
144	12	226¼	452½	678½	904¾	1357¼
156	13	245	490	735¼	980¼	1470¼
168	14	263¾	527¾	791½	1055½	1583½
180	15	282¾	565½	848¼	1131	1696½
192	16	301½	603	904¾	1206¼	1809½
204	17	320½	640¾	961¼	1281¾	1922½
216	18	339¼	678½	1017¾	1357¼	2035¾
228	19	358	716¼	1074½	1432½	2148¾
240	20	377	754	1131	1508	2262

To find the length of pipe in a bend having a radius not given above, add together the length of pipe in bends whose combined radii equal the required radius.

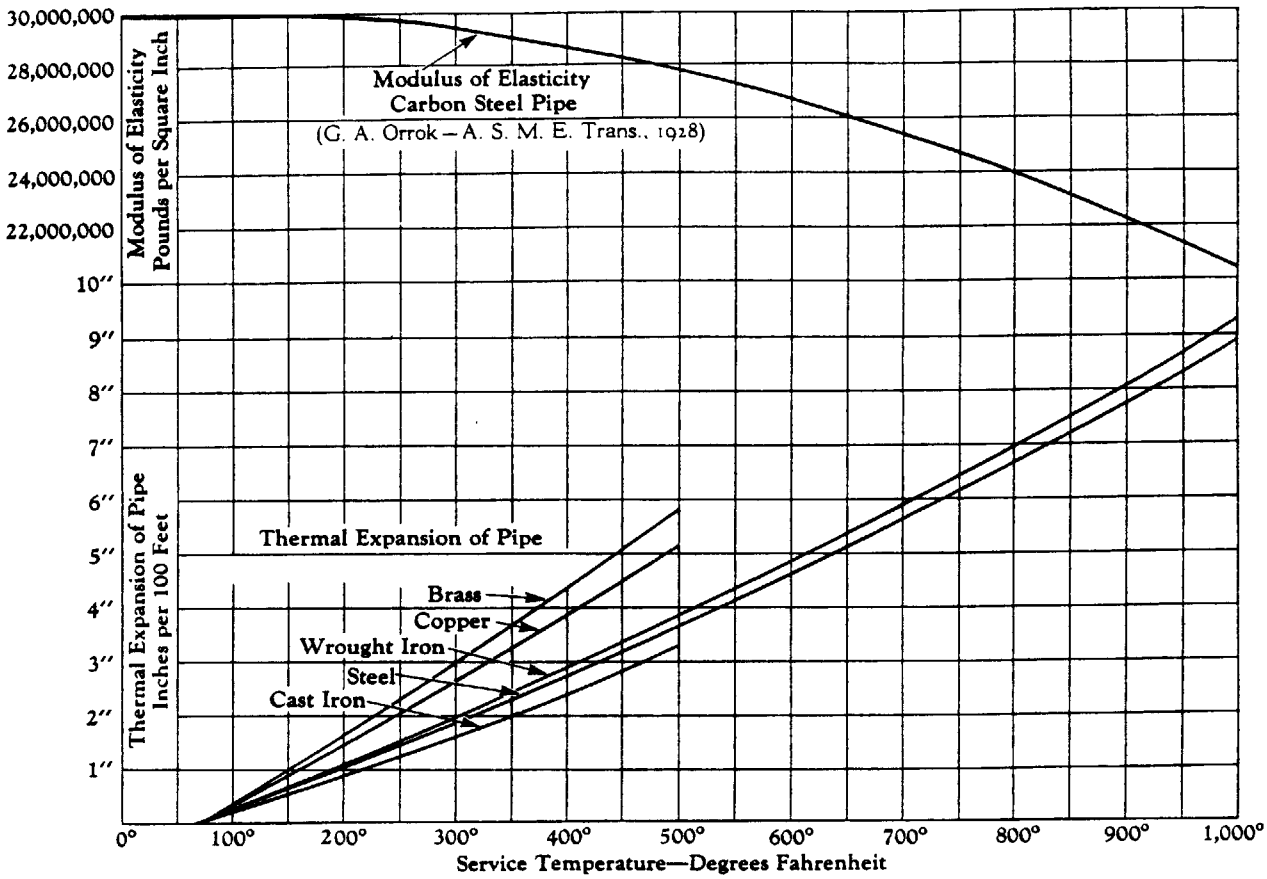
Example: **Find length of pipe in 90° bend of 5′ 9″ radius.**
Length of pipe in 90° bend of 5′ radius = 94¼″
Length of pipe in 90° bend of 9″ radius = 14¼″

Then, length of pipe in 90° bend of 5′ 9″ radius = 108½″

Standard Types of Pipe Bends . . . . pages 484 and 485

Minimum permissible radii of pipe bends . . . page 485

Thermal Expansion and Modulus of Elasticity of Pipe



References

Pipe . . . . . pages 457 to 463
American Standard for Pipe . . . . . pages 466 to 469
Commercial Wrought Steel Pipe Data . . . . . pages 470 and 471

Calculating Working Pressures, Stress, or Wall Thickness of Pipe . . . . . pages 525 to 527

Calculations of Pipe Bends . . . . . pages 528 and 529
Length of Pipe in Bends . . . . . page 530

Spacing of Pipe Supports

When a horizontal pipe line is supported at intermediate points, sagging of the pipe occurs between these supports, the amount of sag being dependent upon the weight of the pipe, fluid, insulation, and valves or fittings which may be included in the line. If the pipe line is installed with no downward pitch, pockets will be formed in each span in which case condensation may collect if the line is transporting steam. In order to eliminate these pockets, the line must be pitched downward so that the outlet of each span is lower than the maximum sag.

Crane has conducted tests to determine the deflection of horizontal standard pipe lines filled with water, in pipe sizes ¾" to 4" inclusive, the results of which have indicated that for pipes larger than 2" and with supports having center to center dimensions greater than 10 feet, the resultant deflection is less than that determined by the use of the formula for a uniformly loaded pipe fixed at both ends. For pipe sizes 2" and smaller, the test deflection was in excess of that determined by the formula for pipe having fixed ends and approached, for the shorter spans, the deflection as determined by the use of the formula for pipe lines having unrestrained ends.

Page 533 gives the deflection of horizontal standard pipe lines filled with water, for varying spans, based upon the results obtained from tests for sizes 2" and smaller, and upon the formula for fixed ends for the larger sizes of pipe. The deflection values given on the chart are twice those obtained from test or calculated, to compensate for any variables including weight of insulation, etc.

The formula given below indicates the vertical distance that the span must be pitched so that the outlet is lower than the maximum sag of the pipe.

$$h = \frac{144\,S^2\,y}{36\,S^2 - y^2}$$

where:

h = Difference in elevation of span ends, inches
S = Length of one span, feet
y = Deflection of one span, inches

By eliminating the unconsequential term "$-y^2$" from the denominator, the formula reduces to:

$$h = 4\,y$$

The pitch of pipe spans, called the Average Gradient, is a ratio between the drop in elevation and the length of the span. This is expressed as so many inches in a certain number of feet.

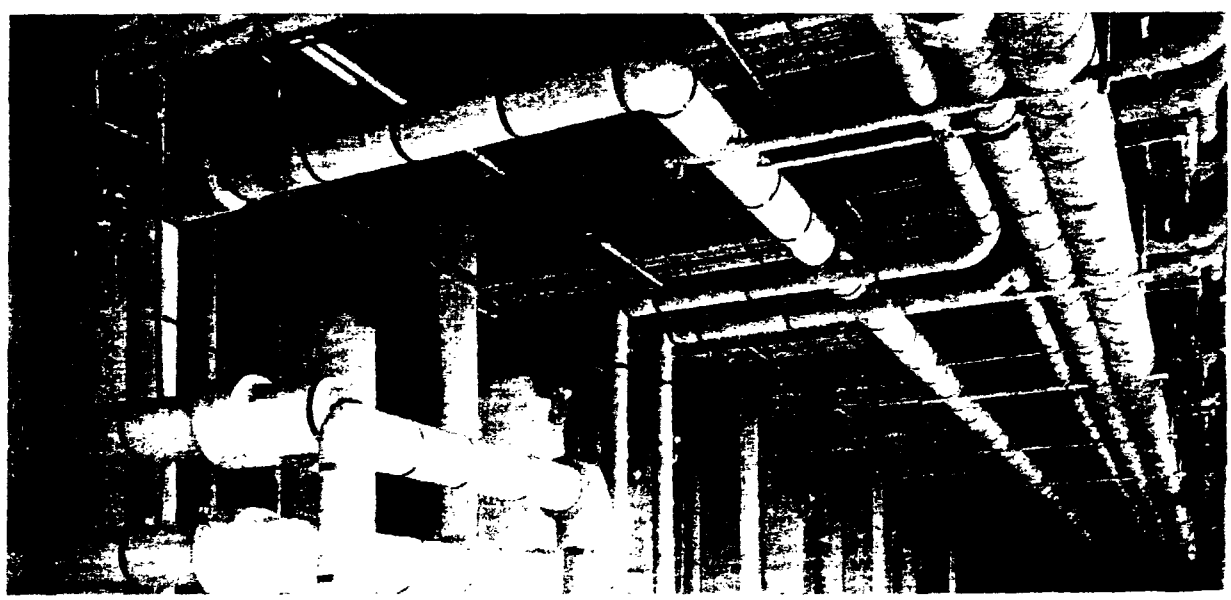
$$\text{Average Gradient} = \frac{4\,y}{S}$$

The dotted lines as shown on the chart on the opposite page are plotted from the above formula and indicate average gradients of 1" in 10', 1" in 15', 1" in 20', 1" in 30', and 1" in 40'.

EXAMPLE

What is the maximum distance between supports for a 4" Standard pipe line assuming a pitch or average gradient of 1" in 30 feet?

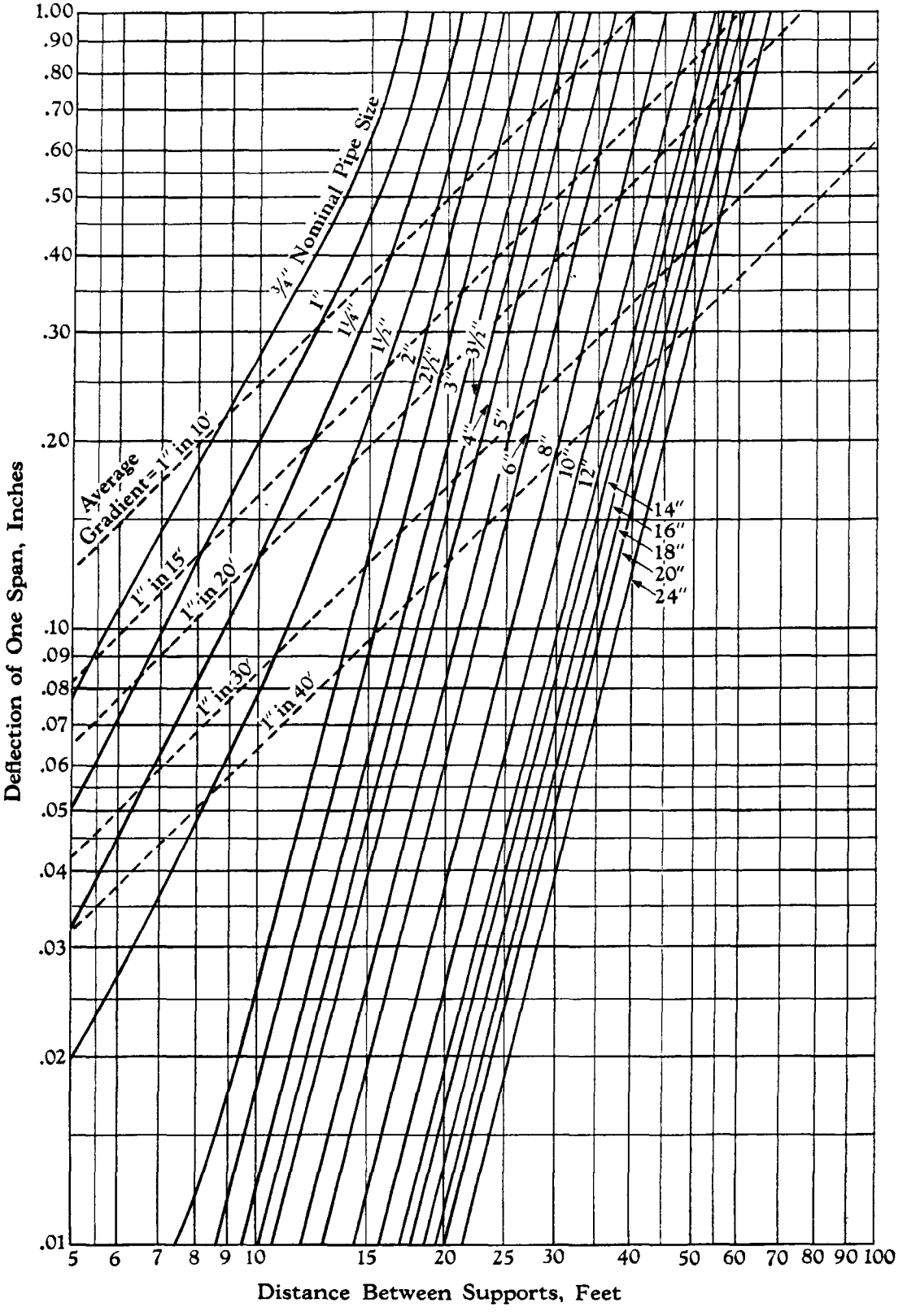
Proceed downward from the intersection of the diagonal dotted line for an average gradient of 1" in 30 feet and the diagonal solid line for 4" pipe to the bottom line where it is noted that the maximum span is approximately 22 feet.



Pipe Hangers and Pipe Supports. . . . pages 409 to 422

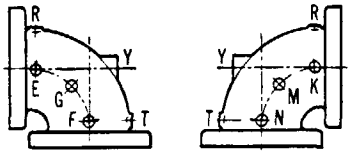
Deflection of Horizontal Pipe Lines

(Based on Standard Pipe Filled with Water)

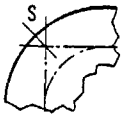


Taps and Drains for Flanged Fittings

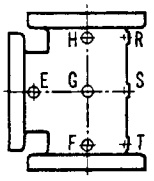
Designating Location of Tapped Holes



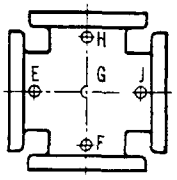
90° Elbow
Straight Size



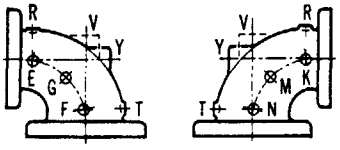
90° Elbow



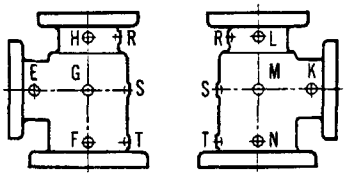
Tee
Straight Size



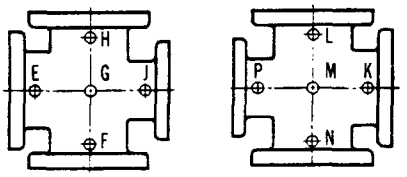
Cross
Straight Size



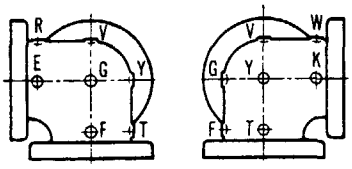
90° Elbow
Reducing Size



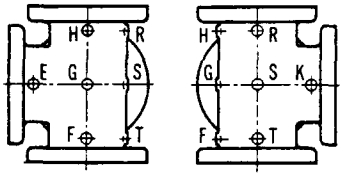
Tee
Reducing Size



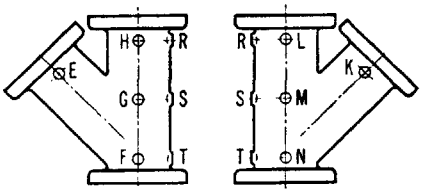
Cross
Reducing Size



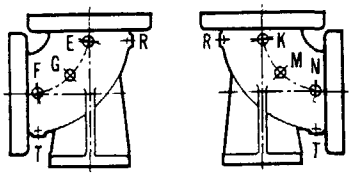
Side Outlet Elbow
Straight Size



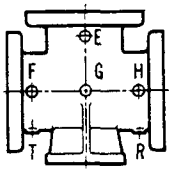
Side Outlet Tee
Straight Size



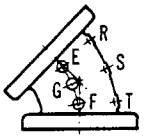
45° Lateral
Straight Size



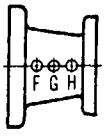
90° Base Elbow



Base Tee
Straight Size



45° Elbow



Reducer

The illustrations above indicate a standard method used for designating the location of tapped holes on ferrous flanged fittings in all pressure classes.

When a tapped connection is required at the heel of an elbow without a boss (at location S), the tapping should be done at right angles to the point of tangency of the radius or sweep of the fitting. This shall be standard practice, and where the tapping is required parallel to the run (at locations V and Y), the fitting shall be furnished with a boss.

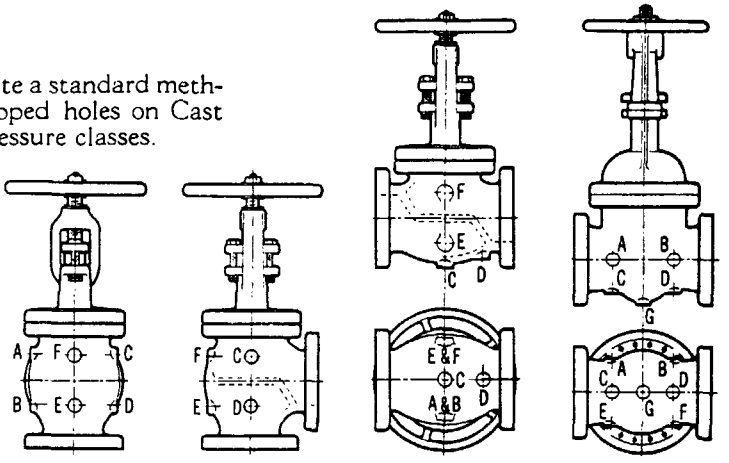
Taps and Drains for Flanged Valves

Designating Location of Tapped Holes

The illustrations at the right and below indicate a standard method used for designating the location of tapped holes on Cast Iron and Cast Steel Flanged Valves in all pressure classes.

Valve bodies can be tapped without a boss for a very small drain hole, the maximum size of hole, however, depends entirely upon the location of the tapped hole and the pressure class of the valve.

Gate valves are regularly made with bosses (except at location "G"); globe and angle valves are not, but they can be furnished with bosses when so specified.



Angle Valve Globe Valve Gate Valve

Location of By-Passes on Flanged Valves

Gate valves: When gate valves are ordered with by-pass attached, it shall be regular practice to attach said by-pass at the side of the main valve with the stems of both valves parallel, pointing vertically upward.

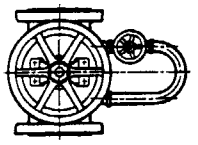
The more common of the "special" attached-locations is on the center of the flow line, at the bottom of the main valve, with the stem of the by-pass valve at right angles to the main valve stem. This is designated as the bottom "attachment", or defined as "by-pass at bottom". When any other "special" attached-location or other position of the by-pass valve stem is desired, a sketch should be submitted.

Globe valves: When globe valves are ordered with by-pass attached, it shall be regular practice to attach said by-pass at the right-hand side of the main valve, with the stems of both valves parallel, pointing vertically upward. When by-pass is "specially" required attached at the left-hand side, the designation shall be "left-hand attachment".

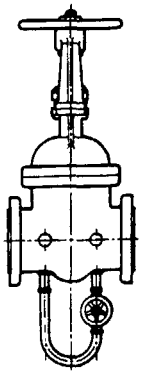
Right-hand side of a globe valve is the side at the right, when facing the flow-port which leads to the under side of the disc.

Angle valves: When angle valves are ordered with by-pass attached, it shall be regular practice to attach said by-pass at the back of the main valve, with the stems of both valves parallel, pointing vertically upward. When by-pass is "specially" required attached at the right or left-hand side, the designations shall be "right-hand attachment" or "left-hand attachment". Right-hand side of an angle valve is at the right, when facing the back of the valve.

These illustrations are representative of steel valves.



Gate Valve with By-Pass on Side



Gate Valve with By-Pass at Bottom

For by-passes, see the following pages:

Iron Wedge Gate Valves ..... ***page 84***
Iron Double Disc Gate Valves ..... ***page 101***
Steel Wedge Gate Valves ..... ***page 231***

Steam

There are three states of matter: solid, liquid, and gas. Under normal atmospheric conditions, substances exist in any one of these three states, and when the outside conditions are varied, they change from one state to another.

Water under average conditions exists in the form of a liquid. When a body of water is heated by means of some external medium, the temperature of the water rises, and soon small bubbles are noted on the surface which break and form continuously. This phenomenon is described as "boiling".

The amount of heat necessary to cause the temperature of the water to rise is expressed in British Thermal Units (B.t.u.), where one B.t.u. is the quantity of heat required to raise the temperature of 1 pound of water from 60 to 61° F. or, as is generally stated, 1/180 part of the heat necessary to raise the temperature of 1 pound of water from 32° F. (freezing point) to 212° F. (boiling point).

After the temperature of 212° F. is reached, each pound of water contains 180 B.t.u. (above 32° F.). This quantity of heat is called "*heat of the liquid*" or "*sensible heat*". In order to change the liquid into a vapor at atmospheric pressure (14.7 pounds per square inch absolute), 970.2 B.t.u. must be added to each pound of water after the temperature of 212° F. is reached. During this transition period the temperature remains constant. The added quantity of heat is called the "*latent heat of evaporation*". Consequently, the "*total heat*" of the vapor, formed when water boils at atmospheric pressure, is the sum of the two quantities 180 B.t.u. and 970.2 B.t.u., or 1150.2 B.t.u. per pound.

If water is heated in a closed vessel not completely filled, the pressure will rise after steam begins to form accompanied by an increase in temperature.

Saturated Steam: Saturated steam is steam in contact with the liquid water from which it was generated, at a temperature which is the boiling point of the water and the condensing point of the steam. It may be either "dry" or "wet", depending upon the generating conditions. "Dry" saturated steam is steam free from mechanically mixed water particles. "Wet" saturated steam, on the other hand, contains water particles in suspension. Saturated steam at any pressure has a definite temperature.

Superheated Steam: Superheated steam is steam at any given pressure which is heated to a temperature higher than the temperature of saturated steam at that pressure. Water cannot exist in the presence of superheated steam.

Steam Data ..... *page 537*
Properties of Saturated Steam ... *pages 538 to 541*
Properties of Superheated Steam ... *pages 542 to 545*
Temperature Conversion table ..... *page 551*

Steam Data

Boiler Horse Power

The accepted rule for figuring boiler horse power is as follows:

One Horse Power equals the evaporation of 30 pounds of water per hour from an initial temperature of 100° F. into steam at 70 pounds gauge pressure, or its equivalent; that is, 34½ pounds of water evaporated per hour from a temperature of 212° F. into steam at 212° F.

Horse Power of an Engine

P = Mean effective pressure per square inch of the steam on the piston.
L = Length of stroke in feet.
A = Area of piston in square inches.
N = Number of strokes per minute.

Then Horse Power $= \frac{PLAN}{33000}$

The approximate mean effective pressure in the cylinder when the valve cuts off at:

¼ stroke equals steam pressure × .597
⅓ stroke equals steam pressure × .670
⅜ stroke equals steam pressure × .743
½ stroke equals steam pressure × .847
⅝ stroke equals steam pressure × .919
⅔ stroke equals steam pressure × .937
¾ stroke equals steam pressure × .966
⅞ stroke equals steam pressure × .992

Ranges in Steam Consumption by Prime Movers

(*For Estimating Purposes*)

Simple Non-Condensing Engines	29 — 45 pounds per H. P. hour
Simple Non-Condensing Automatic Engines	26 — 40 pounds per H. P. hour
Simple Non-Condensing Corliss Engines	26 — 35 pounds per H. P. hour
Compound Non-Condensing Engines	19 — 28 pounds per H. P. hour
Compound Condensing Engines	12 — 22 pounds per H. P. hour
Simple Duplex Steam Pumps	120 — 200 pounds per H. P. hour
Turbines, Non-Condensing	21 — 45 pounds per H. P. hour
Turbines, Condensing	9 — 32 pounds per H. P. hour

Flow of Steam in Pipes

To determine the velocity of steam in feet per minute through a pipe, the quantity, pressure and area being known.

V = Velocity in feet per minute.
A = Pounds of steam per hour.
B = Volume in cubic feet per lb. at given pressure. (See steam tables, pages 538 to 545.)
C = Area of pipe in square inches.
1728 = Cubic inches in a cubic foot.
60 = Minutes in an hour.
12 = Inches in a foot.

Then $V = \frac{A \times B \times 1728}{60 \times C \times 12} = \frac{A \times B \times 2.4}{C}$

$A = \frac{C \times V}{B \times 2.4}$

$B = \frac{C \times V}{A \times 2.4}$

$C = \frac{A \times B \times 2.4}{V}$

Loss of Pressure

The above formula does not consider the probable drop, or loss of pressure which is dependent upon the velocity of flow, length of line, number of turns in fittings or valves, and the covering of the pipe. In every steam line there must be a difference in pressure between the inlet and outlet or there could be no flow, and this difference is increased by friction and radiation.

Reasonable Velocities for Flow of Steam in Pipes

The table below giving reasonable velocities, based on average practice, can be used to advantage in steam lines. It must be realized that the lower velocities should be used for smaller pipes and the higher velocities for pipes larger than 12 inches.

Condition of Steam	Pressure Pounds per Square Inch	Use	Reasonable Velocity Feet per Minute
Saturated	0 pounds — 15 pounds	Heating (Short lines)	4,000 to 6,000
Saturated	50 pounds and up	Miscellaneous	6,000 to 10,000
Superheated	200 pounds and up	High Pressure Steam Piping	7,000 to 20,000

Properties of Saturated Steam[1]

Absolute Pressure		Vacuum Inches of Hg	Temperature	Heat of the Liquid	Latent Heat of Evaporation	Total Heat of Steam	Specific Volume	Entropy
Lbs. per Sq. In.	Inches of Hg		Degrees F.	Btu/lb.	Btu/lb.	Btu/lb.	Cu. ft. per lb.	
P			t	h_f	h_{fg}	h_g	v_g	s_g
0.20	0.41	29.51	53.14	21.21	1063.8	1085.0	1526.0	2.1163
0.25	0.51	29.41	59.30	27.36	1060.3	1087.7	1235.3	2.0970
0.30	0.61	29.31	64.47	32.52	1057.4	1090.0	1039.5	2.0812
0.35	0.71	29.21	68.93	36.97	1054.9	1091.9	898.5	2.0678
0.40	0.81	29.11	72.86	40.89	1052.7	1093.6	791.9	2.0563
0.45	0.92	29.00	76.38	44.41	1050.7	1095.1	708.5	2.0462
0.50	1.02	28.90	79.58	47.60	1048.8	1096.4	641.4	2.0372
0.60	1.22	28.70	85.21	53.21	1045.7	1098.9	540.0	2.0216
0.70	1.43	28.49	90.08	58.07	1042.9	1101.0	466.9	2.0085
0.80	1.63	28.29	94.38	62.36	1040.4	1102.8	411.7	1.9971
0.90	1.83	28.09	98.24	66.21	1038.3	1104.5	368.4	1.9871
1.0	2.04	27.88	101.74	69.70	1036.3	1106.0	333.6	1.9782
1.2	2.44	27.48	107.92	75.87	1032.7	1108.6	280.9	1.9628
1.4	2.85	27.07	113.26	81.20	1029.6	1110.8	243.0	1.9498
1.6	3.26	26.66	117.99	85.91	1026.9	1112.8	214.3	1.9386
1.8	3.66	26.26	122.23	90.14	1024.5	1114.6	191.8	1.9288
2.0	4.07	25.85	126.08	93.99	1022.2	1116.2	173.73	1.9200
2.2	4.48	25.44	129.62	97.52	1020.2	1117.7	158.85	1.9120
2.4	4.89	25.03	132.89	100.79	1018.3	1119.1	146.38	1.9047
2.6	5.29	24.63	135.94	103.83	1016.5	1120.3	135.78	1.8981
2.8	5.70	24.22	138.79	106.68	1014.8	1121.5	126.65	1.8920
3.0	6.11	23.81	141.48	109.37	1013.2	1122.6	118.71	1.8863
3.5	7.13	22.79	147.57	115.46	1009.6	1125.1	102.72	1.8735
4.0	8.14	21.78	152.97	120.86	1006.4	1127.3	90.63	1.8625
4.5	9.16	20.76	157.83	125.71	1003.6	1129.3	81.16	1.8528
5.0	10.18	19.74	162.24	130.13	1001.0	1131.1	73.52	1.8441
5.5	11.20	18.72	166.30	134.19	998.5	1132.7	67.24	1.8363
6.0	12.22	17.70	170.06	137.96	996.2	1134.2	61.98	1.8292
6.5	13.23	16.69	173.56	141.47	994.1	1135.6	57.50	1.8227
7.0	14.25	15.67	176.85	144.76	992.1	1136.9	53.64	1.8167
7.5	15.27	14.65	179.94	147.86	990.2	1138.1	50.29	1.8110
8.0	16.29	13.63	182.86	150.79	988.5	1139.3	47.34	1.8057
8.5	17.31	12.61	185.64	153.57	986.8	1140.4	44.73	1.8008
9.0	18.32	11.60	188.28	156.22	985.2	1141.4	42.40	1.7962
9.5	19.34	10.58	190.80	158.75	983.6	1142.3	40.31	1.7918
10.0	20.36	9.56	193.21	161.17	982.1	1143.3	38.42	1.7876
11.0	22.40	7.52	197.75	165.73	979.3	1145.0	35.14	1.7800
12.0	24.43	5.49	201.96	169.96	976.6	1146.6	32.40	1.7730
13.0	26.47	3.45	205.88	173.91	974.2	1148.1	30.06	1.7665
14.0	28.50	1.42	209.56	177.61	971.9	1149.5	28.04	1.7605

Pressure Lbs. per Sq. In.		Temperature	Heat of the Liquid	Latent Heat of Evaporation	Total Heat of Steam	Specific Volume	Entropy
Absolute	Gage	Degrees F.	Btu/lb.	Btu/lb.	Btu/lb.	Cu. ft. per lb.	
P	p	t	h_f	h_{fg}	h_g	v_g	s_g
14.696	0.0	212.00	180.07	970.3	1150.4	26.80	1.7566
15.0	0.3	213.03	181.11	969.7	1150.8	26.29	1.7549
16.0	1.3	216.32	184.42	967.6	1152.0	24.75	1.7497
17.0	2.3	219.44	187.56	965.5	1153.1	23.39	1.7449
18.0	3.3	222.41	190.56	963.6	1154.2	22.17	1.7403
19.0	4.3	225.24	193.42	961.9	1155.3	21.08	1.7360
20.0	5.3	227.96	196.16	960.1	1156.3	20.089	1.7319
21.0	6.3	230.57	198.79	958.4	1157.2	19.192	1.7280
22.0	7.3	233.07	201.33	956.8	1158.1	18.375	1.7242
23.0	8.3	235.49	203.78	955.2	1159.0	17.627	1.7206
24.0	9.3	237.82	206.14	953.7	1159.8	16.938	1.7172
25.0	10.3	240.07	208.42	952.1	1160.6	16.303	1.7139
26.0	11.3	242.25	210.62	950.7	1161.3	15.715	1.7108
27.0	12.3	244.36	212.75	949.3	1162.0	15.170	1.7078
28.0	13.3	246.41	214.83	947.9	1162.7	14.663	1.7048
29.0	14.3	248.40	216.86	946.5	1163.4	14.189	1.7020
30.0	15.3	250.33	218.82	945.3	1164.1	13.746	1.6993
31.0	16.3	252.22	220.73	944.0	1164.7	13.330	1.6967
32.0	17.3	254.05	222.59	942.8	1165.4	12.940	1.6941
33.0	18.3	255.84	224.41	941.6	1166.0	12.572	1.6917
34.0	19.3	257.58	226.18	940.3	1166.5	12.226	1.6893

[1] Abstracted from Thermodynamic Properties of Steam by J. H. Keenan and F. G. Keyes, 1936 Edition, by permission of the publishers, John Wiley & Sons, Inc.

Pressure Lbs. per Sq. In. Absolute P	Pressure Lbs. per Sq. In. Gage p	Temperature Degrees F. t	Heat of the Liquid Btu/lb. h_f	Latent Heat of Evaporation Btu/lb. h_{fg}	Total Heat of Steam Btu/lb. h_g	Specific Volume Cu. ft. per lb. v_g	Entropy s_g
35.0	20.3	259.28	227.91	939.2	1167.1	11.898	1.6870
36.0	21.3	260.95	229.60	938.0	1167.6	11.588	1.6848
37.0	22.3	262.57	231.26	936.9	1168.2	11.294	1.6826
38.0	23.3	264.16	232.89	935.8	1168.7	11.015	1.6805
39.0	24.3	265.72	234.48	934.7	1169.2	10.750	1.6784
40.0	25.3	267.25	236.03	933.7	1169.7	10.498	1.6763
41.0	26.3	268.74	237.55	932.6	1170.2	10.258	1.6743
42.0	27.3	270.21	239.04	931.6	1170.7	10.029	1.6724
43.0	28.3	271.64	240.51	930.6	1171.1	9.810	1.6706
44.0	29.3	273.05	241.95	929.6	1171.6	9.601	1.6687
45.0	30.3	274.44	243.36	928.6	1172.0	9.401	1.6669
46.0	31.3	275.80	244.75	927.7	1172.4	9.209	1.6652
47.0	32.3	277.13	246.12	926.7	1172.9	9.025	1.6634
48.0	33.3	278.45	247.47	925.8	1173.3	8.848	1.6617
49.0	34.3	279.74	248.79	924.9	1173.7	8.678	1.6601
50.0	35.3	281.01	250.09	924.0	1174.1	8.515	1.6585
51.0	36.3	282.26	251.37	923.0	1174.4	8.359	1.6569
52.0	37.3	283.49	252.63	922.2	1174.8	8.208	1.6553
53.0	38.3	284.70	253.87	921.3	1175.2	8.062	1.6538
54.0	39.3	285.90	255.09	920.5	1175.6	7.922	1.6523
55.0	40.3	287.07	256.30	919.6	1175.9	7.787	1.6509
56.0	41.3	288.23	257.50	918.8	1176.3	7.656	1.6494
57.0	42.3	289.37	258.67	917.9	1176.6	7.529	1.6480
58.0	43.3	290.50	259.82	917.1	1176.9	7.407	1.6466
59.0	44.3	291.61	260.96	916.3	1177.3	7.289	1.6452
60.0	45.3	292.71	262.09	915.5	1177.6	7.175	1.6438
61.0	46.3	293.79	263.20	914.7	1177.9	7.064	1.6425
62.0	47.3	294.85	264.30	913.9	1178.2	6.957	1.6412
63.0	48.3	295.90	265.38	913.1	1178.5	6.853	1.6399
64.0	49.3	296.94	266.45	912.3	1178.8	6.752	1.6387
65.0	50.3	297.97	267.50	911.6	1179.1	6.655	1.6374
66.0	51.3	298.99	268.55	910.8	1179.4	6.560	1.6362
67.0	52.3	299.99	269.58	910.1	1179.7	6.468	1.6350
68.0	53.3	300.98	270.60	909.4	1180.0	6.378	1.6338
69.0	54.3	301.96	271.61	908.7	1180.3	6.291	1.6326
70.0	55.3	302.92	272.61	907.9	1180.6	6.206	1.6315
71.0	56.3	303.88	273.60	907.2	1180.8	6.124	1.6303
72.0	57.3	304.83	274.57	906.5	1181.1	6.044	1.6292
73.0	58.3	305.76	275.54	905.8	1181.3	5.966	1.6281
74.0	59.3	306.68	276.49	905.1	1181.6	5.890	1.6270
75.0	60.3	307.60	277.43	904.5	1181.9	5.816	1.6259
76.0	61.3	308.50	278.37	903.7	1182.1	5.743	1.6248
77.0	62.3	309.40	279.30	903.1	1182.4	5.673	1.6238
78.0	63.3	310.29	280.21	902.4	1182.6	5.604	1.6228
79.0	64.3	311.16	281.12	901.7	1182.8	5.537	1.6217
80.0	65.3	312.03	282.02	901.1	1183.1	5.472	1.6207
81.0	66.3	312.89	282.91	900.4	1183.3	5.408	1.6197
82.0	67.3	313.74	283.79	899.7	1183.5	5.346	1.6187
83.0	68.3	314.59	284.66	899.1	1183.8	5.285	1.6177
84.0	69.3	315.42	285.53	898.5	1184.0	5.226	1.6168
85.0	70.3	316.25	286.39	897.8	1184.2	5.168	1.6158
86.0	71.3	317.07	287.24	897.2	1184.4	5.111	1.6149
87.0	72.3	317.88	288.08	896.5	1184.6	5.055	1.6139
88.0	73.3	318.68	288.91	895.9	1184.8	5.001	1.6130
89.0	74.3	319.48	289.74	895.3	1185.1	4.948	1.6121
90.0	75.3	320.27	290.56	894.7	1185.3	4.896	1.6112
91.0	76.3	321.06	291.38	894.1	1185.5	4.845	1.6103
92.0	77.3	321.83	292.18	893.5	1185.7	4.796	1.6094
93.0	78.3	322.60	292.98	892.9	1185.9	4.747	1.6085
94.0	79.3	323.36	293.78	892.3	1186.1	4.699	1.6076
95.0	80.3	324.12	294.56	891.7	1186.2	4.652	1.6068
96.0	81.3	324.87	295.34	891.1	1186.4	4.606	1.6060
97.0	82.3	325.61	296.12	890.5	1186.6	4.561	1.6051
98.0	83.3	326.35	296.89	889.9	1186.8	4.517	1.6043
99.0	84.3	327.08	297.65	889.4	1187.0	4.474	1.6035
100.0	85.3	327.81	298.40	888.8	1187.2	4.432	1.6026
101.0	86.3	328.53	299.15	888.2	1187.4	4.391	1.6018
102.0	87.3	329.25	299.90	887.6	1187.5	4.350	1.6010
103.0	88.3	329.96	300.64	887.1	1187.7	4.310	1.6002
104.0	89.3	330.66	301.37	886.5	1187.9	4.271	1.5994
105.0	90.3	331.36	302.10	886.0	1188.1	4.232	1.5986
106.0	91.3	332.05	302.82	885.4	1188.2	4.194	1.5978
107.0	92.3	332.74	303.54	884.9	1188.4	4.157	1.5971
108.0	93.3	333.42	304.26	884.3	1188.6	4.120	1.5963
109.0	94.3	334.10	304.97	883.7	1188.7	4.084	1.5956

Pressure Lbs. per Sq. In. Absolute P	Pressure Lbs. per Sq. In. Gage p	Temperature Degrees F. t	Heat of the Liquid Btu/lb. h_f	Latent Heat of Evaporation Btu/lb. h_{fg}	Total Heat of Steam Btu/lb. h_g	Specific Volume Cu. ft. per lb. v_g	Entropy s_g
110.0	95.3	334.77	305.66	883.2	1188.9	4.049	1.5948
111.0	96.3	335.44	306.37	882.6	1189.0	4.015	1.5941
112.0	97.3	336.11	307.06	882.1	1189.2	3.981	1.5934
113.0	98.3	336.77	307.75	881.6	1189.4	3.947	1.5927
114.0	99.3	337.42	308.43	881.1	1189.5	3.914	1.5919
115.0	100.3	338.07	309.11	880.6	1189.7	3.882	1.5912
116.0	101.3	338.72	309.79	880.0	1189.8	3.850	1.5905
117.0	102.3	339.36	310.46	879.5	1190.0	3.819	1.5898
118.0	103.3	339.99	311.12	879.0	1190.1	3.788	1.5891
119.0	104.3	340.62	311.78	878.4	1190.2	3.758	1.5885
120.0	105.3	341.25	312.44	877.9	1190.4	3.728	1.5878
121.0	106.3	341.88	313.10	877.4	1190.5	3.699	1.5871
122.0	107.3	342.50	313.75	876.9	1190.7	3.670	1.5865
123.0	108.3	343.11	314.40	876.4	1190.8	3.642	1.5858
124.0	109.3	343.72	315.04	875.9	1190.9	3.614	1.5851
125.0	110.3	344.33	315.68	875.4	1191.1	3.587	1.5844
126.0	111.3	344.94	316.31	874.9	1191.2	3.560	1.5838
127.0	112.3	345.54	316.94	874.4	1191.3	3.533	1.5831
128.0	113.3	346.13	317.57	873.9	1191.5	3.507	1.5825
129.0	114.3	346.73	318.19	873.4	1191.6	3.481	1.5819
130.0	115.3	347.32	318.81	872.9	1191.7	3.455	1.5812
131.0	116.3	347.90	319.43	872.5	1191.9	3.430	1.5806
132.0	117.3	348.48	320.04	872.0	1192.0	3.405	1.5800
133.0	118.3	349.06	320.65	871.5	1192.1	3.381	1.5793
134.0	119.3	349.64	321.25	871.0	1192.2	3.357	1.5787
135.0	120.3	350.21	321.85	870.6	1192.4	3.333	1.5781
136.0	121.3	350.78	322.45	870.1	1192.5	3.310	1.5775
137.0	122.3	351.35	323.05	869.6	1192.6	3.287	1.5769
138.0	123.3	351.91	323.64	869.1	1192.7	3.264	1.5763
139.0	124.3	352.47	324.23	868.7	1192.9	3.242	1.5757
140.0	125.3	353.02	324.82	868.2	1193.0	3.220	1.5751
141.0	126.3	353.57	325.40	867.7	1193.1	3.198	1.5745
142.0	127.3	354.12	325.98	867.2	1193.2	3.177	1.5740
143.0	128.3	354.67	326.56	866.7	1193.3	3.155	1.5734
144.0	129.3	355.21	327.13	866.3	1193.4	3.134	1.5728
145.0	130.3	355.76	327.70	865.8	1193.5	3.114	1.5722
146.0	131.3	356.29	328.27	865.3	1193.6	3.094	1.5716
147.0	132.3	356.83	328.83	864.9	1193.8	3.074	1.5710
148.0	133.3	357.36	329.39	864.5	1193.9	3.054	1.5705
149.0	134.3	357.89	329.95	864.0	1194.0	3.034	1.5699
150.0	135.3	358.42	330.51	863.6	1194.1	3.015	1.5694
152.0	137.3	359.46	331.61	862.7	1194.3	2.977	1.5683
154.0	139.3	360.49	332.70	861.8	1194.5	2.940	1.5672
156.0	141.3	361.52	333.79	860.9	1194.7	2.904	1.5661
158.0	143.3	362.53	334.86	860.0	1194.9	2.869	1.5650
160.0	145.3	363.53	335.93	859.2	1195.1	2.834	1.5640
162.0	147.3	364.53	336.98	858.3	1195.3	2.801	1.5630
164.0	149.3	365.51	338.02	857.5	1195.5	2.768	1.5620
166.0	151.3	366.48	339.05	856.6	1195.7	2.736	1.5610
168.0	153.3	367.45	340.07	855.7	1195.8	2.705	1.5600
170.0	155.3	368.41	341.09	854.9	1196.0	2.675	1.5590
172.0	157.3	369.35	342.10	854.1	1196.2	2.645	1.5580
174.0	159.3	370.29	343.10	853.3	1196.4	2.616	1.5570
176.0	161.3	371.22	344.09	852.4	1196.5	2.587	1.5561
178.0	163.3	372.14	345.06	851.6	1196.7	2.559	1.5551
180.0	165.3	373.06	346.03	850.8	1196.9	2.532	1.5542
182.0	167.3	373.96	347.00	850.0	1197.0	2.505	1.5532
184.0	169.3	374.86	347.96	849.2	1197.2	2.479	1.5523
186.0	171.3	375.75	348.92	848.4	1197.3	2.454	1.5514
188.0	173.3	376.64	349.86	847.6	1197.5	2.429	1.5506
190.0	175.3	377.51	350.79	846.8	1197.6	2.404	1.5497
192.0	177.3	378.38	351.72	846.1	1197.8	2.380	1.5488
194.0	179.3	379.24	352.64	845.3	1197.9	2.356	1.5479
196.0	181.3	380.10	353.55	844.5	1198.1	2.333	1.5470
198.0	183.3	380.95	354.46	843.7	1198.2	2.310	1.5462
200.0	185.3	381.79	355.36	843.0	1198.4	2.288	1.5453
205.0	190.3	383.86	357.58	841.1	1198.7	2.234	1.5432
210.0	195.3	385.90	359.77	839.2	1199.0	2.183	1.5412
215.0	200.3	387.89	361.91	837.4	1199.3	2.134	1.5392
220.0	205.3	389.86	364.02	835.6	1199.6	2.087	1.5372
225.0	210.3	391.79	366.09	833.8	1199.9	2.0422	1.5353
230.0	215.3	393.68	368.13	832.0	1200.1	1.9992	1.5334
235.0	220.3	395.54	370.14	830.3	1200.4	1.9579	1.5316
240.0	225.3	397.37	372.12	828.5	1200.6	1.9183	1.5298
245.0	230.3	399.18	374.08	826.8	1200.9	1.8803	1.5280

Pressure Lbs. per Sq. In. Absolute P	Pressure Lbs. per Sq. In. Gage p	Temperature Degrees F. t	Heat of the Liquid Btu/lb. h_f	Latent Heat of Evaporation Btu/lb. h_{fg}	Total Heat of Steam Btu/lb. h_g	Specific Volume Cu. ft. per lb. v_g	Entropy s_g
250.0	235.3	400.95	376.00	825.1	1201.1	1.8438	1.5263
255.0	240.3	402.70	377.89	823.4	1201.3	1.8086	1.5246
260.0	245.3	404.42	379.76	821.8	1201.5	1.7748	1.5229
265.0	250.3	406.11	381.60	820.1	1201.7	1.7422	1.5212
270.0	255.3	407.78	383.42	818.5	1201.9	1.7107	1.5196
275.0	260.3	409.43	385.21	816.9	1202.1	1.6804	1.5180
280.0	265.3	411.05	386.98	815.3	1202.3	1.6511	1.5164
285.0	270.3	412.65	388.73	813.7	1202.4	1.6228	1.5149
290.0	275.3	414.23	390.46	812.1	1202.6	1.5954	1.5133
295.0	280.3	415.79	392.16	810.5	1202.7	1.5689	1.5118
300.0	285.3	417.33	393.84	809.0	1202.8	1.5433	1.5104
320.0	305.3	423.29	400.39	803.0	1203.4	1.4485	1.5046
340.0	325.3	428.97	406.66	797.1	1203.7	1.3645	1.4992
360.0	345.3	434.40	412.67	791.4	1204.1	1.2895	1.4941
380.0	365.3	439.60	418.45	785.8	1204.3	1.2222	1.4891
400.0	385.3	444.59	424.0	780.5	1204.5	1.1613	1.4844
420.0	405.3	449.39	429.4	775.2	1204.6	1.1061	1.4799
440.0	425.3	454.02	434.6	770.0	1204.6	1.0556	1.4755
460.0	445.3	458.50	439.7	764.9	1204.6	1.0094	1.4713
480.0	465.3	462.82	444.6	759.9	1204.5	0.9670	1.4673
500.0	485.3	467.01	449.4	755.0	1204.4	0.9278	1.4634
520.0	505.3	471.07	454.1	750.1	1204.2	0.8915	1.4596
540.0	525.3	475.01	458.6	745.4	1204.0	0.8578	1.4560
560.0	545.3	478.85	463.0	740.8	1203.8	0.8265	1.4524
580.0	565.3	482.58	467.4	736.1	1203.5	0.7973	1.4489
600.0	585.3	486.21	471.6	731.6	1203.2	0.7698	1.4454
620.0	605.3	489.75	475.7	727.2	1202.9	0.7440	1.4421
640.0	625.3	493.21	479.8	722.7	1202.5	0.7198	1.4389
660.0	645.3	496.58	483.8	718.3	1202.1	0.6971	1.4358
680.0	665.3	499.88	487.7	714.0	1201.7	0.6757	1.4327
700.0	685.3	503.10	491.5	709.7	1201.2	0.6554	1.4296
720.0	705.3	506.25	495.3	705.4	1200.7	0.6362	1.4266
740.0	725.3	509.34	499.0	701.2	1200.2	0.6180	1.4237
760.0	745.3	512.36	502.6	697.1	1199.7	0.6007	1.4209
780.0	765.3	515.33	506.2	692.9	1199.1	0.5843	1.4181
800.0	785.3	518.23	509.7	688.9	1198.6	0.5687	1.4153
820.0	805.3	521.08	513.2	684.8	1198.0	0.5538	1.4126
840.0	825.3	523.88	516.6	680.8	1197.4	0.5396	1.4099
860.0	845.3	526.63	520.0	676.8	1196.8	0.5260	1.4072
880.0	865.3	529.33	523.3	672.8	1196.1	0.5130	1.4046
900.0	885.3	531.98	526.6	668.8	1195.4	0.5006	1.4020
920.0	905.3	534.59	529.8	664.9	1194.7	0.4886	1.3995
940.0	925.3	537.16	533.0	661.0	1194.0	0.4772	1.3970
960.0	945.3	539.68	536.2	657.1	1193.3	0.4663	1.3945
980.0	965.3	542.17	539.3	653.3	1192.6	0.4557	1.3921
1000.0	985.3	544.61	542.4	649.4	1191.8	0.4456	1.3897
1050.0	1035.3	550.57	550.0	639.9	1189.9	0.4218	1.3838
1100.0	1085.3	556.31	557.4	630.4	1187.8	0.4001	1.3780
1150.0	1135.3	561.86	564.6	621.0	1185.6	0.3802	1.3723
1200.0	1185.3	567.22	571.7	611.7	1183.4	0.3619	1.3667
1250.0	1235.3	572.42	578.6	602.4	1181.0	0.3450	1.3612
1300.0	1285.3	577.46	585.4	593.2	1178.6	0.3293	1.3559
1350.0	1335.3	582.35	592.1	584.0	1176.1	0.3148	1.3506
1400.0	1385.3	587.10	598.7	574.7	1173.4	0.3012	1.3454
1450.0	1435.3	591.73	605.2	565.5	1170.7	0.2884	1.3402
1500.0	1485.3	596.23	611.6	556.3	1167.9	0.2765	1.3351
1600.0	1585.3	604.90	624.1	538.0	1162.1	0.2548	1.3249
1700.0	1685.3	613.15	636.3	519.6	1155.9	0.2354	1.3149
1800.0	1785.3	621.03	648.3	501.1	1149.4	0.2179	1.3049
1900.0	1885.3	628.58	660.1	482.4	1142.4	0.2021	1.2949
2000.0	1985.3	635.82	671.7	463.4	1135.1	0.1878	1.2849
2100.0	2085.3	642.77	683.3	444.1	1127.4	0.1746	1.2748
2200.0	2185.3	649.46	694.8	424.4	1119.2	0.1625	1.2646
2300.0	2285.3	655.91	706.5	403.9	1110.4	0.1513	1.2541
2400.0	2385.3	662.12	718.4	382.7	1101.1	0.1407	1.2434
2500.0	2485.3	668.13	730.6	360.5	1091.1	0.1307	1.2322
2600.0	2585.3	673.94	743.0	337.2	1080.2	0.1213	1.2205
2700.0	2685.3	679.55	756.2	312.1	1068.3	0.1123	1.2082
2800.0	2785.3	684.99	770.1	284.7	1054.8	0.1035	1.1946
2900.0	2885.3	690.26	785.4	253.6	1039.0	0.0947	1.1792
3000.0	2985.3	695.36	802.5	217.8	1020.3	0.0858	1.1615
3100.0	3085.3	700.31	825.0	168.1	993.1	0.0753	1.1368
3200.0	3185.3	705.11	872.4	62.0	934.4	0.0580	1.0852
3206.2	3191.5	705.40	902.7	0.0	902.7	0.0503	1.0580

Properties of Superheated Steam[1]

v = specific volume, cubic feet per pound
h = total heat of steam, Btu per pound
s = entropy

Pressure Lbs. per Sq. In. Abs. P	Pressure Lbs. per Sq. In. Gage p	Sat. Temp. t		Total Temperature — Degrees Fahrenheit 360°	400°	440°	480°	500°	600°	700°	800°	900°	1000°	1200°
			v	33.03	34.68	36.32	37.96	38.78	42.86	46.94	51.00	55.07	59.13	67.25
14.696	0.0	212.00	h	1221.1	1239.9	1258.8	1277.6	1287.1	1334.8	1383.2	1432.3	1482.3	1533.1	1637.5
			s	1.8518	1.8743	1.8956	1.9162	1.9261	1.9734	2.0170	2.0576	2.0958	2.1319	2.1989
			v	24.21	25.43	26.65	27.86	28.46	31.47	34.47	37.46	40.45	43.44	49.41
20.0	5.3	227.96	h	1220.3	1239.2	1258.2	1277.1	1286.6	1334.4	1382.9	1432.1	1482.1	1533.0	1637.4
			s	1.8170	1.8396	1.8612	1.8818	1.8918	1.9392	1.9829	2.0235	2.0618	2.0978	2.1648
			v	16.072	16.897	17.714	18.528	18.933	20.95	22.96	24.96	26.95	28.95	32.93
30.0	15.3	250.33	h	1218.6	1237.9	1257.0	1276.2	1285.7	1333.8	1382.4	1431.7	1481.8	1532.7	1637.2
			s	1.7708	1.7937	1.8155	1.8363	1.8464	1.8940	1.9379	1.9786	2.0169	2.0530	2.1201
			v	12.001	12.628	13.247	13.862	14.168	15.688	17.198	18.702	20.20	21.70	24.69
40.0	25.3	267.25	h	1216.9	1236.5	1255.9	1275.2	1284.8	1333.1	1381.9	1431.3	1481.4	1532.4	1637.0
			s	1.7375	1.7608	1.7828	1.8038	1.8140	1.8619	1.9058	1.9467	1.9850	2.0212	2.0883
			v	9.557	10.065	10.567	11.062	11.309	12.532	13.744	14.950	16.152	17.352	19.747
50.0	35.3	281.01	h	1215.2	1235.1	1254.7	1274.2	1283.9	1332.5	1381.4	1430.9	1481.1	1532.1	1636.8
			s	1.7112	1.7349	1.7572	1.7784	1.7887	1.8368	1.8809	1.9219	1.9602	1.9964	2.0636
			v	7.927	8.357	8.779	9.196	9.403	10.427	11.441	12.449	13.452	14.454	16.451
60.0	45.3	292.71	h	1213.4	1233.6	1253.5	1273.2	1283.0	1331.8	1380.9	1430.5	1480.8	1531.9	1636.6
			s	1.6894	1.7135	1.7361	1.7575	1.7678	1.8162	1.8605	1.9015	1.9400	1.9762	2.0434
			v	6.762	7.136	7.502	7.863	8.041	8.924	9.796	10.662	11.524	12.383	14.097
70.0	55.3	302.92	h	1211.5	1232.1	1252.3	1272.2	1282.0	1331.1	1380.4	1430.1	1480.5	1531.6	1636.3
			s	1.6707	1.6952	1.7181	1.7397	1.7501	1.7988	1.8432	1.8843	1.9228	1.9591	2.0263
			v	5.888	6.220	6.544	6.862	7.020	7.797	8.562	9.322	10.077	10.830	12.332
80.0	65.3	312.03	h	1209.7	1230.7	1251.1	1271.1	1281.1	1330.5	1379.9	1429.7	1480.1	1531.3	1636.2
			s	1.6541	1.6791	1.7023	1.7242	1.7346	1.7836	1.8281	1.8694	1.9079	1.9442	2.0115
			v	5.208	5.508	5.799	6.084	6.225	6.920	7.603	8.279	8.952	9.623	10.959
90.0	75.3	320.27	h	1207.7	1229.1	1249.8	1270.1	1280.1	1329.8	1379.4	1429.3	1479.8	1531.0	1635.9
			s	1.6393	1.6648	1.6883	1.7103	1.7209	1.7702	1.8149	1.8562	1.8948	1.9311	1.9984
			v	4.663	4.937	5.202	5.462	5.589	6.218	6.835	7.446	8.052	8.656	9.860
100.0	85.3	327.81	h	1205.7	1227.6	1248.6	1269.0	1279.1	1329.1	1378.9	1428.9	1479.5	1530.8	1635.7
			s	1.6258	1.6518	1.6756	1.6979	1.7085	1.7581	1.8029	1.8443	1.8829	1.9193	1.9867
			v	3.844	4.081	4.307	4.527	4.636	5.165	5.683	6.195	6.702	7.207	8.212
120.0	105.3	341.25	h	1201.6	1224.4	1246.0	1266.9	1277.2	1327.7	1377.8	1428.1	1478.8	1530.2	1635.3
			s	1.6017	1.6287	1.6533	1.6760	1.6869	1.7370	1.7822	1.8237	1.8625	1.8990	1.9664
			v	3.258	3.468	3.667	3.860	3.954	4.413	4.861	5.301	5.738	6.172	7.035
140.0	125.3	353.02	h	1197.3	1221.1	1243.3	1264.7	1275.2	1326.4	1376.8	1427.3	1478.2	1529.7	1634.9
			s	1.5804	1.6087	1.6340	1.6573	1.6683	1.7190	1.7645	1.8063	1.8451	1.8817	1.9493
			v		3.008	3.187	3.359	3.443	3.849	4.244	4.631	5.015	5.396	6.152
160.0	145.3	363.53	h		1217.6	1240.6	1262.4	1273.1	1325.0	1375.7	1426.4	1477.5	1529.1	1634.5
			s		1.5908	1.6169	1.6407	1.6519	1.7033	1.7491	1.7911	1.8301	1.8667	1.9344
			v		2.649	2.813	2.969	3.044	3.411	3.764	4.110	4.452	4.792	5.466
180.0	165.3	373.06	h		1214.0	1237.8	1260.2	1271.0	1323.5	1374.7	1425.6	1476.8	1528.6	1634.1
			s		1.5745	1.6015	1.6258	1.6373	1.6894	1.7355	1.7776	1.8167	1.8534	1.9212
			v		2.361	2.513	2.656	2.726	3.060	3.380	3.693	4.002	4.309	4.917
200.0	185.3	381.79	h		1210.3	1234.9	1257.8	1268.9	1322.1	1373.6	1424.8	1476.2	1528.0	1633.7
			s		1.5594	1.5873	1.6123	1.6240	1.6767	1.7232	1.7655	1.8048	1.8415	1.9094
			v		2.125	2.267	2.400	2.465	2.772	3.066	3.352	3.634	3.913	4.467
220.0	205.3	389.86	h		1206.5	1231.9	1255.4	1266.7	1320.7	1372.6	1424.0	1475.5	1527.5	1633.3
			s		1.5453	1.5742	1.5998	1.6117	1.6652	1.7120	1.7545	1.7939	1.8308	1.8987
			v		1.9276	2.062	2.187	2.247	2.533	2.804	3.068	3.327	3.584	4.093
240.0	225.3	397.37	h		1202.5	1228.8	1253.0	1264.5	1319.2	1371.5	1423.2	1474.8	1526.9	1632.9
			s		1.5319	1.5619	1.5882	1.6003	1.6546	1.7017	1.7444	1.7839	1.8209	1.8889

[1]Abstracted from Thermodynamic Properties of Steam by J. H. Keenan and F. G. Keyes, 1936 Edition, by permission of the publishers, John Wiley & Sons, Inc.

Pressure Lbs. per Sq. In. Abs. P	Pressure Lbs. per Sq. In. Gage p	Sat. Temp. t		Total Temperature — Degrees Fahrenheit 460°	500°	540°	580°	600°	660°	700°	800°	900°	1000°	1200°
			v	1.9483	2.063	2.172	2.278	2.330	2.482	2.582	2.827	3.067	3.305	3.776
260.0	245.3	404.42	h	1238.3	1262.3	1285.0	1306.9	1317.7	1349.5	1370.4	1422.3	1474.2	1526.3	1632.5
			s	1.5642	1.5897	1.6129	1.6344	1.6447	1.6739	1.6922	1.7352	1.7748	1.8118	1.8799
			v	1.7960	1.9047	2.008	2.107	2.156	2.299	2.392	2.621	2.845	3.066	3.504
280.0	265.3	411.05	h	1235.4	1260.0	1283.1	1305.3	1316.2	1348.3	1369.4	1421.5	1473.5	1525.8	1632.1
			s	1.5536	1.5796	1.6032	1.6251	1.6354	1.6649	1.6834	1.7265	1.7662	1.8033	1.8716
			v	1.6638	1.7675	1.8654	1.9594	2.005	2.140	2.227	2.442	2.652	2.859	3.269
300.0	285.3	417.33	h	1232.5	1257.6	1281.1	1303.7	1314.7	1347.1	1368.3	1420.6	1472.8	1525.2	1631.7
			s	1.5434	1.5701	1.5941	1.6163	1.6268	1.6565	1.6751	1.7184	1.7582	1.7954	1.8638
			v	1.5479	1.6472	1.7406	1.8298	1.8734	2.001	2.083	2.285	2.483	2.678	3.063
320.0	305.3	423.29	h	1229.5	1255.2	1279.2	1302.0	1313.2	1345.8	1367.2	1419.8	1472.1	1524.7	1631.3
			s	1.5337	1.5611	1.5855	1.6079	1.6186	1.6485	1.6673	1.7108	1.7508	1.7880	1.8565
			v	1.4454	1.5410	1.6303	1.7155	1.7569	1.8777	1.9562	2.147	2.334	2.518	2.881
340.0	325.3	428.97	h	1226.4	1252.8	1277.2	1300.4	1311.6	1344.6	1366.1	1419.0	1471.5	1524.1	1630.9
			s	1.5243	1.5524	1.5773	1.6000	1.6108	1.6410	1.6599	1.7036	1.7437	1.7811	1.8496
			v	1.3539	1.4464	1.5322	1.6137	1.6533	1.7685	1.8431	2.025	2.202	2.376	2.719
360.0	345.3	434.40	h	1223.2	1250.3	1275.2	1298.7	1310.1	1343.3	1365.0	1418.1	1470.8	1523.5	1630.5
			s	1.5152	1.5440	1.5694	1.5925	1.6033	1.6339	1.6529	1.6968	1.7371	1.7745	1.8431
			v	1.2719	1.3616	1.4444	1.5226	1.5605	1.6707	1.7419	1.9149	2.083	2.249	2.575
380.0	365.3	439.60	h	1219.9	1247.7	1273.1	1297.0	1308.5	1342.0	1363.8	1417.3	1470.1	1523.0	1630.0
			s	1.5063	1.5359	1.5618	1.5852	1.5962	1.6270	1.6462	1.6904	1.7307	1.7683	1.8370
			v	1.1978	1.2851	1.3652	1.4406	1.4770	1.5827	1.6508	1.8161	1.9767	2.134	2.445
400.0	385.3	444.59	h	1216.5	1245.1	1271.0	1295.2	1306.9	1340.8	1362.7	1416.4	1469.4	1522.4	1629.6
			s	1.4977	1.5281	1.5546	1.5783	1.5894	1.6205	1.6398	1.6842	1.7247	1.7623	1.8311
			v	1.1305	1.2158	1.2935	1.3663	1.4014	1.5030	1.5684	1.7267	1.8802	2.031	2.327
420.0	405.3	449.39	h	1213.1	1242.5	1268.9	1293.5	1305.3	1339.5	1361.6	1415.5	1468.7	1521.9	1629.2
			s	1.4892	1.5205	1.5475	1.5716	1.5829	1.6143	1.6337	1.6783	1.7189	1.7566	1.8256
			v	1.0691	1.1526	1.2282	1.2988	1.3327	1.4306	1.4934	1.6454	1.7925	1.9368	2.220
440.0	425.3	454.02	h	1209.5	1239.8	1266.7	1291.7	1303.6	1338.2	1360.4	1414.7	1468.1	1521.3	1628.8
			s	1.4809	1.5132	1.5407	1.5652	1.5766	1.6083	1.6278	1.6727	1.7135	1.7512	1.8203
			v	1.0128	1.0948	1.1685	1.2370	1.2698	1.3644	1.4250	1.5711	1.7124	1.8508	2.122
460.0	445.3	458.50	h	1205.8	1237.0	1264.5	1289.9	1302.0	1336.9	1359.3	1413.8	1467.4	1520.7	1628.4
			s	1.4728	1.5059	1.5340	1.5589	1.5705	1.6025	1.6222	1.6673	1.7082	1.7460	1.8152
			v		1.0417	1.1138	1.1803	1.2122	1.3038	1.3622	1.5031	1.6390	1.7720	2.033
480.0	465.3	462.82	h		1234.2	1262.3	1288.0	1300.3	1335.6	1358.2	1412.9	1466.7	1520.2	1628.0
			s		1.4989	1.5276	1.5528	1.5645	1.5969	1.6167	1.6621	1.7031	1.7411	1.8103
			v		0.9927	1.0633	1.1282	1.1591	1.2478	1.3044	1.4405	1.5715	1.6996	1.9504
500.0	485.3	467.01	h		1231.3	1260.0	1286.2	1298.6	1334.2	1357.0	1412.1	1466.0	1519.6	1627.6
			s		1.4919	1.5213	1.5470	1.5588	1.5915	1.6115	1.6571	1.6982	1.7363	1.8056
			v		0.9473	1.0166	1.0799	1.1101	1.1962	1.2511	1.3826	1.5091	1.6326	1.8743
520.0	505.3	471.07	h		1228.3	1257.7	1284.3	1296.9	1332.9	1355.8	1411.2	1465.3	1519.0	1627.2
			s		1.4851	1.5151	1.5412	1.5532	1.5863	1.6064	1.6522	1.6935	1.7317	1.8011
			v		0.9052	0.9733	1.0352	1.0646	1.1485	1.2017	1.3291	1.4514	1.5707	1.8039
540.0	525.3	475.01	h		1225.3	1255.4	1282.4	1295.2	1331.5	1354.6	1410.3	1464.6	1518.5	1626.8
			s		1.4784	1.5091	1.5356	1.5478	1.5812	1.6015	1.6475	1.6890	1.7272	1.7968
			v		0.8659	0.9330	0.9937	1.0224	1.1041	1.1558	1.2794	1.3978	1.5132	1.7385
560.0	545.3	478.85	h		1222.2	1253.0	1280.5	1293.4	1330.2	1353.5	1409.4	1463.9	1517.9	1626.4
			s		1.4717	1.5032	1.5302	1.5425	1.5762	1.5967	1.6430	1.6846	1.7229	1.7926
			v		0.8291	0.8954	0.9549	0.9830	1.0627	1.1131	1.2331	1.3479	1.4596	1.6776
580.0	565.3	482.58	h		1219.0	1250.5	1278.5	1291.7	1328.8	1352.3	1408.6	1463.2	1517.3	1626.0
			s		1.4652	1.4974	1.5248	1.5373	1.5714	1.5920	1.6386	1.6804	1.7188	1.7885

Pressure Lbs. per Sq. In. Abs. P	Pressure Lbs. per Sq. In. Gage p	Sat. Temp. t		Total Temperature — Degrees Fahrenheit										
				560°	600°	640°	680°	700°	760°	780°	800°	900°	1000°	1200°
600.0	585.3	486.21	v	0.8901	0.9463	0.9988	1.0489	1.0732	1.1440	1.1670	1.1899	1.3013	1.4096	1.6208
			h	1262.7	1289.9	1315.2	1339.3	1351.1	1385.3	1396.5	1407.7	1462.5	1516.7	1625.5
			s	1.5061	1.5323	1.5558	1.5773	1.5875	1.6163	1.6254	1.6343	1.6762	1.7147	1.7846
620.0	605.3	489.75	v	0.8567	0.9118	0.9633	1.0121	1.0358	1.1048	1.1272	1.1494	1.2577	1.3628	1.5676
			h	1260.4	1288.1	1313.7	1338.0	1349.9	1384.3	1395.6	1406.8	1461.8	1516.2	1625.1
			s	1.5007	1.5273	1.5511	1.5728	1.5831	1.6121	1.6213	1.6302	1.6722	1.7108	1.7808
640.0	625.3	493.21	v	0.8253	0.8795	0.9299	0.9777	1.0008	1.0680	1.0899	1.1115	1.2168	1.3190	1.5178
			h	1258.2	1286.2	1312.2	1336.7	1348.6	1383.3	1394.7	1405.9	1461.1	1515.6	1624.7
			s	1.4955	1.5225	1.5465	1.5684	1.5788	1.6080	1.6172	1.6262	1.6684	1.7070	1.7771
660.0	645.3	496.58	v	0.7958	0.8491	0.8985	0.9453	0.9679	1.0335	1.0548	1.0759	1.1784	1.2778	1.4709
			h	1255.9	1284.4	1310.6	1335.4	1347.4	1382.3	1393.7	1405.0	1460.4	1515.0	1624.3
			s	1.4903	1.5177	1.5420	1.5642	1.5746	1.6040	1.6132	1.6222	1.6646	1.7034	1.7735
680.0	665.3	499.88	v	0.7679	0.8205	0.8690	0.9148	0.9369	1.0010	1.0218	1.0424	1.1423	1.2390	1.4269
			h	1253.5	1282.5	1309.1	1334.1	1346.2	1381.3	1392.8	1404.1	1459.7	1514.5	1623.9
			s	1.4851	1.5130	1.5376	1.5600	1.5705	1.6001	1.6094	1.6184	1.6609	1.6998	1.7700
700.0	685.3	503.10	v	0.7416	0.7934	0.8411	0.8860	0.9077	0.9704	0.9907	1.0108	1.1082	1.2024	1.3853
			h	1251.1	1280.6	1307.5	1332.8	1345.0	1380.3	1391.8	1403.2	1459.0	1513.9	1623.5
			s	1.4800	1.5084	1.5333	1.5559	1.5665	1.5962	1.6056	1.6147	1.6573	1.6963	1.7666
750.0	735.3	510.86	v	0.6816	0.7319	0.7778	0.8208	0.8414	0.9008	0.9201	0.9391	1.0310	1.1196	1.2912
			h	1245.0	1275.7	1303.5	1329.4	1341.8	1377.7	1389.4	1400.9	1457.2	1512.4	1622.4
			s	1.4676	1.4972	1.5229	1.5460	1.5568	1.5870	1.5965	1.6057	1.6487	1.6879	1.7586
800.0	785.3	518.23	v	0.6288	0.6779	0.7223	0.7635	0.7833	0.8400	0.8583	0.8763	0.9633	1.0470	1.2088
			h	1238.6	1270.7	1299.4	1325.9	1338.6	1375.2	1387.0	1398.6	1455.4	1511.0	1621.4
			s	1.4553	1.4863	1.5129	1.5366	1.5476	1.5783	1.5879	1.5972	1.6407	1.6801	1.7510
850.0	835.3	525.26	v	0.5818	0.6301	0.6732	0.7130	0.7320	0.7863	0.8037	0.8209	0.9037	0.9830	1.1360
			h	1231.9	1265.5	1295.2	1322.4	1335.4	1372.5	1384.5	1396.3	1453.6	1509.5	1620.4
			s	1.4433	1.4756	1.5032	1.5275	1.5388	1.5700	1.5797	1.5892	1.6330	1.6727	1.7438
900.0	885.3	531.98	v	0.5396	0.5873	0.6294	0.6680	0.6863	0.7385	0.7552	0.7716	0.8506	0.9262	1.0714
			h	1224.9	1260.1	1290.9	1318.8	1332.1	1369.9	1382.0	1393.9	1451.8	1508.1	1619.3
			s	1.4313	1.4653	1.4938	1.5187	1.5303	1.5620	1.5719	1.5814	1.6257	1.6656	1.7371
950.0	935.3	538.42	v	0.5015	0.5489	0.5901	0.6276	0.6453	0.6957	0.7117	0.7275	0.8031	0.8753	1.0136
			h	1217.5	1254.6	1286.4	1315.2	1328.7	1367.2	1379.5	1391.6	1450.0	1506.6	1618.3
			s	1.4194	1.4551	1.4846	1.5103	1.5221	1.5544	1.5644	1.5741	1.6187	1.6589	1.7306
1000.0	985.3	544.61	v	0.4668	0.5140	0.5546	0.5912	0.6084	0.6571	0.6726	0.6878	0.7604	0.8294	0.9615
			h	1209.7	1248.8	1281.9	1311.4	1325.3	1364.4	1376.9	1389.2	1448.2	1505.1	1617.3
			s	1.4073	1.4450	1.4757	1.5021	1.5141	1.5470	1.5572	1.5670	1.6121	1.6525	1.7245
1100.0	1085.3	556.31	v	0.4053	0.4532	0.4929	0.5281	0.5445	0.5904	0.6049	0.6191	0.6866	0.7503	0.8716
			h	1192.6	1236.7	1272.4	1303.7	1318.3	1358.9	1371.7	1384.3	1444.5	1502.2	1615.2
			s	1.3827	1.4251	1.4583	1.4862	1.4989	1.5330	1.5435	1.5535	1.5995	1.6405	1.7130
1200.0	1185.3	567.22	v		0.4016	0.4410	0.4752	0.4909	0.5347	0.5484	0.5617	0.6250	0.6843	0.7967
			h		1223.5	1262.4	1295.7	1311.0	1353.2	1366.4	1379.3	1440.7	1499.2	1613.1
			s		1.4052	1.4413	1.4710	1.4843	1.5198	1.5306	1.5409	1.5879	1.6293	1.7025
1300.0	1285.3	577.46	v		0.3569	0.3966	0.4301	0.4454	0.4874	0.5004	0.5131	0.5728	0.6284	0.7333
			h		1209.0	1251.8	1287.3	1303.4	1347.3	1361.0	1374.3	1437.0	1496.2	1611.0
			s		1.3850	1.4246	1.4563	1.4703	1.5073	1.5184	1.5290	1.5769	1.6190	1.6927
1400.0	1385.3	587.10	v		0.3174	0.3580	0.3912	0.4062	0.4468	0.4593	0.4714	0.5281	0.5805	0.6789
			h		1193.0	1240.4	1278.5	1295.5	1341.3	1355.4	1369.1	1433.1	1493.2	1608.9
			s		1.3639	1.4079	1.4419	1.4567	1.4953	1.5068	1.5177	1.5666	1.6093	1.6836
1500.0	1485.3	596.23	v		0.2815	0.3240	0.3572	0.3719	0.4114	0.4235	0.4352	0.4893	0.5390	0.6318
			h		1174.5	1228.3	1269.3	1287.2	1335.2	1349.7	1363.8	1429.3	1490.1	1606.8
			s		1.3412	1.3912	1.4278	1.4434	1.4837	1.4956	1.5068	1.5569	1.6001	1.6750

Pressure Lbs. per Sq. In. Abs. P	Pressure Lbs. per Sq. In. Gage p	Sat. Temp. t		Total Temperature — Degrees Fahrenheit										
				660°	700°	740°	780°	800°	860°	900°	1000°	1050°	1100°	1200°
			v	0.3112	0.3417	0.3682	0.3921	0.4034	0.4353	0.4553	0.5027	0.5253	0.5474	0.5906
1600.0	1585.3	604.90	h	1238.7	1278.7	1313.0	1343.9	1358.4	1399.5	1425.3	1487.0	1516.9	1546.4	1604.6
			s	1.3952	1.4303	1.4595	1.4848	1.4964	1.5283	1.5476	1.5914	1.6115	1.6307	1.6669
			v	0.2842	0.3148	0.3410	0.3643	0.3753	0.4061	0.4253	0.4706	0.4922	0.5132	0.5542
1700.0	1685.3	613.15	h	1226.8	1269.7	1305.8	1337.9	1352.9	1395.0	1421.4	1484.0	1514.1	1543.8	1602.5
			s	1.3797	1.4173	1.4480	1.4743	1.4863	1.5190	1.5387	1.5831	1.6034	1.6228	1.6592
			v	0.2597	0.2907	0.3166	0.3395	0.3502	0.3801	0.3986	0.4421	0.4627	0.4828	0.5218
1800.0	1785.3	621.03	h	1214.0	1260.3	1298.4	1331.8	1347.2	1390.4	1417.4	1480.8	1511.3	1541.3	1600.4
			s	1.3638	1.4044	1.4367	1.4641	1.4765	1.5100	1.5301	1.5752	1.5957	1.6153	1.6520
			v	0.2371	0.2688	0.2947	0.3173	0.3277	0.3568	0.3747	0.4165	0.4363	0.4556	0.4929
1900.0	1885.3	628.58	h	1200.2	1250.4	1290.6	1325.4	1341.5	1385.8	1413.3	1477.7	1508.5	1538.8	1598.2
			s	1.3474	1.3915	1.4256	1.4541	1.4669	1.5014	1.5219	1.5676	1.5883	1.6081	1.6450
			v	0.2161	0.2489	0.2748	0.2972	0.3074	0.3358	0.3532	0.3935	0.4126	0.4311	0.4668
2000.0	1985.3	635.82	h	1184.9	1240.0	1282.6	1319.0	1335.5	1381.2	1409.2	1474.5	1505.7	1536.2	1596.1
			s	1.3300	1.3783	1.4145	1.4443	1.4576	1.4930	1.5139	1.5603	1.5813	1.6012	1.6384
			v	0.1962	0.2306	0.2567	0.2789	0.2890	0.3167	0.3337	0.3727	0.3911	0.4089	0.4433
2100.0	2085.3	642.77	h	1167.7	1229.0	1274.3	1312.3	1329.5	1376.4	1405.0	1471.4	1502.9	1533.6	1593.9
			s	1.3112	1.3651	1.4035	1.4346	1.4484	1.4848	1.5062	1.5533	1.5745	1.5945	1.6320
			v	0.1768	0.2135	0.2400	0.2621	0.2721	0.2994	0.3159	0.3538	0.3715	0.3887	0.4218
2200.0	2185.3	649.46	h	1147.8	1217.4	1265.7	1305.4	1323.3	1371.5	1400.8	1468.2	1500.0	1531.1	1591.8
			s	1.2903	1.3515	1.3925	1.4250	1.4393	1.4768	1.4986	1.5465	1.5679	1.5881	1.6259
			v	0.1575	0.1978	0.2247	0.2468	0.2567	0.2835	0.2997	0.3365	0.3537	0.3703	0.4023
2300.0	2285.3	655.91	h	1123.8	1204.9	1256.7	1298.4	1316.9	1366.6	1396.5	1464.9	1497.1	1528.5	1589.6
			s	1.2661	1.3375	1.3814	1.4156	1.4304	1.4690	1.4913	1.5399	1.5615	1.5820	1.6200
			v		0.1828	0.2105	0.2327	0.2425	0.2689	0.2848	0.3207	0.3373	0.3534	0.3843
2400.0	2385.3	662.12	h		1191.5	1247.3	1291.1	1310.3	1361.6	1392.2	1461.7	1494.2	1525.9	1587.4
			s		1.3228	1.3702	1.4061	1.4215	1.4613	1.4842	1.5335	1.5554	1.5760	1.6143
			v		0.1686	0.1973	0.2196	0.2294	0.2555	0.2710	0.3061	0.3222	0.3379	0.3678
2500.0	2485.3	668.13	h		1176.8	1237.6	1283.6	1303.6	1356.5	1387.8	1458.4	1491.3	1523.2	1585.3
			s		1.3073	1.3589	1.3967	1.4127	1.4538	1.4772	1.5273	1.5495	1.5702	1.6088
			v		0.1549	0.1849	0.2074	0.2172	0.2431	0.2584	0.2926	0.3083	0.3236	0.3526
2600.0	2585.3	673.94	h		1160.6	1227.3	1275.8	1296.8	1351.4	1383.4	1455.1	1488.4	1520.6	1583.1
			s		1.2908	1.3474	1.3873	1.4040	1.4464	1.4703	1.5212	1.5437	1.5646	1.6035
			v		0.1415	0.1732	0.1960	0.2059	0.2315	0.2466	0.2801	0.2955	0.3103	0.3385
2700.0	2685.3	679.55	h		1142.5	1216.5	1267.9	1289.7	1346.1	1378.9	1451.8	1485.5	1518.0	1580.9
			s		1.2728	1.3357	1.3778	1.3953	1.4391	1.4635	1.5154	1.5380	1.5592	1.5983
			v		0.1281	0.1622	0.1854	0.1953	0.2208	0.2356	0.2685	0.2835	0.2979	0.3254
2800.0	2785.3	684.99	h		1121.4	1205.1	1259.6	1282.4	1340.8	1374.3	1448.5	1482.5	1515.4	1578.7
			s		1.2524	1.3236	1.3683	1.3865	1.4318	1.4569	1.5096	1.5325	1.5539	1.5933
			v		0.1143	0.1517	0.1754	0.1853	0.2108	0.2254	0.2577	0.2723	0.2864	0.3132
2900.0	2885.3	690.26	h		1095.9	1193.0	1251.1	1274.9	1335.3	1369.7	1445.1	1479.6	1512.7	1576.5
			s		1.2286	1.3111	1.3587	1.3778	1.4247	1.4504	1.5040	1.5272	1.5487	1.5884
			v		0.0984	0.1416	0.1660	0.1760	0.2014	0.2159	0.2476	0.2620	0.2757	0.3018
3000.0	2985.3	695.36	h		1060.7	1180.1	1242.2	1267.2	1329.7	1365.0	1441.8	1476.6	1510.0	1574.3
			s		1.1966	1.2981	1.3490	1.3690	1.4176	1.4439	1.4984	1.5219	1.5437	1.5837
			v			0.1320	0.1571	0.1672	0.1926	0.2070	0.2382	0.2523	0.2657	0.2911
3100.0	3085.3	700.31	h			1166.2	1233.0	1259.3	1324.1	1360.3	1438.4	1473.6	1507.4	1572.1
			s			1.2844	1.3392	1.3602	1.4105	1.4376	1.4930	1.5168	1.5388	1.5790
			v			0.1220	0.1480	0.1583	0.1838	0.1981	0.2288	0.2426	0.2557	0.2806
3206.2	3191.5	705.40	h			1150.2	1222.9	1250.5	1317.9	1355.2	1434.7	1470.4	1504.5	1569.8
			s			1.2690	1.3287	1.3508	1.4031	1.4309	1.4874	1.5115	1.5337	1.5742

Conversion Table

Measure

1 in. = 25.4 mm.
1 mm. = .03937 in.
1 mm. = .00328 ft.
1 ft. = 304.8 mm.
1 ft. = 30.48 cm.

1 sq. in. = 6.4516 sq. cm.
1 sq. cm. = 0.155 sq. in.
1 sq. cm. = .00108 sq. ft.
1 sq. ft. = 929.03 sq. cm.

1 cu. in. = 16.39 cu. cm.
1 cu. ft. = 1728 cu. in.
1 cu. ft. = 28,316.83 cu. cm.
1 cu. ft. = 7.4805 U. S. gals.
1 cu. ft. = 6.23 imp. gals.
1 cu. ft. = 28.375 liters

1 U. S. gal. = 0.1337 cu. ft.
1 imp. gal. = 277.27 cu. in.
1 imp. gal. = 0.16 cu. ft.
1 imp. gal. = 1.2 U. S. gals.
1 imp. gal. = 4.537 liters

1 liter = 61 cu. in.
1 liter = .0353 cu. ft.
1 liter = .22 imp. gal.

Weight

1 cu. in. of water = .0361 lb. (15° C)
1 cu. ft. of water = 62.4 lbs. (15° C)
1 U. S. gal. of water = 8.33 lbs. (15° C)
1 imp. gal. of water = 10 lbs. (15° C)
1 liter of water = 2.2 lbs. (15° C)

1 kg. = 2.2 lbs.
1 cu. in. of water = .0735 cu. in. of mercury
1 cu. in. of mercury = 13.6 cu. in. of water
1 cu. in. of mercury = .491 lb.

Velocity

1 ft. per sec. = .3048 m. per sec.
1 m. per sec. = 3.2808 ft. per sec.

Density

1 lb. per cu. in. = 27.68 gram. per cu. cm.
1 gr. per cu. cm. = .03613 lb. per cu. in.
1 lb. per cu. ft. = 16.0184 kg. per cu. m.
1 kg. per cu. m. = .06243 lb. per cu. ft.

Pressure

1 in. of water = .0361 lb. per sq. in.
1 in. of water = .0735 in. of mercury
1 ft. of water = .4332 lb. per sq. in.
1 ft. of water = .8824 in. of mercury

1 in. of mercury = .4912 lb. per sq. in.
1 in. of mercury = 13.6 in. of water
1 in. of mercury = 1.133 ft. of water
1 cm. of mercury = .1934 lb. per sq. in.

1 atmosphere = 14.696 lbs. per sq. in.
1 atmosphere = 34 ft. of water
1 atmosphere = 760 mm. of mercury

1 lb. per sq. in. = 27.71 in. of water
1 lb. per sq. in. = 2.312 ft. of water
1 lb. per sq. in. = 2.04 in. of mercury
1 lb. per sq. in. = .06804 atmosphere
1 lb. per sq. in. = .0703 kg. per sq. cm.
1 lb. per sq. in. = 703.08 kg. per sq. m.

1 kg. per sq. cm. = 14.223 lbs. per sq. in.
1 kg. per sq. m. = .00142 lb. per sq. in.

Heat Transfer

1 B.t.u. per sq. ft. = .2712 gram. calorie per sq. cm.
1 gram. cal. per sq. cm. = 3.687 B.t.u. per sq. ft.
1 B.t.u. per hr. per sq. ft. per F° = 4.88 kg. cal. per hr. per sq. m. per C°.
1 kg. cal. per hr. per sq. m. per C° = .205 B.t.u. per hr. per sq. ft. per F°.
1 B.t.u. per hr. per sq. ft. per F° = .0001355 gram. cal. per sec. per sq. cm. per C°.
1 gram. cal. per sec. per sq. cm. per C° = 7380 B.t.u. per hr. per sq. ft. per F°.

Thermal Conductivity

1 B.t.u. per sq. ft. per in. = .6892 gram. calories per sq. cm. per cm.
1 gram. cal. per sq. cm. per cm. = 1.451 B.t.u. per sq. ft. per in.
1 B.t.u. per hr. per sq. ft. per F° per in. = .0003445 gram. cal. per sec. per sq. cm. per C° per cm.
1 gram. cal. per sec. per sq. cm. per C° per cm. = 2903 B.t.u. per hr. per sq. ft. per F° per in.
1 B.t.u. per hr. per sq. ft. per F° per ft. = .00413 gram. cal. per sec. per sq. cm. per C° per cm.
1 gram. cal. per sec. per sq. cm. per C° per cm. = 242.13 B.t.u. per hr. per sq. ft. per F° per ft.

Linear Conversion

Fractions of an Inch
To Decimals of an Inch and to Millimeters

Fraction	Decimal	Millimeter
1/64	.015625	0.39688
1/32	.03125	0.79375
3/64	.046875	1.19063
1/16	.0625	1.58750
5/64	.078125	1.98438
3/32	.09375	2.38125
7/64	.109375	2.77813
1/8	.125	3.17501
9/64	.140625	3.57188
5/32	.15625	3.96876
11/64	.171875	4.36563
3/16	.1875	4.76251
13/64	.203125	5.15939
7/32	.21875	5.55626
15/64	.234375	5.95314
1/4	.25	6.35001
17/64	.265625	6.74689
9/32	.28125	7.14376
19/64	.296875	7.54064
5/16	.3125	7.93752
21/64	.328125	8.33439
11/32	.34375	8.73127
23/64	.359375	9.12814
3/8	.375	9.52502
25/64	.390625	9.92189
13/32	.40625	10.31877
27/64	.421875	10.71565
7/16	.4375	11.11252
29/64	.453125	11.50940
15/32	.46875	11.90627
31/64	.484375	12.30315
1/2	.5	12.70002
33/64	.515625	13.09690
17/32	.53125	13.49378
35/64	.546875	13.89065
9/16	.5625	14.28753
37/64	.578125	14.68440
19/32	.59375	15.08128
39/64	.609375	15.47816
5/8	.625	15.87503
41/64	.640625	16.27191
21/32	.65625	16.66878
43/64	.671875	17.06566
11/16	.6875	17.46253
45/64	.703125	17.85941
23/32	.71875	18.25629
47/64	.734375	18.65316
3/4	.75	19.05004
49/64	.765625	19.44691
25/32	.78125	19.84379
51/64	.796875	20.24066
13/16	.8125	20.63754
53/64	.828125	21.03442
27/32	.84375	21.43129
55/64	.859375	21.82817
7/8	.875	22.22504
57/64	.890625	22.62192
29/32	.90625	23.01880
59/64	.921875	23.41567
15/16	.9375	23.81255
61/64	.953125	24.20942
31/32	.96875	24.60630
63/64	.984375	25.00317
1	1.0	25.40005

Linear Conversion

Decimals of an Inch to Millimeters

(0.10 inch = 2.54 millimeters)

Inches	0.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	Inches
0.00	0.00	0.25	0.51	0.76	1.02	1.27	1.52	1.78	2.03	2.29	0.00
.10	2.54	2.79	3.05	3.30	3.56	3.81	4.06	4.32	4.57	4.83	.10
.20	5.08	5.33	5.59	5.84	6.10	6.35	6.60	6.86	7.11	7.37	.20
.30	7.62	7.87	8.13	8.38	8.64	8.89	9.14	9.40	9.65	9.91	.30
.40	10.16	10.41	10.67	10.92	11.18	11.43	11.68	11.94	12.19	12.45	.40
.50	12.70	12.95	13.21	13.46	13.72	13.97	14.22	14.48	14.73	14.99	.50
.60	15.24	15.49	15.75	16.00	16.26	16.51	16.76	17.02	17.27	17.53	.60
.70	17.78	18.03	18.29	18.54	18.80	19.05	19.30	19.56	19.81	20.07	.70
.80	20.32	20.57	20.83	21.08	21.34	21.59	21.84	22.10	22.35	22.61	.80
.90	22.86	23.11	23.37	23.62	23.88	24.13	24.38	24.64	24.89	25.15	.90

Millimeters to Inches

(1 millimeter = .03937 inch)

Millimeters	0	1	2	3	4	5	6	7	8	9	Millimeters
0	0.00	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354	0
10	0.39	0.43	0.47	0.51	0.55	0.59	0.63	0.67	0.71	0.75	10
20	0.79	0.83	0.87	0.91	0.94	0.98	1.02	1.06	1.10	1.14	20
30	1.18	1.22	1.26	1.30	1.34	1.38	1.42	1.46	1.50	1.54	30
40	1.57	1.61	1.65	1.69	1.73	1.77	1.81	1.85	1.89	1.93	40
50	1.97	2.01	2.05	2.09	2.13	2.17	2.20	2.24	2.28	2.32	50
60	2.36	2.40	2.44	2.48	2.52	2.56	2.60	2.64	2.68	2.72	60
70	2.76	2.80	2.83	2.87	2.91	2.95	2.99	3.03	3.07	3.11	70
80	3.15	3.19	3.23	3.27	3.31	3.35	3.39	3.43	3.46	3.50	80
90	3.54	3.58	3.62	3.66	3.70	3.74	3.78	3.82	3.86	3.90	90
100	3.94	3.98	4.02	4.06	4.09	4.13	4.17	4.21	4.25	4.29	100
110	4.33	4.37	4.41	4.45	4.49	4.53	4.57	4.61	4.65	4.69	110
120	4.72	4.76	4.80	4.84	4.88	4.92	4.96	5.00	5.04	5.08	120
130	5.12	5.16	5.20	5.24	5.28	5.31	5.35	5.39	5.43	5.47	130
140	5.51	5.55	5.59	5.63	5.67	5.71	5.75	5.79	5.83	5.87	140
150	5.91	5.94	5.98	6.02	6.06	6.10	6.14	6.18	6.22	6.26	150
160	6.30	6.34	6.38	6.42	6.46	6.50	6.54	6.57	6.61	6.65	160
170	6.69	6.73	6.77	6.81	6.85	6.89	6.93	6.97	7.01	7.05	170
180	7.09	7.13	7.17	7.20	7.24	7.28	7.32	7.36	7.40	7.44	180
190	7.48	7.52	7.56	7.60	7.64	7.68	7.72	7.76	7.80	7.83	190
200	7.87	7.91	7.95	7.99	8.03	8.07	8.11	8.15	8.19	8.23	200
210	8.27	8.31	8.35	8.39	8.43	8.46	8.50	8.54	8.58	8.62	210
220	8.66	8.70	8.74	8.78	8.82	8.86	8.90	8.94	8.98	9.02	220
230	9.06	9.09	9.13	9.17	9.21	9.25	9.29	9.33	9.37	9.41	230
240	9.45	9.49	9.53	9.57	9.61	9.65	9.69	9.72	9.76	9.80	240
250	9.84	9.88	9.92	9.96	10.00	10.04	10.08	10.12	10.16	10.20	250
260	10.24	10.28	10.31	10.35	10.39	10.43	10.47	10.51	10.55	10.59	260
270	10.63	10.67	10.71	10.75	10.79	10.83	10.87	10.91	10.94	10.98	270
280	11.02	11.06	11.10	11.14	11.18	11.22	11.26	11.30	11.34	11.38	280
290	11.42	11.46	11.50	11.54	11.57	11.61	11.65	11.69	11.73	11.77	290
300	11.81	11.85	11.89	11.93	11.97	12.01	12.05	12.09	12.13	12.17	300
310	12.20	12.24	12.28	12.32	12.36	12.40	12.44	12.48	12.52	12.56	310
320	12.60	12.64	12.68	12.72	12.76	12.80	12.83	12.87	12.91	12.95	320
330	12.99	13.03	13.07	13.11	13.15	13.19	13.23	13.27	13.31	13.35	330
340	13.39	13.43	13.46	13.50	13.54	13.58	13.62	13.66	13.70	13.74	340
350	13.78	13.82	13.86	13.90	13.94	13.98	14.02	14.06	14.09	14.13	350
360	14.17	14.21	14.25	14.29	14.33	14.37	14.41	14.45	14.49	14.53	360
370	14.57	14.61	14.65	14.69	14.72	14.76	14.80	14.84	14.88	14.92	370
380	14.96	15.00	15.04	15.08	15.12	15.16	15.20	15.24	15.28	15.31	380
390	15.35	15.39	15.43	15.47	15.51	15.55	15.59	15.63	15.67	15.71	390

(Continued on next page)

Millimeters to Inches (Cont.)

Millimeters	0	1	2	3	4	5	6	7	8	9	Millimeters
400	15.75	15.79	15.83	15.87	15.91	15.94	15.98	16.02	16.06	16.10	400
410	16.14	16.18	16.22	16.26	16.30	16.34	16.38	16.42	16.46	16.50	410
420	16.54	16.57	16.61	16.65	16.69	16.73	16.77	16.81	16.85	16.89	420
430	16.93	16.97	17.01	17.05	17.09	17.13	17.17	17.20	17.24	17.28	430
440	17.32	17.36	17.40	17.44	17.48	17.52	17.56	17.60	17.64	17.68	440
450	17.72	17.76	17.80	17.83	17.87	17.91	17.95	17.99	18.03	18.07	450
460	18.11	18.15	18.19	18.23	18.27	18.31	18.35	18.39	18.43	18.46	460
470	18.50	18.54	18.58	18.62	18.66	18.70	18.74	18.78	18.82	18.86	470
480	18.90	18.94	18.98	19.02	19.06	19.09	19.13	19.17	19.21	19.25	480
490	19.29	19.33	19.37	19.41	19.45	19.49	19.53	19.57	19.61	19.65	490
500	19.69	19.72	19.76	19.80	19.84	19.88	19.92	19.96	20.00	20.04	500
510	20.08	20.12	20.16	20.20	20.24	20.28	20.31	20.35	20.39	20.43	510
520	20.47	20.51	20.55	20.59	20.63	20.67	20.71	20.75	20.79	20.83	520
530	20.87	20.91	20.94	20.98	21.02	21.06	21.10	21.14	21.18	21.22	530
540	21.26	21.30	21.34	21.38	21.42	21.46	21.50	21.54	21.58	21.61	540
550	21.65	21.69	21.73	21.77	21.81	21.85	21.89	21.93	21.97	22.01	550
560	22.05	22.09	22.13	22.17	22.20	22.24	22.28	22.32	22.36	22.40	560
570	22.44	22.48	22.52	22.56	22.60	22.64	22.68	22.72	22.76	22.80	570
580	22.83	22.87	22.91	22.95	22.99	23.03	23.07	23.11	23.15	23.19	580
590	23.23	23.27	23.31	23.35	23.39	23.43	23.46	23.50	23.54	23.58	590
600	23.62	23.66	23.70	23.74	23.78	23.82	23.86	23.90	23.94	23.98	600
610	24.02	24.06	24.09	24.13	24.17	24.21	24.25	24.29	24.33	24.37	610
620	24.41	24.45	24.49	24.53	24.57	24.61	24.65	24.68	24.72	24.76	620
630	24.80	24.84	24.88	24.92	24.96	25.00	25.04	25.08	25.12	25.16	630
640	25.20	25.24	25.28	25.31	25.35	25.39	25.43	25.47	25.51	25.55	640
650	25.59	25.63	25.67	25.71	25.75	25.79	25.83	25.87	25.91	25.94	650
660	25.98	26.02	26.06	26.10	26.14	26.18	26.22	26.26	26.30	26.34	660
670	26.38	26.42	26.46	26.50	26.54	26.57	26.61	26.65	26.69	26.73	670
680	26.77	26.81	26.85	26.89	26.93	26.97	27.01	27.05	27.09	27.13	680
690	27.17	27.20	27.24	27.28	27.32	27.36	27.40	27.44	27.48	27.52	690
700	27.56	27.60	27.64	27.68	27.72	27.76	27.80	27.83	27.87	27.91	700
710	27.95	27.99	28.03	28.07	28.11	28.15	28.19	28.23	28.27	28.31	710
720	28.35	28.39	28.43	28.46	28.50	28.54	28.58	28.62	28.66	28.70	720
730	28.74	28.78	28.82	28.86	28.90	28.94	28.98	29.02	29.06	29.09	730
740	29.13	29.17	29.21	29.25	29.29	29.33	29.37	29.41	29.45	29.49	740
750	29.53	29.57	29.61	29.65	29.68	29.72	29.76	29.80	29.84	29.88	750
760	29.92	29.96	30.00	30.04	30.08	30.12	30.16	30.20	30.24	30.28	760
770	30.31	30.35	30.39	30.43	30.47	30.51	30.55	30.59	30.63	30.67	770
780	30.71	30.75	30.79	30.83	30.87	30.91	30.94	30.98	31.02	31.06	780
790	31.10	31.14	31.18	31.22	31.26	31.30	31.34	31.38	31.42	31.46	790
800	31.50	31.54	31.57	31.61	31.65	31.69	31.73	31.77	31.81	31.85	800
810	31.89	31.93	31.97	32.01	32.05	32.09	32.13	32.17	32.20	32.24	810
820	32.28	32.32	32.36	32.40	32.44	32.48	32.52	32.56	32.60	32.64	820
830	32.68	32.72	32.76	32.80	32.83	32.87	32.91	32.95	32.99	33.03	830
840	33.07	33.11	33.15	33.19	33.23	33.27	33.31	33.35	33.39	33.43	840
850	33.46	33.50	33.54	33.58	33.62	33.66	33.70	33.74	33.78	33.82	850
860	33.86	33.90	33.94	33.98	34.02	34.06	34.09	34.13	34.17	34.21	860
870	34.25	34.29	34.33	34.37	34.41	34.45	34.49	34.53	34.57	34.61	870
880	34.65	34.68	34.72	34.76	34.80	34.84	34.88	34.92	34.96	35.00	880
890	35.04	35.08	35.12	35.16	35.20	35.24	35.28	35.31	35.35	35.39	890
900	35.43	35.47	35.51	35.55	35.59	35.63	35.67	35.71	35.75	35.79	900
910	35.83	35.87	35.91	35.94	35.98	36.02	36.06	36.10	36.14	36.18	910
920	36.22	36.26	36.30	36.34	36.38	36.42	36.46	36.50	36.54	36.57	920
930	36.61	36.65	36.69	36.73	36.77	36.81	36.85	36.89	36.93	36.97	930
940	37.01	37.05	37.09	37.13	37.17	37.20	37.24	37.28	37.32	37.36	940
950	37.40	37.44	37.48	37.52	37.56	37.60	37.64	37.68	37.72	37.76	950
960	37.80	37.83	37.87	37.91	37.95	37.99	38.03	38.07	38.11	38.15	960
970	38.19	38.23	38.27	38.31	38.35	38.39	38.43	38.46	38.50	38.54	970
980	38.58	38.62	38.66	38.70	38.74	38.78	38.82	38.86	38.90	38.94	980
990	38.98	39.02	39.06	39.09	39.13	39.17	39.21	39.25	39.29	39.33	990
1000	39.37	39.41	39.45	39.49	39.53	39.57	39.61	39.65	39.68	39.72	1000

Linear Conversion

Inches to Millimeters

(1 inch = 25.4 millimeters)

In.	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
0	0.0	1.6	3.2	4.8	6.4	7.9	9.5	11.1	12.7	14.3	15.9	17.5	19.1	20.6	22.2	23.8
1	25.4	27.0	28.6	30.2	31.8	33.3	34.9	36.5	38.1	39.7	41.3	42.9	44.5	46.0	47.6	49.2
2	50.8	52.4	54.0	55.6	57.2	58.7	60.3	61.9	63.5	65.1	66.7	68.3	69.9	71.4	73.0	74.6
3	76.2	77.8	79.4	81.0	82.6	84.1	85.7	87.3	88.9	90.5	92.1	93.7	95.3	96.8	98.4	100.0
4	101.6	103.2	104.8	106.4	108.0	109.5	111.1	112.7	114.3	115.9	117.5	119.1	120.7	122.2	123.8	125.4
5	127.0	128.6	130.2	131.8	133.4	134.9	136.5	138.1	139.7	141.3	142.9	144.5	146.1	147.6	149.2	150.8
6	152.4	154.0	155.6	157.2	158.8	160.3	161.9	163.5	165.1	166.7	168.3	169.9	171.5	173.0	174.6	176.2
7	177.8	179.4	181.0	182.6	184.2	185.7	187.3	188.9	190.5	192.1	193.7	195.3	196.9	198.4	200.0	201.6
8	203.2	204.8	206.4	208.0	209.6	211.1	212.7	214.3	215.9	217.5	219.1	220.7	222.3	223.8	225.4	227.0
9	228.6	230.2	231.8	233.4	235.0	236.5	238.1	239.7	241.3	242.9	244.5	246.1	247.7	249.2	250.8	252.4
10	254.0	255.6	257.2	258.8	260.4	261.9	263.5	265.1	266.7	268.3	269.9	271.5	273.1	274.6	276.2	277.8
11	279.4	281.0	282.6	284.2	285.8	287.3	288.9	290.5	292.1	293.7	295.3	296.9	298.5	300.0	301.6	303.2
12	304.8	306.4	308.0	309.6	311.2	312.7	314.3	315.9	317.5	319.1	320.7	322.3	323.9	325.4	327.0	328.6
13	330.2	331.8	333.4	335.0	336.6	338.1	339.7	341.3	342.9	344.5	346.1	347.7	349.3	350.8	352.4	354.0
14	355.6	357.2	358.8	360.4	362.0	363.5	365.1	366.7	368.3	369.9	371.5	373.1	374.7	376.2	377.8	379.4
15	381.0	382.6	384.2	385.8	387.4	388.9	390.5	392.1	393.7	395.3	396.9	398.5	400.1	401.6	403.2	404.8
16	406.4	408.0	409.6	411.2	412.8	414.3	415.9	417.5	419.1	420.7	422.3	423.9	425.5	427.0	428.6	430.2
17	431.8	433.4	435.0	436.6	438.2	439.7	441.3	442.9	444.5	446.1	447.7	449.3	450.9	452.4	454.0	455.6
18	457.2	458.8	460.4	462.0	463.6	465.1	466.7	468.3	469.9	471.5	473.1	474.7	476.3	477.8	479.4	481.0
19	482.6	484.2	485.8	487.4	489.0	490.5	492.1	493.7	495.3	496.9	498.5	500.1	501.7	503.2	504.8	506.4
20	508.0	509.6	511.2	512.8	514.4	515.9	517.5	519.1	520.7	522.3	523.9	525.5	527.1	528.6	530.2	531.8
21	533.4	535.0	536.6	538.2	539.8	541.3	542.9	544.5	546.1	547.7	549.3	550.9	552.5	554.0	555.6	557.2
22	558.8	560.4	562.0	563.6	565.2	566.7	568.3	569.9	571.5	573.1	574.7	576.3	577.9	579.4	581.0	582.6
23	584.2	585.8	587.4	589.0	590.6	592.1	593.7	595.3	596.9	598.5	600.1	601.7	603.3	604.8	606.4	608.0
24	609.6	611.2	612.8	614.4	616.0	617.5	619.1	620.7	622.3	623.9	625.5	627.1	628.7	630.2	631.8	633.4
25	635.0	636.6	638.2	639.8	641.4	642.9	644.5	646.1	647.7	649.3	650.9	652.5	654.1	655.6	657.2	658.8
26	660.4	662.0	663.6	665.2	666.8	668.3	669.9	671.5	673.1	674.7	676.3	677.9	679.5	681.0	682.6	684.2
27	685.8	687.4	689.0	690.6	692.2	693.7	695.3	696.9	698.5	700.1	701.7	703.3	704.9	706.4	708.0	709.6
28	711.2	712.8	714.4	716.0	717.6	719.1	720.7	722.3	723.9	725.5	727.1	728.7	730.3	731.8	733.4	735.0
29	736.6	738.2	739.8	714.4	743.0	744.5	746.1	747.7	749.3	750.9	752.5	754.1	755.7	757.2	758.8	760.4
30	762.0	763.6	765.2	766.8	768.4	769.9	771.5	773.1	774.7	776.3	777.9	779.5	781.1	782.6	784.2	785.8
31	787.4	789.0	790.6	792.2	793.8	795.3	796.9	798.5	800.1	801.7	803.3	804.9	806.5	808.0	809.6	811.2
32	812.8	814.4	816.0	817.6	819.2	820.7	822.3	823.9	825.5	827.1	828.7	830.3	831.9	833.4	835.0	836.6
33	838.2	839.8	841.4	843.0	844.6	846.1	847.7	849.3	850.9	852.5	854.1	855.7	857.3	858.8	860.4	862.0
34	863.6	865.2	866.8	868.4	870.0	871.5	873.1	874.7	876.3	877.9	879.5	881.1	882.7	884.2	885.8	887.4
35	889.0	890.6	892.2	893.8	895.4	896.9	898.5	900.1	901.7	903.3	904.9	906.5	908.1	909.6	911.2	912.8
36	914.4	916.0	917.6	919.2	920.8	922.3	923.9	925.5	927.1	928.7	930.3	931.9	933.5	935.0	936.6	938.2
37	939.8	941.4	943.0	944.6	946.2	947.7	949.3	950.9	952.5	954.1	955.7	957.3	958.9	960.4	962.0	963.6
38	965.2	966.8	968.4	970.0	971.6	973.1	974.7	976.3	977.9	979.5	981.1	982.7	984.3	985.8	987.4	989.0
39	990.6	992.2	993.8	995.4	997.0	998.5	1000.1	1001.7	1003.3	1004.9	1006.5	1008.1	1009.7	1011.2	1012.8	1014.4
40	1016.0	1017.6	1019.2	1020.8	1022.4	1023.9	1025.5	1027.1	1028.7	1030.3	1031.9	1033.5	1035.1	1036.6	1038.2	1039.8
41	1041.4	1043.0	1044.6	1046.2	1047.8	1049.3	1050.9	1052.5	1054.1	1055.7	1057.3	1058.9	1060.5	1062.0	1063.6	1065.2
42	1066.8	1068.4	1070.0	1071.6	1073.2	1074.7	1076.3	1077.9	1079.5	1081.1	1082.7	1084.3	1085.9	1087.4	1089.0	1090.6
43	1092.2	1093.8	1095.4	1097.0	1098.6	1100.1	1101.7	1103.3	1104.9	1106.5	1108.1	1109.7	1111.3	1112.8	1114.4	1116.0
44	1117.6	1119.2	1120.8	1122.4	1124.0	1125.5	1127.1	1128.7	1130.3	1131.9	1133.5	1135.1	1136.7	1138.2	1139.8	1141.4
45	1143.0	1144.6	1146.2	1147.8	1149.4	1150.9	1152.5	1154.1	1155.7	1157.3	1158.9	1160.5	1162.1	1163.6	1165.2	1166.8
46	1168.4	1170.0	1171.6	1173.2	1174.8	1176.3	1177.9	1179.5	1181.1	1182.7	1184.3	1185.9	1187.5	1189.0	1190.6	1192.2
47	1193.8	1195.4	1197.0	1198.6	1200.2	1201.7	1203.3	1204.9	1206.5	1208 1	1209.7	1211.3	1212.9	1214.4	1216.0	1217.6
48	1219.2	1220.8	1222.4	1224.0	1225.6	1227.1	1228.7	1230.3	1231.9	1233.5	1235.1	1236.7	1238.3	1239.8	1241.4	1243.0
49	1244.6	1246.2	1247.8	1249.4	1251.0	1252.5	1254.1	1255.7	1257.3	1258.9	1260.5	1262.1	1263.7	1265.2	1266.8	1268.4
50	1270.0	1271.6	1273.2	1274.8	1276.4	1277.9	1279.5	1281.1	1282.7	1284.3	1285.9	1287.5	1289.1	1290.6	1292.2	1293.8

Temperature Conversion

−459.4 to 0			1 to 60			61 to 290			300 to 890			900 to 3000		
C	C / F	F	C	C / F	F	C	C / F	F	C	C / F	F	C	C / F	F
−273	−459.4		−17.2	1	33.8	16.1	61	141.8	149	300	572	482	900	1652
−268	−450		−16.7	2	35.6	16.7	62	143.6	154	310	590	488	910	1670
−262	−440		−16.1	3	37.4	17.2	63	145.4	160	320	608	493	920	1688
−257	−430		−15.6	4	39.2	17.8	64	147.2	166	330	626	499	930	1706
−251	−420		−15.0	5	41.0	18.3	65	149.0	171	340	644	504	940	1724
−246	−410		−14.4	6	42.8	18.9	66	150.8	177	350	662	510	950	1742
−240	−400		−13.9	7	44.6	19.4	67	152.6	182	360	680	516	960	1760
−234	−390		−13.3	8	46.4	20.0	68	154.4	188	370	698	521	970	1778
−229	−380		−12.8	9	48.2	20.6	69	156.2	193	380	716	527	980	1796
−223	−370		−12.2	10	50.0	21.1	70	158.0	199	390	734	532	990	1814
−218	−360		−11.7	11	51.8	21.7	71	159.8	204	400	752	538	1000	1832
−212	−350		−11.1	12	53.6	22.2	72	161.6	210	410	770	549	1020	1868
−207	−340		−10.6	13	55.4	22.8	73	163.4	216	420	788	560	1040	1904
−201	−330		−10.0	14	57.2	23.3	74	165.2	221	430	806	571	1060	1940
−196	−320		− 9.4	15	59.0	23.9	75	167.0	227	440	824	582	1080	1976
−190	−310		− 8.9	16	60.8	24.4	76	168.8	232	450	842	593	1100	2012
−184	−300		− 8.3	17	62.6	25.0	77	170.6	238	460	860	604	1120	2048
−179	−290		− 7.8	18	64.4	25.6	78	172.4	243	470	878	616	1140	2084
−173	−280		− 7.2	19	66.2	26.1	79	174.2	249	480	896	627	1160	2120
−169	−273	−459.4	− 6.7	20	68.0	26.7	80	176.0	254	490	914	638	1180	2156
−168	−270	−454	− 6.1	21	69.8	27.2	81	177.8	260	500	932	649	1200	2192
−162	−260	−436	− 5.6	22	71.6	27.8	82	179.6	266	510	950	660	1220	2228
−157	−250	−418	− 5.0	23	73.4	28.3	83	181.4	271	520	968	671	1240	2264
−151	−240	−400	− 4.4	24	75.2	28.9	84	183.2	277	530	986	682	1260	2300
−146	−230	−382	− 3.9	25	77.0	29.4	85	185.0	282	540	1004	693	1280	2336
−140	−220	−364	− 3.3	26	78.8	30.0	86	186.8	288	550	1022	704	1300	2372
−134	−210	−346	− 2.8	27	80.6	30.6	87	188.6	293	560	1040	732	1350	2462
−129	−200	−328	− 2.2	28	82.4	31.1	88	190.4	299	570	1058	760	1400	2552
−123	−190	−310	− 1.7	29	84.2	31.7	89	192.2	304	580	1076	788	1450	2642
−118	−180	−292	− 1.1	30	86.0	32.2	90	194.0	310	590	1094	816	1500	2732
−112	−170	−274	− 0.6	31	87.8	32.8	91	195.8	316	600	1112	843	1550	2822
−107	−160	−256	0.0	32	89.6	33.3	92	197.6	321	610	1130	871	1600	2912
−101	−150	−238	0.6	33	91.4	33.9	93	199.4	327	620	1148	899	1650	3002
− 96	−140	−220	1.1	34	93.2	34.4	94	201.2	332	630	1166	927	1700	3092
− 90	−130	−202	1.7	35	95.0	35.0	95	203.0	338	640	1184	954	1750	3182
− 84	−120	−184	2.2	36	96.8	35.6	96	204.8	343	650	1202	982	1800	3272
− 79	−110	−166	2.8	37	98.6	36.1	97	206.6	349	660	1220	1010	1850	3362
− 73	−100	−148	3.3	38	100.4	36.7	98	208.4	354	670	1238	1038	1900	3452
− 68	− 90	−130	3.9	39	102.2	37.2	99	210.2	360	680	1256	1066	1950	3542
− 62	− 80	−112	4.4	40	104.0	37.8	100	212.0	366	690	1274	1093	2000	3632
− 57	− 70	− 94	5.0	41	105.8	43	110	230	371	700	1292	1121	2050	3722
− 51	− 60	− 76	5.6	42	107.6	49	120	248	377	710	1310	1149	2100	3812
− 46	− 50	− 58	6.1	43	109.4	54	130	266	382	720	1328	1177	2150	3902
− 40	− 40	− 40	6.7	44	111.2	60	140	284	388	730	1346	1204	2200	3992
− 34	− 30	− 22	7.2	45	113.0	66	150	302	393	740	1364	1232	2250	4082
− 29	− 20	− 4	7.8	46	114.8	71	160	320	399	750	1382	1260	2300	4172
− 23	− 10	14	8.3	47	116.6	77	170	338	404	760	1400	1288	2350	4262
− 17.8	0	32	8.9	48	118.4	82	180	356	410	770	1418	1316	2400	4352
			9.4	49	120.2	88	190	374	416	780	1436	1343	2450	4442
			10.0	50	122.0	93	200	392	421	790	1454	1371	2500	4532
			10.6	51	123.8	99	210	410	427	800	1472	1399	2550	4622
			11.1	52	125.6	100	212	413.6	432	810	1490	1427	2600	4712
			11.7	53	127.4	104	220	428	438	820	1508	1454	2650	4802
			12.2	54	129.2	110	230	446	443	830	1526	1482	2700	4892
			12.8	55	131.0	116	240	464	449	840	1544	1510	2750	4982
			13.3	56	132.8	121	250	482	454	850	1562	1538	2800	5072
			13.9	57	134.6	127	260	500	460	860	1580	1566	2850	5162
			14.4	58	136.4	132	270	518	466	870	1598	1593	2900	5252
			15.0	59	138.2	138	280	536	471	880	1616	1621	2950	5342
			15.6	60	140.0	143	290	554	477	890	1634	1649	3000	5432

Locate temperature in middle column. If in degrees Centigrade, read Fahrenheit equivalent in right hand column; if in degrees Fahrenheit, read Centigrade equivalent in left hand column.

Abstracted from "Bethlehem Alloy Steels". (Albert Sauveur type of table. Values revised.) Courtesy Bethlehem Steel Company.

Weight Conversion

Pounds to Kilograms

(1 pound = 0.4536 kilogram)

Pounds	0	1	2	3	4	5	6	7	8	9
0	0.00	0.45	0.91	1.36	1.81	2.27	2.72	3.18	3.63	4.08
10	4.54	4.99	5.44	5.90	6.35	6.80	7.26	7.71	8.16	8.62
20	9.07	9.53	9.98	10.43	10.89	11.34	11.79	12.25	12.70	13.15
30	13.61	14.06	14.52	14.97	15.42	15.88	16.33	16.78	17.24	17.69
40	18.14	18.60	19.05	19.50	19.96	20.41	20.87	21.32	21.77	22.23
50	22.68	23.13	23.59	24.04	24.49	24.95	25.40	25.86	26.31	26.76
60	27.22	27.67	28.12	28.58	29.03	29.48	29.94	30.39	30.84	31.30
70	31.75	32.21	32.66	33.11	33.57	34.02	34.47	34.93	35.38	35.83
80	36.29	36.74	37.20	37.65	38.10	38.56	39.01	39.46	39.92	40.37
90	40.82	41.28	41.73	42.18	42.64	43.09	43.55	44.00	44.45	44.91

Kilograms to Pounds

(1 kilogram = 2.2046 pounds)

Kilograms	0	1	2	3	4	5	6	7	8	9
0	0.00	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	52.91	55.12	57.32	59.52	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.77	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.43	114.64	116.84	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.09	143.30	145.50	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.75	171.96	174.16
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.00	196.21
90	198.41	200.62	202.82	205.03	207.23	209.44	211.64	213.85	216.05	218.26

Pressure Conversion

Pounds per Square Inch to Kilograms per Square Centimeter

(1 pound per square inch = .0703066 kilogram per square centimeter)

1 to 30		31 to 60		61 to 90		91 to 200		205 to 400		410 to 700		710 to 1000		1010 to 1500	
Lbs. per Sq. Inch	Kg. per Sq. Cm.	Lbs. per Sq. Inch	Kg. per Sq. Cm.	Lbs. per Sq. Inch	Kg. per Sq. Cm.	Lbs. per Sq. Inch	Kg. per Sq. Cm.	Lbs. per Sq. Inch	Kg. per Sq. Cm.	Lbs. per Sq. Inch	Kg. per Sq. Cm.	Lbs. per Sq. Inch	Kg. per Sq. Cm.	Lbs. per Sq. Inch	Kg. per Sq. Cm.
1	.07	31	2.18	61	4.29	91	6.40	205	14.41	410	28.83	710	49.92	1010	71.01
2	.14	32	2.25	62	4.36	92	6.47	210	14.76	420	29.53	720	50.62	1020	71.71
3	.21	33	2.32	63	4.43	93	6.54	215	15.12	430	30.23	730	51.32	1030	72.42
4	.28	34	2.39	64	4.50	94	6.61	220	15.47	440	30.93	740	52.03	1040	73.12
5	.35	35	2.46	65	4.57	95	6.68	225	15.82	450	31.64	750	52.73	1050	73.82
6	.42	36	2.53	66	4.64	96	6.75	230	16.17	460	32.34	760	53.43	1060	74.52
7	.49	37	2.60	67	4.71	97	6.82	235	16.52	470	33.04	770	54.14	1070	75.23
8	.56	38	2.67	68	4.78	98	6.89	240	16.87	480	33.75	780	54.84	1080	75.93
9	.63	39	2.74	69	4.85	99	6.96	245	17.23	490	34.45	790	55.54	1090	76.63
10	.70	40	2.81	70	4.92	100	7.03	250	17.58	500	35.15	800	56.25	1100	77.34
11	.77	41	2.88	71	4.99	105	7.38	255	17.93	510	35.86	810	56.95	1120	78.74
12	.84	42	2.95	72	5.06	110	7.73	260	18.28	520	36.56	820	57.65	1140	80.15
13	.91	43	3.02	73	5.13	115	8.09	265	18.63	530	37.26	830	58.35	1160	81.56
14	.98	44	3.09	74	5.20	120	8.44	270	18.98	540	37.97	840	59.06	1180	82.96
15	1.05	45	3.16	75	5.27	125	8.79	275	19.33	550	38.67	850	59.76	1200	84.37
16	1.12	46	3.23	76	5.34	130	9.14	280	19.69	560	39.37	860	60.46	1220	85.77
17	1.20	47	3.30	77	5.41	135	9.49	285	20.04	570	40.07	870	61.17	1240	87.18
18	1.27	48	3.37	78	5.48	140	9.84	290	20.39	580	40.78	880	61.87	1260	88.59
19	1.34	49	3.45	79	5.55	145	10.19	295	20.74	590	41.48	890	62.57	1280	89.99
20	1.41	50	3.52	80	5.62	150	10.55	300	21.09	600	42.18	900	63.28	1300	91.40
21	1.48	51	3.59	81	5.69	155	10.90	310	21.80	610	42.89	910	63.98	1320	92.80
22	1.55	52	3.66	82	5.77	160	11.25	320	22.50	620	43.59	920	64.68	1340	94.21
23	1.62	53	3.73	83	5.84	165	11.60	330	23.20	630	44.29	930	65.39	1360	95.62
24	1.69	54	3.80	84	5.91	170	11.95	340	23.90	640	45.00	940	66.09	1380	97.02
25	1.76	55	3.87	85	5.98	175	12.30	350	24.61	650	45.70	950	66.79	1400	98.43
26	1.83	56	3.94	86	6.05	180	12.66	360	25.31	660	46.40	960	67.49	1420	99.84
27	1.90	57	4.01	87	6.12	185	13.01	370	26.01	670	47.11	970	68.20	1440	101.24
28	1.97	58	4.08	88	6.19	190	13.36	380	26.72	680	47.81	980	68.90	1460	102.65
29	2.04	59	4.15	89	6.26	195	13.71	390	27.42	690	48.51	990	69.60	1480	104.05
30	2.11	60	4.22	90	6.33	200	14.06	400	28.12	700	49.21	1000	70.31	1500	105.46

Circumferences and Areas of Circles (Cont.)

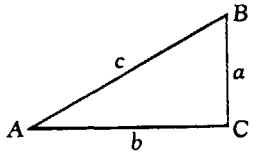
Dia.	Circum.	Area	Dia.	Circum.	Area	Dia.	Circum.	Area	Dia.	Circum.	Area	Dia.	Circum.	Area
30	94.248	706.86	37	116.239	1075.2	44	138.230	1520.5	51	160.221	2042.8	58	182.212	2642.1
1/8	94.640	712.76	1/8	116.632	1082.5	1/8	138.623	1529.2	1/8	160.614	2052.8	1/8	182.605	2653.5
1/4	95.033	718.69	1/4	117.024	1089.8	1/4	139.015	1537.9	1/4	161.007	2062.9	1/4	182.998	2664.9
3/8	95.426	724.64	3/8	117.417	1097.1	3/8	139.408	1546.6	3/8	161.399	2073.0	3/8	183.390	2676.4
1/2	95.819	730.62	1/2	117.810	1104.5	1/2	139.801	1555.3	1/2	161.792	2083.1	1/2	183.783	2687.8
5/8	96.211	736.62	5/8	118.202	1111.8	5/8	140.194	1564.0	5/8	162.185	2093.2	5/8	184.176	2699.3
3/4	96.604	742.64	3/4	118.596	1119.2	3/4	140.586	1572.8	3/4	162.577	2103.3	3/4	184.569	2710.9
7/8	96.997	748.69	7/8	118.988	1126.7	7/8	140.979	1581.6	7/8	162.970	2113.5	7/8	184.961	2722.4
31	97.389	754.77	38	119.381	1134.1	45	141.372	1590.4	52	163.363	2123.7	59	185.354	2734.0
1/8	97.782	760.87	1/8	119.773	1141.6	1/8	141.764	1599.3	1/8	163.756	2133.9	1/8	185.747	2745.6
1/4	98.175	766.99	1/4	120.166	1149.1	1/4	142.157	1608.2	1/4	164.148	2144.2	1/4	186.139	2757.2
3/8	98.567	773.14	3/8	120.559	1156.6	3/8	142.550	1617.0	3/8	164.541	2154.5	3/8	186.532	2768.8
1/2	98.960	779.31	1/2	120.951	1164.2	1/2	142.942	1626.0	1/2	164.934	2164.8	1/2	186.925	2780.5
5/8	99.353	785.51	5/8	121.344	1171.7	5/8	143.335	1634.9	5/8	165.326	2175.1	5/8	187.317	2792.2
3/4	99.746	791.73	3/4	121.737	1179.3	3/4	143.728	1643.9	3/4	165.719	2185.4	3/4	187.710	2803.9
7/8	100.138	797.98	7/8	122.129	1186.9	7/8	144.121	1652.9	7/8	166.112	2195.8	7/8	188.103	2815.7
32	100.531	804.25	39	122.522	1194.6	46	144.513	1661.9	53	166.504	2206.2	60	188.496	2827.4
1/8	100.924	810.54	1/8	122.915	1202.3	1/8	144.906	1670.9	1/8	166.897	2216.6	1/8	188.888	2839.2
1/4	101.316	816.86	1/4	123.308	1210.0	1/4	145.299	1680.0	1/4	167.290	2227.0	1/4	189.281	2851.0
3/8	101.709	823.21	3/8	123.700	1217.7	3/8	145.691	1689.1	3/8	167.683	2237.5	3/8	189.674	2862.9
1/2	102.102	829.58	1/2	124.093	1225.4	1/2	146.084	1698.2	1/2	168.075	2248.0	1/2	190.066	2874.8
5/8	102.494	835.97	5/8	124.486	1233.2	5/8	146.477	1707.4	5/8	168.468	2258.5	5/8	190.459	2886.6
3/4	102.887	842.39	3/4	124.878	1241.0	3/4	146.869	1716.5	3/4	168.861	2269.1	3/4	190.852	2898.6
7/8	103.280	848.83	7/8	125.271	1248.8	7/8	147.262	1725.7	7/8	169.253	2279.6	7/8	191.244	2910.5
33	103.673	855.30	40	125.664	1256.6	47	147.655	1734.9	54	169.646	2290.2	61	191.637	2922.5
1/8	104.065	861.79	1/8	126.056	1264.5	1/8	148.048	1744.2	1/8	170.039	2300.8	1/8	192.030	2934.5
1/4	104.458	868.31	1/4	126.449	1272.4	1/4	148.440	1753.5	1/4	170.431	2311.5	1/4	192.423	2946.5
3/8	104.851	874.85	3/8	126.842	1280.3	3/8	148.833	1762.7	3/8	170.824	2322.1	3/8	192.815	2958.5
1/2	105.243	881.41	1/2	127.235	1288.2	1/2	149.226	1772.1	1/2	171.217	2332.8	1/2	193.208	2970.6
5/8	105.636	888.00	5/8	127.627	1296.2	5/8	149.618	1781.4	5/8	171.609	2343.5	5/8	193.601	2982.7
3/4	106.029	894.62	3/4	128.020	1304.2	3/4	150.011	1790.8	3/4	172.002	2354.3	3/4	193.993	2994.8
7/8	106.421	901.26	7/8	128.413	1312.2	7/8	150.404	1800.1	7/8	172.395	2365.0	7/8	194.386	3006.9
34	106.814	907.92	41	128.805	1320.3	48	150.796	1809.6	55	172.788	2375.8	62	194.779	3019.1
1/8	107.207	914.61	1/8	129.198	1328.3	1/8	151.189	1819.0	1/8	173.180	2386.6	1/8	195.171	3031.3
1/4	107.600	921.32	1/4	129.591	1336.4	1/4	151.582	1828.5	1/4	173.573	2397.5	1/4	195.564	3043.5
3/8	107.992	928.06	3/8	129.983	1344.5	3/8	151.975	1837.9	3/8	173.966	2408.3	3/8	195.957	3055.7
1/2	108.385	934.82	1/2	130.376	1352.7	1/2	152.367	1847.5	1/2	174.358	2419.2	1/2	196.350	3068.0
5/8	108.778	941.61	5/8	130.769	1360.8	5/8	152.760	1857.0	5/8	174.751	2430.1	5/8	196.742	3080.3
3/4	109.170	948.42	3/4	131.161	1369.0	3/4	153.153	1866.5	3/4	175.144	2441.1	3/4	197.135	3092.6
7/8	109.563	955.25	7/8	131.554	1377.2	7/8	153.545	1876.1	7/8	175.536	2452.0	7/8	197.528	3104.9
35	109.956	962.11	42	131.947	1385.4	49	153.938	1885.7	56	175.929	2463.0	63	197.920	3117.2
1/8	110.348	969.00	1/8	132.340	1393.7	1/8	154.331	1895.4	1/8	176.322	2474.0	1/8	198.313	3129.6
1/4	110.741	975.91	1/4	132.732	1402.0	1/4	154.723	1905.0	1/4	176.715	2485.0	1/4	198.706	3142.0
3/8	111.134	982.84	3/8	133.125	1410.3	3/8	155.116	1914.7	3/8	177.107	2496.1	3/8	199.098	3154.5
1/2	111.527	989.80	1/2	133.518	1418.6	1/2	155.509	1924.4	1/2	177.500	2507.2	1/2	199.491	3166.9
5/8	111.919	996.78	5/8	133.910	1427.0	5/8	155.902	1934.2	5/8	177.893	2518.3	5/8	199.884	3179.4
3/4	112.312	1003.8	3/4	134.303	1435.4	3/4	156.294	1943.9	3/4	178.285	2529.4	3/4	200.277	3191.9
7/8	112.705	1010.8	7/8	134.696	1443.8	7/8	156.687	1953.7	7/8	178.678	2540.6	7/8	200.669	3204.4
36	113.097	1017.9	43	135.088	1452.2	50	157.080	1963.5	57	179.071	2551.8	64	201.062	3217.0
1/8	113.490	1025.0	1/8	135.481	1460.7	1/8	157.472	1973.3	1/8	179.463	2563.0	1/8	201.455	3229.6
1/4	113.883	1032.1	1/4	135.874	1469.1	1/4	157.865	1983.2	1/4	179.856	2574.2	1/4	201.847	3242.2
3/8	114.275	1039.2	3/8	136.267	1477.6	3/8	158.258	1993.1	3/8	180.249	2585.4	3/8	202.240	3254.8
1/2	114.668	1046.3	1/2	136.659	1486.2	1/2	158.650	2003.0	1/2	180.642	2596.7	1/2	202.633	3267.5
5/8	115.061	1053.5	5/8	137.052	1494.7	5/8	159.043	2012.9	5/8	181.034	2608.0	5/8	203.025	3280.1
3/4	115.454	1060.7	3/4	137.445	1503.3	3/4	159.436	2022.8	3/4	181.427	2619.4	3/4	203.418	3292.8
7/8	115.846	1068.0	7/8	137.837	1511.9	7/8	159.829	2032.8	7/8	181.820	2630.7	7/8	203.811	3305.6

Circumferences and Areas of Circles (Cont.)

Dia.	Circum.	Area	Dia.	Circum.	Area	Dia.	Circum.	Area	Dia.	Circum.	Area	Dia.	Circum.	Area
65	204.204	3318.3	72	226.195	4071.5	79	248.186	4901.7	86	270.177	5808.8	93	292.168	6792.9
1/8	204.596	3331.1	1/8	226.587	4085.7	1/8	248.579	4917.2	1/8	270.570	5825.7	1/8	292.561	6811.2
1/4	204.989	3343.9	1/4	226.980	4099.8	1/4	248.971	4932.7	1/4	270.962	5842.6	1/4	292.954	6829.5
3/8	205.382	3356.7	3/8	227.373	4114.0	3/8	249.364	4948.3	3/8	271.355	5859.6	3/8	293.346	6847.8
1/2	205.774	3369.6	1/2	227.765	4128.2	1/2	249.757	4963.9	1/2	271.748	5876.5	1/2	293.739	6866.1
5/8	206.167	3382.4	5/8	228.158	4142.5	5/8	250.149	4979.5	5/8	272.140	5893.5	5/8	294.132	6884.5
3/4	206.560	3395.3	3/4	228.551	4156.8	3/4	250.542	4995.2	3/4	272.533	5910.6	3/4	294.524	6902.9
7/8	206.952	3408.2	7/8	228.944	4171.1	7/8	250.935	5010.9	7/8	272.926	5927.6	7/8	294.917	6921.3
66	207.345	3421.2	73	229.336	4185.4	80	251.327	5026.5	87	273.319	5944.7	94	295.310	6939.8
1/8	207.738	3434.2	1/8	229.729	4199.7	1/8	251.720	5042.3	1/8	273.711	5961.8	1/8	295.702	6958.2
1/4	208.131	3447.2	1/4	230.122	4214.1	1/4	252.113	5058.0	1/4	274.104	5978.9	1/4	296.095	6976.7
3/8	208.523	3460.2	3/8	230.514	4228.5	3/8	252.506	5073.8	3/8	274.497	5996.0	3/8	296.488	6995.3
1/2	208.916	3473.2	1/2	230.907	4242.9	1/2	252.898	5089.6	1/2	274.889	6013.2	1/2	296.881	7013.8
5/8	209.309	3486.3	5/8	231.300	4257.4	5/8	253.291	5105.4	5/8	275.282	6030.4	5/8	297.273	7032.4
3/4	209.701	3499.4	3/4	231.692	4271.8	3/4	253.684	5121.2	3/4	275.675	6047.6	3/4	297.666	7051.0
7/8	210.094	3512.5	7/8	232.085	4286.3	7/8	254.076	5137.1	7/8	276.067	6064.9	7/8	298.059	7069.6
67	210.487	3525.7	74	232.478	4300.8	81	254.469	5153.0	88	276.460	6082.1	95	298.451	7088.2
1/8	210.879	3538.8	1/8	232.871	4315.4	1/8	254.862	5168.9	1/8	276.853	6099.4	1/8	298.844	7106.9
1/4	211.272	3552.0	1/4	233.263	4329.9	1/4	255.254	5184.9	1/4	277.246	6116.7	1/4	299.237	7125.6
3/8	211.665	3565.2	3/8	233.656	4344.5	3/8	255.647	5200.8	3/8	277.638	6134.1	3/8	299.629	7144.3
1/2	212.058	3578.5	1/2	234.049	4359.2	1/2	256.040	5216.8	1/2	278.031	6151.4	1/2	300.022	7163.0
5/8	212.450	3591.7	5/8	234.441	4373.8	5/8	256.433	5232.8	5/8	278.424	6168.8	5/8	300.415	7181.8
3/4	212.843	3605.0	3/4	234.834	4388.5	3/4	256.825	5248.9	3/4	278.816	6186.2	3/4	300.807	7200.6
7/8	213.236	3618.3	7/8	235.227	4403.1	7/8	257.218	5264.9	7/8	279.209	6203.7	7/8	301.200	7219.4
68	213.628	3631.7	75	235.619	4417.9	82	257.611	5281.0	89	279.602	6221.1	96	301.593	7238.2
1/8	214.021	3645.0	1/8	236.012	4432.6	1/8	258.003	5297.1	1/8	279.994	6238.6	1/8	301.986	7257.1
1/4	214.414	3658.4	1/4	236.405	4447.4	1/4	258.396	5313.3	1/4	280.387	6256.1	1/4	302.378	7276.0
3/8	214.806	3671.8	3/8	236.798	4462.2	3/8	258.789	5329.4	3/8	280.780	6273.7	3/8	302.771	7294.9
1/2	215.199	3685.3	1/2	237.190	4477.0	1/2	259.181	5345.6	1/2	281.173	6291.2	1/2	303.164	7313.8
5/8	215.592	3698.7	5/8	237.583	4491.8	5/8	259.574	5361.8	5/8	281.565	6308.8	5/8	303.556	7332.8
3/4	215.984	3712.2	3/4	237.976	4506.7	3/4	259.967	5378.1	3/4	281.958	6326.4	3/4	303.949	7351.8
7/8	216.377	3725.7	7/8	238.368	4521.5	7/8	260.359	5394.3	7/8	282.351	6344.1	7/8	304.342	7370.8
69	216.770	3739.3	76	238.761	4536.5	83	260.752	5410.6	90	282.743	6361.7	97	304.734	7389.8
1/8	217.163	3752.8	1/8	239.154	4551.4	1/8	261.145	5426.9	1/8	283.136	6379.4	1/8	305.127	7408.9
1/4	217.555	3766.4	1/4	239.546	4566.4	1/4	261.538	5443.3	1/4	283.529	6397.1	1/4	305.520	7428.0
3/8	217.948	3780.0	3/8	239.939	4581.3	3/8	261.930	5459.6	3/8	283.921	6414.9	3/8	305.913	7447.1
1/2	218.341	3793.7	1/2	240.332	4596.3	1/2	262.323	5476.0	1/2	284.314	6432.6	1/2	306.305	7466.2
5/8	218.733	3807.3	5/8	240.725	4611.4	5/8	262.716	5492.4	5/8	284.707	6450.4	5/8	306.698	7485.3
3/4	219.126	3821.0	3/4	241.117	4626.4	3/4	263.108	5508.8	3/4	285.100	6468.2	3/4	307.091	7504.5
7/8	219.519	3834.7	7/8	241.510	4641.5	7/8	263.501	5525.3	7/8	285.492	6486.0	7/8	307.483	7523.7
70	219.911	3848.5	77	241.903	4656.6	84	263.894	5541.8	91	285.885	6503.9	98	307.876	7543.0
1/8	220.304	3862.2	1/8	242.295	4671.8	1/8	264.286	5558.3	1/8	286.278	6521.8	1/8	308.269	7562.2
1/4	220.697	3876.0	1/4	242.688	4686.9	1/4	264.679	5574.8	1/4	286.670	6539.7	1/4	308.661	7581.5
3/8	221.090	3889.8	3/8	243.081	4702.1	3/8	265.072	5591.4	3/8	287.063	6557.6	3/8	309.054	7600.8
1/2	221.482	3903.6	1/2	243.473	4717.3	1/2	265.465	5607.9	1/2	287.456	6575.5	1/2	309.447	7620.1
5/8	221.875	3917.5	5/8	243.866	4732.5	5/8	265.857	5624.5	5/8	287.848	6593.5	5/8	309.840	7639.5
3/4	222.268	3931.4	3/4	244.259	4747.8	3/4	266.250	5641.2	3/4	288.241	6611.5	3/4	310.232	7658.9
7/8	222.660	3945.3	7/8	244.652	4763.1	7/8	266.643	5657.8	7/8	288.634	6629.6	7/8	310.625	7678.3
71	223.053	3959.2	78	245.044	4778.4	85	267.035	5674.5	92	289.027	6647.6	99	311.018	7697.7
1/8	223.446	3973.1	1/8	245.437	4793.7	1/8	267.428	5691.2	1/8	289.419	6665.7	1/8	311.410	7717.1
1/4	223.838	3987.1	1/4	245.830	4809.0	1/4	267.821	5707.9	1/4	289.812	6683.8	1/4	311.803	7736.6
3/8	224.231	4001.1	3/8	246.222	4824.4	3/8	268.213	5724.7	3/8	290.205	6701.9	3/8	312.196	7756.1
1/2	224.624	4015.2	1/2	246.615	4839.8	1/2	268.606	5741.5	1/2	290.597	6720.1	1/2	312.588	7775.6
5/8	225.017	4029.2	5/8	247.008	4855.2	5/8	268.999	5758.3	5/8	290.990	6738.2	5/8	312.981	7795.2
3/4	225.409	4043.3	3/4	247.400	4870.7	3/4	269.392	5775.1	3/4	291.383	6756.4	3/4	313.374	7814.8
7/8	225.802	4057.4	7/8	247.793	4886.2	7/8	269.784	5791.9	7/8	291.775	6774.7	7/8	313.767	7834.4
												100	314.159	7854.0

Mensuration of Plane Figures

Right Triangle



Angles $A + B = 90°$

$\sin A = \frac{a}{c}$

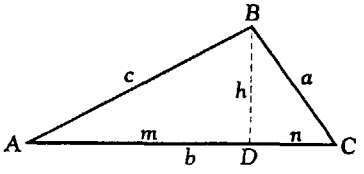
$\cos A = \frac{b}{c}$

$\tan A = \frac{a}{b}$

$a^2 + b^2 = c^2$

Area $= \frac{1}{2}ab$

Oblique Triangle



$\overline{AB} = c$ $\quad \overline{BC} = a$

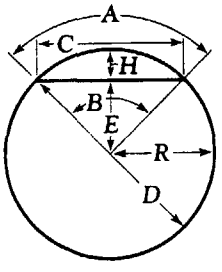
$\overline{AC} = b$ $\quad \overline{BD} = h$

$\overline{AD} = m$ $\quad \overline{DC} = n$

A, B and C are angles

Given	Required	Formulas
A, B, a	C, b, c	$C = 180° - A - B$; $b = \frac{a \sin B}{\sin A}$; $c = \frac{a \sin C}{\sin A}$
b, c, A	B, C, a	$\cos B = \frac{c^2 + a^2 - b^2}{2ac}$; $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$ $a^2 = b^2 + c^2 - 2bc \cos A$; $h = c \sin A$ $m = c \cos A$; $n = b - m$; $a^2 = h^2 + n^2$
a, c, A	B, C, b	$\sin C = \sin A \times \frac{c}{a}$; $B = 180° - A - C$ $b = a \frac{\sin B}{\sin A}$ Note: In some cases two values for B, C and b are possible
a, b, c	A	$\sin \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{b \times c}}$ $\cos \frac{A}{2} = \sqrt{\frac{s(s-a)}{b \times c}}$ $\quad s = \frac{1}{2}(a+b+c)$ $\tan \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$
a, b, c	m, n	$m = \frac{c^2 + b^2 - a^2}{2b}$; $n = \frac{a^2 + b^2 - c^2}{2b}$

Circle



B = Angle in Degrees
A = Length of Arc

Circumference $= \pi D = 2\pi R$

Area $= \pi R^2$

$A = \frac{\pi RB}{180}$

$C = 2\sqrt{2HR - H^2} = 2R \sin \frac{B}{2}$

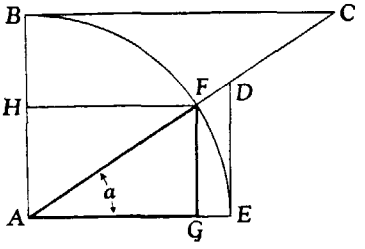
$H = R - \frac{1}{2}\sqrt{4R^2 - C^2} = 2R \sin^2 \frac{B}{4}$

$E = R - H$

Area of Sector $= \frac{1}{2}RA$

Area of Segment $= \frac{1}{2}RA - \frac{1}{2}EC$

Trigonometric Formulae



Radius $AE = 1$

$FG = \sin a$ $\quad BC = \cot a$

$AG = \cos a$ $\quad AD = \sec a$

$DE = \tan a$ $\quad AC = \csc a$

$\sin^2 a + \cos^2 a = 1$

$\tan a = \frac{\sin a}{\cos a}$

$\sec^2 a - \tan^2 a = 1$

$\sin a$		$\sqrt{1 - \cos^2 a}$	$\frac{\tan a}{\sqrt{1 + \tan^2 a}}$	$\frac{1}{\sqrt{1 + \cot^2 a}}$
$\cos a$	$\sqrt{1 - \sin^2 a}$		$\frac{1}{\sqrt{1 + \tan^2 a}}$	$\frac{\cot a}{\sqrt{1 + \cot^2 a}}$
$\tan a$	$\frac{\sin a}{\sqrt{1 - \sin^2 a}}$	$\frac{\sqrt{1 - \cos^2 a}}{\cos a}$		$\frac{1}{\cot a}$
$\cot a$	$\frac{\sqrt{1 - \sin^2 a}}{\sin a}$	$\frac{\cos a}{\sqrt{1 - \cos^2 a}}$	$\frac{1}{\tan a}$	

Natural Trigonometric Functions

Degrees	Sines 0′	10′	20′	30′	40′	50′	60′	Cosines
0	0.00000	0.00291	0.00582	0.00873	0.01164	0.01454	0.01745	89
1	0.01745	0.02036	0.02327	0.02618	0.02908	0.03199	0.03490	88
2	0.03490	0.03781	0.04071	0.04362	0.04653	0.04943	0.05234	87
3	0.05234	0.05524	0.05814	0.06105	0.06395	0.06685	0.06976	86
4	0.06976	0.07266	0.07556	0.07846	0.08136	0.08426	0.08716	85
5	0.08716	0.09005	0.09295	0.09585	0.09874	0.10164	0.10453	84
6	0.10453	0.10742	0.11031	0.11320	0.11609	0.11898	0.12187	83
7	0.12187	0.12476	0.12764	0.13053	0.13341	0.13629	0.13917	82
8	0.13917	0.14205	0.14493	0.14781	0.15069	0.15356	0.15643	81
9	0.15643	0.15931	0.16218	0.16505	0.16792	0.17078	0.17365	80
10	0.17365	0.17651	0.17937	0.18224	0.18509	0.18795	0.19081	79
11	0.19081	0.19366	0.19652	0.19937	0.20222	0.20507	0.20791	78
12	0.20791	0.21076	0.21360	0.21644	0.21928	0.22212	0.22495	77
13	0.22495	0.22778	0.23062	0.23345	0.23627	0.23910	0.24192	76
14	0.24192	0.24474	0.24756	0.25038	0.25320	0.25601	0.25882	75
15	0.25882	0.26163	0.26443	0.26724	0.27004	0.27284	0.27564	74
16	0.27564	0.27843	0.28123	0.28402	0.28680	0.28959	0.29237	73
17	0.29237	0.29515	0.29793	0.30071	0.30348	0.30625	0.30902	72
18	0.30902	0.31178	0.31454	0.31730	0.32006	0.32282	0.32557	71
19	0.32557	0.32832	0.33106	0.33381	0.33655	0.33929	0.34202	70
20	0.34202	0.34475	0.34748	0.35021	0.35293	0.35565	0.35837	69
21	0.35837	0.36108	0.36379	0.36650	0.36921	0.37191	0.37461	68
22	0.37461	0.37730	0.37999	0.38268	0.38537	0.38805	0.39073	67
23	0.39073	0.39341	0.39608	0.39875	0.40141	0.40408	0.40674	66
24	0.40674	0.40939	0.41204	0.41469	0.41734	0.41998	0.42262	65
25	0.42262	0.42525	0.42788	0.43051	0.43313	0.43575	0.43837	64
26	0.43837	0.44098	0.44359	0.44620	0.44880	0.45140	0.45399	63
27	0.45399	0.45658	0.45917	0.46175	0.46433	0.46690	0.46947	62
28	0.46947	0.47204	0.47460	0.47716	0.47971	0.48226	0.48481	61
29	0.48481	0.48735	0.48989	0.49242	0.49495	0.49748	0.50000	60
30	0.50000	0.50252	0.50503	0.50754	0.51004	0.51254	0.51504	59
31	0.51504	0.51753	0.52002	0.52250	0.52498	0.52745	0.52992	58
32	0.52992	0.53238	0.53484	0.53730	0.53975	0.54220	0.54464	57
33	0.54464	0.54708	0.54951	0.55194	0.55436	0.55678	0.55919	56
34	0.55919	0.56160	0.56401	0.56641	0.56880	0.57119	0.57358	55
35	0.57358	0.57596	0.57833	0.58070	0.58307	0.58543	0.58779	54
36	0.58779	0.59014	0.59248	0.59482	0.59716	0.59949	0.60182	53
37	0.60182	0.60414	0.60645	0.60876	0.61107	0.61337	0.61566	52
38	0.61566	0.61795	0.62024	0.62251	0.62479	0.62706	0.62932	51
39	0.62932	0.63158	0.63383	0.63608	0.63832	0.64056	0.64279	50
40	0.64279	0.64501	0.64723	0.64945	0.65166	0.65386	0.65606	49
41	0.65606	0.65825	0.66044	0.66262	0.66480	0.66697	0.66913	48
42	0.66913	0.67129	0.67344	0.67559	0.67773	0.67987	0.68200	47
43	0.68200	0.68412	0.68624	0.68835	0.69046	0.69256	0.69466	46
44	0.69466	0.69675	0.69883	0.70091	0.70298	0.70505	0.70711	45
Sines	60′	50′	40′	30′	20′	10′	0′	Degrees
	Cosines							

Natural Trigonometric Functions (Cont.)

Degrees	Cosines 0′	10′	20′	30′	40′	50′	60′	Sines
0	1.00000	1.00000	0.99998	0.99996	0.99993	0.99989	0.99985	89
1	0.99985	0.99979	0.99973	0.99966	0.99958	0.99949	0.99939	88
2	0.99939	0.99929	0.99917	0.99905	0.99892	0.99878	0.99863	87
3	0.99863	0.99847	0.99831	0.99813	0.99795	0.99776	0.99756	86
4	0.99756	0.99736	0.99714	0.99692	0.99668	0.99644	0.99619	85
5	0.99619	0.99594	0.99567	0.99540	0.99511	0.99482	0.99452	84
6	0.99452	0.99421	0.99390	0.99357	0.99324	0.99290	0.99255	83
7	0.99255	0.99219	0.99182	0.99144	0.99106	0.99067	0.99027	82
8	0.99027	0.98986	0.98944	0.98902	0.98858	0.98814	0.98769	81
9	0.98769	0.98723	0.98676	0.98629	0.98580	0.98531	0.98481	80
10	0.98481	0.98430	0.98378	0.98325	0.98272	0.98218	0.98163	79
11	0.98163	0.98107	0.98050	0.97992	0.97934	0.97875	0.97815	78
12	0.97815	0.97754	0.97692	0.97630	0.97566	0.97502	0.97437	77
13	0.97437	0.97371	0.97304	0.97237	0.97169	0.97100	0.97030	76
14	0.97030	0.96959	0.96887	0.96815	0.96742	0.96667	0.96593	75
15	0.96593	0.96517	0.96440	0.96363	0.96285	0.96206	0.96126	74
16	0.96126	0.96046	0.95964	0.95882	0.95799	0.95715	0.95630	73
17	0.95630	0.95545	0.95459	0.95372	0.95284	0.95195	0.95106	72
18	0.95106	0.95015	0.94924	0.94832	0.94740	0.94646	0.94552	71
19	0.94552	0.94457	0.94361	0.94264	0.94167	0.94068	0.93969	70
20	0.93969	0.93869	0.93769	0.93667	0.93565	0.93462	0.93358	69
21	0.93358	0.93253	0.93148	0.93042	0.92935	0.92827	0.92718	68
22	0.92718	0.92609	0.92499	0.92388	0.92276	0.92164	0.92050	67
23	0.92050	0.91936	0.91822	0.91706	0.91590	0.91472	0.91355	66
24	0.91355	0.91236	0.91116	0.90996	0.90875	0.90753	0.90631	65
25	0.90631	0.90507	0.90383	0.90259	0.90133	0.90007	0.89879	64
26	0.89879	0.89752	0.89623	0.89493	0.89363	0.89232	0.89101	63
27	0.89101	0.88968	0.88835	0.88701	0.88566	0.88431	0.88295	62
28	0.88295	0.88158	0.88020	0.87882	0.87743	0.87603	0.87462	61
29	0.87462	0.87321	0.87178	0.87036	0.86892	0.86748	0.86603	60
30	0.86603	0.86457	0.86310	0.86163	0.86015	0.85866	0.85717	59
31	0.85717	0.85567	0.85416	0.85264	0.85112	0.84959	0.84805	58
32	0.84805	0.84650	0.84495	0.84339	0.84182	0.84025	0.83867	57
33	0.83867	0.83708	0.83549	0.83389	0.83228	0.83066	0.82904	56
34	0.82904	0.82741	0.82577	0.82413	0.82248	0.82082	0.81915	55
35	0.81915	0.81748	0.81580	0.81412	0.81242	0.81072	0.80902	54
36	0.80902	0.80730	0.80558	0.80386	0.80212	0.80038	0.79864	53
37	0.79864	0.79688	0.79512	0.79335	0.79158	0.78980	0.78801	52
38	0.78801	0.78622	0.78442	0.78261	0.78079	0.77897	0.77715	51
39	0.77715	0.77531	0.77347	0.77162	0.76977	0.76791	0.76604	50
40	0.76604	0.76417	0.76229	0.76041	0.75851	0.75661	0.75471	49
41	0.75471	0.75280	0.75088	0.74896	0.74703	0.74509	0.74314	48
42	0.74314	0.74120	0.73924	0.73728	0.73531	0.73333	0.73135	47
43	0.73135	0.72937	0.72737	0.72537	0.72337	0.72136	0.71934	46
44	0.71934	0.71732	0.71529	0.71325	0.71121	0.70916	0.70711	45
Cosines	60′	50′	40′	30′	20′	10′	0′	Degrees
	Sines							

Natural Trigonometric Functions (Cont.)

Degrees	Tangents 0′	10′	20′	30′	40′	50′	60′	Cotangents
0	0.00000	0.00291	0.00582	0.00873	0.01164	0.01455	0.01746	89
1	0.01746	0.02036	0.02328	0.02619	0.02910	0.03201	0.03492	88
2	0.03492	0.03783	0.04075	0.04366	0.04658	0.04949	0.05241	87
3	0.05241	0.05533	0.05824	0.06116	0.06408	0.06700	0.06993	86
4	0.06993	0.07285	0.07578	0.07870	0.08163	0.08456	0.08749	85
5	0.08749	0.09042	0.09335	0.09629	0.09923	0.10216	0.10510	84
6	0.10510	0.10805	0.11099	0.11394	0.11688	0.11983	0.12278	83
7	0.12278	0.12574	0.12869	0.13165	0.13461	0.13758	0.14054	82
8	0.14054	0.14351	0.14648	0.14945	0.15243	0.15540	0.15838	81
9	0.15838	0.16137	0.16435	0.16734	0.17033	0.17333	0.17633	80
10	0.17633	0.17933	0.18233	0.18534	0.18835	0.19136	0.19438	79
11	0.19438	0.19740	0.20042	0.20345	0.20648	0.20952	0.21256	78
12	0.21256	0.21560	0.21864	0.22169	0.22475	0.22781	0.23087	77
13	0.23087	0.23393	0.23700	0.24008	0.24316	0.24624	0.24933	76
14	0.24933	0.25242	0.25552	0.25862	0.26172	0.26483	0.26795	75
15	0.26795	0.27107	0.27419	0.27732	0.28046	0.28360	0.28675	74
16	0.28675	0.28990	0.29305	0.29621	0.29938	0.30255	0.30573	73
17	0.30573	0.30891	0.31210	0.31530	0.31850	0.32171	0.32492	72
18	0.32492	0.32814	0.33136	0.33460	0.33783	0.34108	0.34433	71
19	0.34433	0.34758	0.35085	0.35412	0.35740	0.36068	0.36397	70
20	0.36397	0.36727	0.37057	0.37388	0.37720	0.38053	0.38386	69
21	0.38386	0.38721	0.39055	0.39391	0.39727	0.40065	0.40403	68
22	0.40403	0.40741	0.41081	0.41421	0.41763	0.42105	0.42447	67
23	0.42447	0.42791	0.43136	0.43481	0.43828	0.44175	0.44523	66
24	0.44523	0.44872	0.45222	0.45573	0.45924	0.46277	0.46631	65
25	0.46631	0.46985	0.47341	0.47698	0.48055	0.48414	0.48773	64
26	0.48773	0.49134	0.49495	0.49858	0.50222	0.50587	0.50953	63
27	0.50953	0.51319	0.51688	0.52057	0.52427	0.52798	0.53171	62
28	0.53171	0.53545	0.53920	0.54296	0.54673	0.55051	0.55431	61
29	0.55431	0.55812	0.56194	0.56577	0.56962	0.57348	0.57735	60
30	0.57735	0.58124	0.58513	0.58905	0.59297	0.59691	0.60086	59
31	0.60086	0.60483	0.60881	0.61280	0.61681	0.62083	0.62487	58
32	0.62487	0.62892	0.63299	0.63707	0.64117	0.64528	0.64941	57
33	0.64941	0.65355	0.65771	0.66189	0.66608	0.67028	0.67451	56
34	0.67451	0.67875	0.68301	0.68728	0.69157	0.69588	0.70021	55
35	0.70021	0.70455	0.70891	0.71329	0.71769	0.72211	0.72654	54
36	0.72654	0.73100	0.73547	0.73996	0.74447	0.74900	0.75355	53
37	0.75355	0.75812	0.76272	0.76733	0.77196	0.77661	0.78129	52
38	0.78129	0.78598	0.79070	0.79544	0.80020	0.80498	0.80978	51
39	0.80978	0.81461	0.81946	0.82434	0.82923	0.83415	0.83910	50
40	0.83910	0.84407	0.84906	0.85408	0.85912	0.86419	0.86929	49
41	0.86929	0.87441	0.87955	0.88473	0.88992	0.89515	0.90040	48
42	0.90040	0.90569	0.91099	0.91633	0.92170	0.92709	0.93252	47
43	0.93252	0.93797	0.94345	0.94896	0.95451	0.96008	0.96569	46
44	0.96569	0.97133	0.97700	0.98270	0.98843	0.99420	1.00000	45
Tangents	60′	50′	40′	30′	20′	10′	0′	Degrees
	Cotangents							

Four-Place Table of Common Logarithms

The common logarithms of numbers between 1 and 10, correct to four places, are given in the table shown on this and the following page.

If the decimal point in the number is moved n places to the right (or left), the value of n (or $-n$) is added to the logarithm, thus:

log 3.14 = 0.4969
log 314. = 0.4969 + 2 or 2.4969
log .0314 = 0.4969 − 2, which may be written, $\bar{2}$.4969 or 8.4969 − 10

If the given number has more than four significant figures, it should be reduced to four figures, since those beyond four figures will not affect the result in four-place computations.

The logarithm of a number having four significant figures must be interpolated by adding to the logarithm of the three figure number, the amount under the fourth figure, as read in the proportional parts section of the table.

Thus, the logarithm of 3.1416 is found as follows:

a. Reduce the number to four significant figures: 3.142
b. The log of 3.14 is .4969
c. The value of the proportional part under 2 (the fourth figure) is 3
d. Then, the log 3.142 = 0.4969 + .0003 or 0.4972

$$\log ab = \log a + \log b \qquad \log a^n = n \log a$$

$$\log \frac{a}{b} = \log a - \log b \qquad \log \sqrt[n]{a} = \frac{\log a}{n}$$

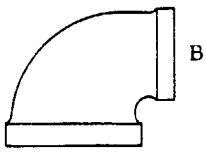
N	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5	6	7	8	9
1.0	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21	25	29	33	37
1.1	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
1.2	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
1.3	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
1.4	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
1.5	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
1.6	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
1.7	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
1.8	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
1.9	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
2.0	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
2.1	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
2.2	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
2.3	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
2.4	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
2.5	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
2.6	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
2.7	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
2.8	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
2.9	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
3.0	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
3.1	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
3.2	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
3.3	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
3.4	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
3.5	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
3.6	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
3.7	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
3.8	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
3.9	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

Four-Place Table of Common Logarithms (Cont.)

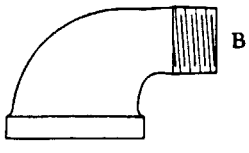
N	0	1	2	3	4	5	6	7	8	9	Proportional Parts								
											1	2	3	4	5	6	7	8	9
4.0	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
4.1	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
4.2	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
4.3	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
4.4	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
4.5	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
4.6	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
4.7	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
4.8	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
4.9	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
5.0	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
5.1	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
5.2	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
5.3	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
5.4	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
5.5	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
5.6	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
5.7	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
5.8	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
5.9	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
6.0	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
6.1	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
6.2	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
6.3	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
6.4	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
6.5	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
6.6	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
6.7	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
6.8	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
6.9	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
7.0	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
7.1	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
7.2	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
7.3	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
7.4	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
7.5	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
7.6	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
7.7	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
7.8	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
7.9	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
8.0	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
8.1	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
8.2	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
8.3	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
8.4	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
8.5	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
8.6	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
8.7	9395	9400	9405	9010	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
8.8	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
8.9	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
9.0	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
9.1	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
9.2	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
9.3	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
9.4	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
9.5	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
9.6	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
9.7	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
9.8	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
9.9	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4

N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

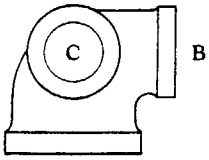
How to Read Reducing Fittings



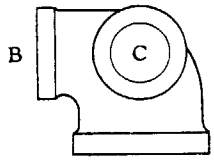
90° Elbow Reducing



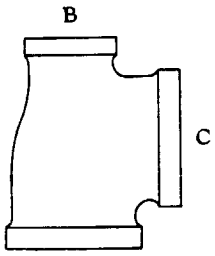
90° Street Elbow Reducing on male end



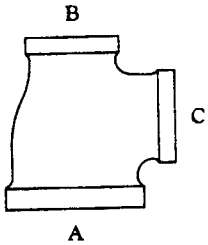
Right Hand Side Outlet 90° Elbows Reducing on two Outlets



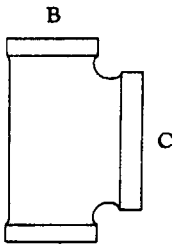
Left Hand Side Outlet 90° Elbows Reducing on two Outlets



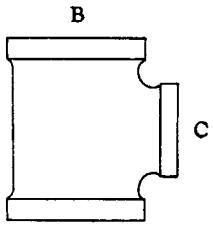
Tee, with one end of Run reduced



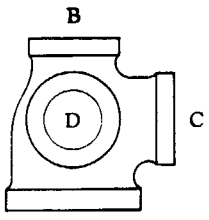
Tee, with one end of Run and Outlet reduced



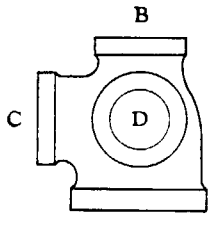
Tee (Bull Head) Both ends of Run reduced



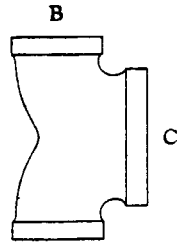
Tee, with Reduced Outlet



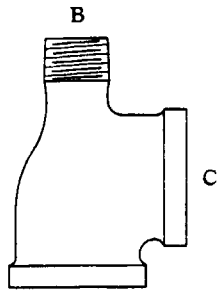
Right Hand Side Outlet Tees, with one end of Run and Outlets reduced



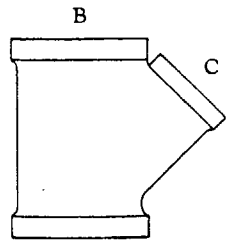
Left Hand Side Outlet Tees, with one end of Run and Outlets reduced



Double Branch Elbow Reducing on both ends of Run



Service Tee Reducing on male end only



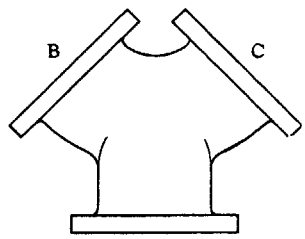
45° Y-Bend (Lateral) Reducing on Outlet only

To assist the user in "reading" reducing fittings, a variety of types most commonly required for piping systems are illustrated on this page. In these illustrations, each opening of the fitting is identified with a letter which indicates the sequence to be followed in reading the size of the fitting.

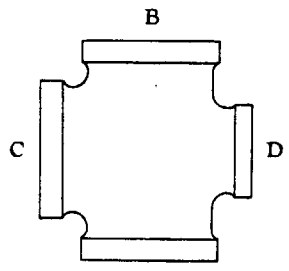
In designating the outlets of reducing fittings, the openings should be read in the order indicated by the sequence of the letters "A", "B", "C", and "D". On side outlet reducing fittings, the size of the side outlet is named last.

For example: A Cross having one end of run and one outlet reduced is designated as 2½(A) x 1¼(B) x 2½(C) x 1½(D), simply by naming the largest opening first and then naming the other openings in the order indicated.

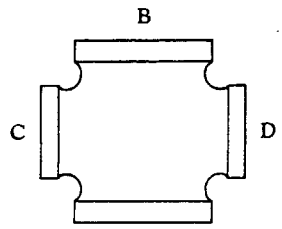
Flanged fittings: Although all but one of the illustrations are of screwed fittings, the same rules apply to the "reading" of reducing flanged fittings.



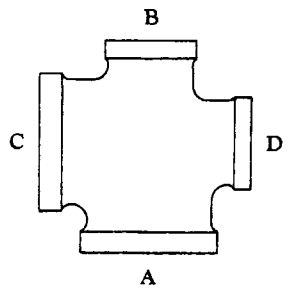
True "Y"



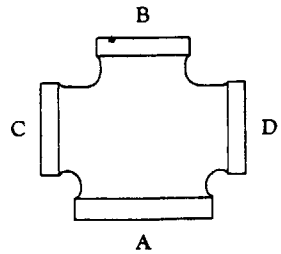
Cross Reducing on one Outlet only



Cross Reducing on both Outlets



Cross Reducing on one end of Run and on one Outlet



Cross Reducing on one end of Run and on both Outlets

Selecting Size of Crane Stop-Check Valves

The use of the chart below in selecting the size of a stop-check valve determines the largest size valve with which full disc lift will occur under given flow conditions.

Selecting the correct valve size under normal load conditions by means of this chart will result in minimum pressure drop and a properly operating valve.

A smaller size valve can be used for the same flow conditions to secure full disc lift under low load. This is advisable if the boiler is to be operated at low load conditions for considerable periods of time. The continued use of a stop-check valve in a partially open position is undesirable because of possible wear of parts. If a smaller size valve is used, the pressure drop will be increased, since the pressure losses increase directly as the square of the velocity through the valve.

How to Use the Chart

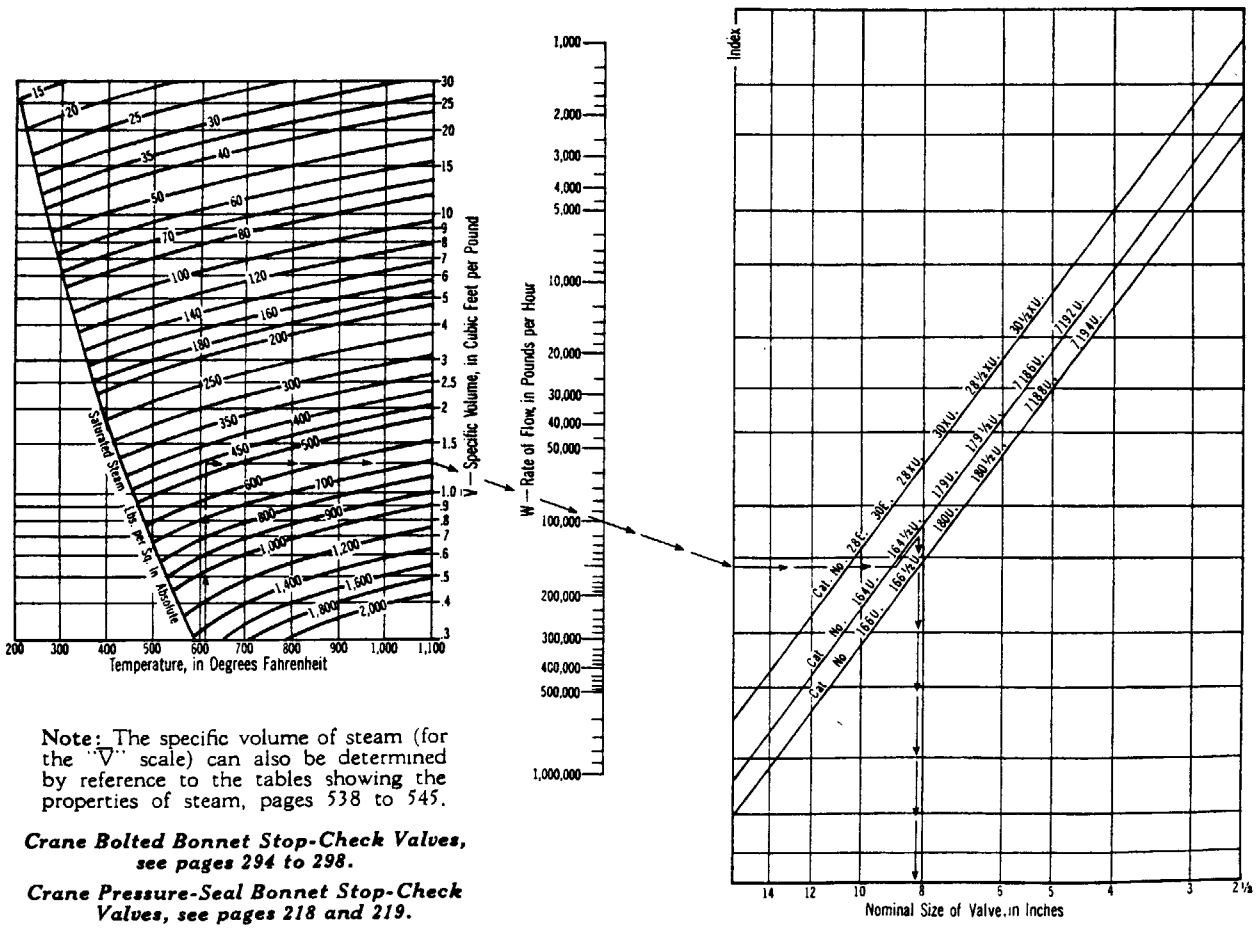
Given: Steam conditions—460 pounds per square inch absolute, 610° F.
Normal flow rate—100,000 pounds of steam per hour.

Required: Largest size Crane No. 164 U Stop-Check Valve.

Solution: Proceed along the arrowed line on the chart. Enter the left hand chart at 610° F., and follow up vertically to the 460 psi absolute pressure line. From this point, proceed horizontally to the right to the Specific Volume Scale, "V". The specific volume is 1.28 cubic feet per pound.

From this value, follow through to 100,000 on the "W" scale to the Index Line. Then move horizontally to the line for No. 164 U Valves in the right hand chart. Proceed upward and to the right to the next vertical line representing valve sizes. This point indicates the largest size stop-check valve (in this case, 8-inch), that will operate properly; that is, with the disc in a fully lifted position, at the given flow conditions.

Crane Engineers will be glad to make specific recommendations and furnish pressure drop data for stop-check valves upon request. Inquiries should be accompanied by a complete description of the operating conditions.



Note: The specific volume of steam (for the "V" scale) can also be determined by reference to the tables showing the properties of steam, pages 538 to 545.

Crane Bolted Bonnet Stop-Check Valves, see pages 294 to 298.

Crane Pressure-Seal Bonnet Stop-Check Valves, see pages 218 and 219.