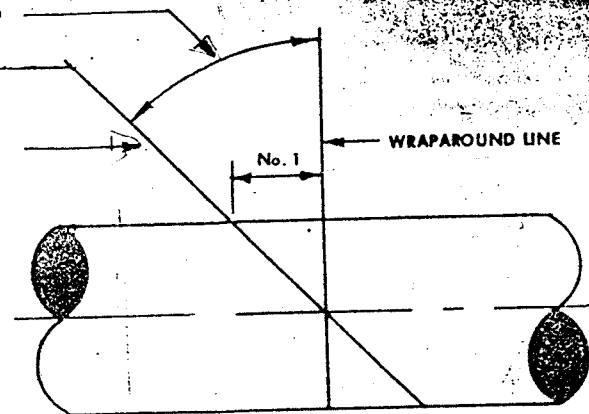
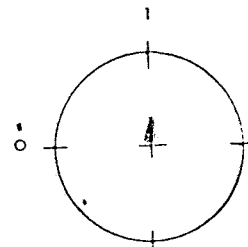


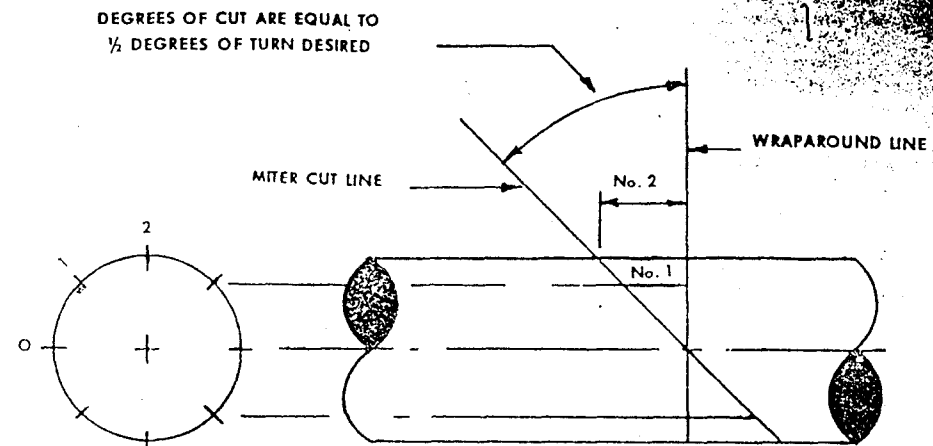
DEGREES OF CUT ARE EQUAL TO
 $\frac{1}{2}$ DEGREES OF TURN DESIRED
 MITER CUT LINE



MITER CUTS FOR $1\frac{1}{2}$ " THROUGH 3" WITH PIPE MARKED IN QUARTERS.
 LINE No. 1 DIMENSION EQUALS TANGENT OF CUT X O.D. OF
 PIPE DIVIDED BY 2

$1\frac{1}{2}$ " THROUGH 3" MITER CUTS PIPE QUARTERED

7½° CUT FOR 15° TURN		22½° CUT FOR 45° TURN	
SIZE	NO. 1	SIZE	NO. 1
1½	1/8	1½	3/8
2	1/4	2	1/2
2½	3/8	2½	5/8
3	1/2	3	3/4
9° CUT FOR 18° TURN		30° CUT FOR 60° TURN	
SIZE	NO. 1	SIZE	NO. 1
1½	1/8	1½	1/2
2	1/4	2	3/4
2½	3/8	2½	5/8
3	1/2	3	1
11¼° CUT FOR 22½° TURN		45° CUT FOR 90° TURN	
SIZE	NO. 1	SIZE	NO. 1
1½	3/16	1½	13/16
2	1/4	2	15/16
2½	5/16	2½	17/16
3	3/8	3	19/16
15° CUT FOR 30° TURN			
SIZE	NO. 1		
1½	1/4		
2	5/16		
2½	3/8		
3	7/16		



MITER CUTS FOR 4" THROUGH 10" WITH PIPE MARKED IN EIGHTHS
LINE No. 2 DIMENSION EQUALS TANGENT OF CUT X O.D. OF PIPE

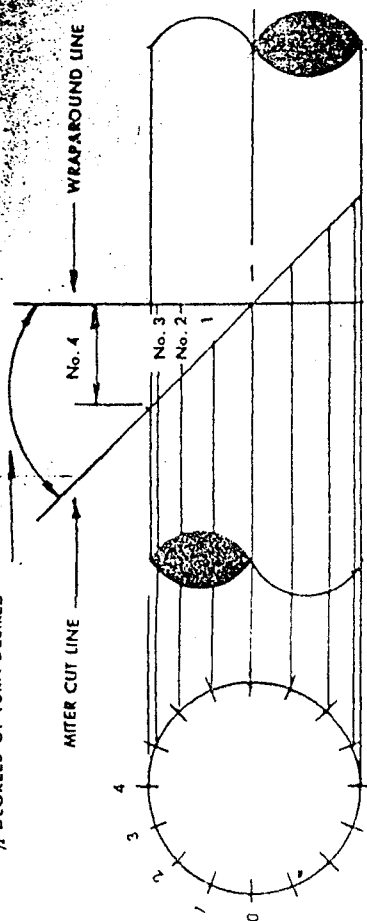
DIVIDED BY 2

LINE No. 1 DIMENSION EQUALS DIMENSION No. 2 X .7071

4" THROUGH 10" MITER CUTS PIPE IN EIGHTHS

7½° CUT FOR 15° TURN			22½° CUT FOR 45° TURN		
SIZE	NO. 1	NO. 2	SIZE	NO. 1	NO. 2
4	$\frac{1}{16}$	$\frac{1}{4}$	4	$\frac{11}{16}$	$\frac{15}{16}$
6	$\frac{3}{16}$	$\frac{7}{16}$	6	1	$1\frac{3}{8}$
8	$\frac{5}{16}$	$\frac{9}{16}$	8	$1\frac{1}{4}$	$1\frac{3}{4}$
10	$\frac{7}{16}$	$1\frac{1}{16}$	10	$1\frac{5}{16}$	$2\frac{3}{16}$
9° CUT FOR 18° TURN			30° CUT FOR 60° TURN		
SIZE	NO. 1	NO. 2	SIZE	NO. 1	NO. 2
4	$\frac{1}{4}$	$\frac{3}{8}$	4	$1\frac{1}{16}$	$1\frac{1}{8}$
6	$\frac{3}{8}$	$\frac{1}{2}$	6	$1\frac{3}{8}$	$1\frac{7}{8}$
8	$\frac{1}{2}$	$1\frac{1}{16}$	8	$1\frac{3}{4}$	$2\frac{1}{2}$
10	$\frac{5}{8}$	$\frac{7}{8}$	10	$2\frac{3}{16}$	$3\frac{1}{16}$
11¼° CUT FOR 22½° TURN			45° CUT FOR 90° TURN		
SIZE	NO. 1	NO. 2	SIZE	NO. 1	NO. 2
4	$\frac{5}{16}$	$\frac{7}{16}$	4	$1\frac{9}{16}$	$2\frac{1}{4}$
6	$\frac{7}{16}$	$\frac{5}{8}$	6	$2\frac{3}{8}$	$3\frac{5}{16}$
8	$\frac{5}{8}$	$\frac{7}{8}$	8	$3\frac{3}{16}$	$4\frac{5}{16}$
10	$\frac{3}{4}$	$1\frac{1}{16}$	10	$3\frac{13}{16}$	$5\frac{5}{16}$
15° CUT FOR 30° TURN					
SIZE	NO. 1	NO. 2			
4	$\frac{3}{8}$	$\frac{9}{16}$			
6	$\frac{5}{8}$	$\frac{7}{8}$			
8	$1\frac{13}{16}$	$1\frac{1}{2}$			
10	1	$1\frac{7}{16}$			

DEGREES OF CUT ARE EQUAL TO
1/2 DEGREES OF TURN DESIRED



MITER CUTS FOR 12" THROUGH 24" WITH PIPE MARKED IN SIXTEENTHS

LINE No. 4 DIMENSION EQUALS TANGENT OF CUT X O.D. OF

PIPE DIVIDED BY 2

LINE No. 3 DIMENSION EQUALS DIMENSION No. 4 X .9239

LINE No. 2 DIMENSION EQUALS DIMENSION No. 4 X .7071

LINE No. 1 DIMENSION EQUALS DIMENSION No. 4 X .3827

12" THROUGH 24" MITER CUTS MARK PIPE IN SIXTEENTHS

7 1/2° CUT FOR 15° TURN

SIZE	NO. 1	NO. 2	NO. 3	NO. 4
12	3/16	9/16	3/4	13/16
14	3/8	5/8	7/8	15/16
16	7/16	3/4	1	1 1/16
18	7/16	13/16	1 1/16	1 3/16
20	1/2	15/16	1 3/16	1 5/16
24	5/8	1 1/8	1 7/16	1 9/16

9° CUT FOR 18° TURN

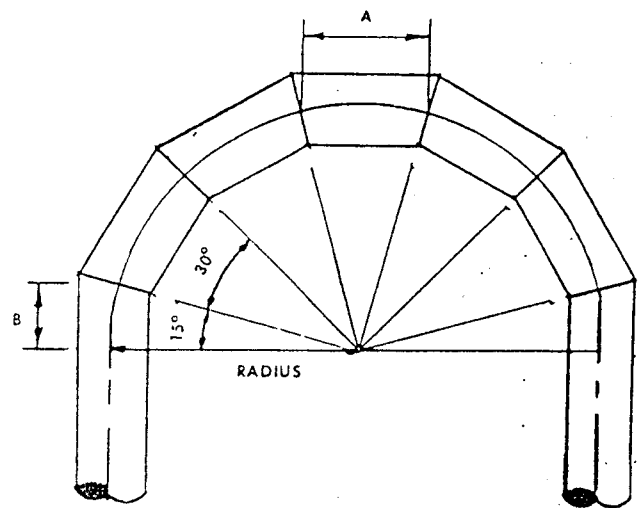
SIZE	NO. 1	NO. 2	NO. 3	NO. 4
12	3/8	11/16	15/16	1
14	7/16	13/16	1	1 1/8
16	1/2	7/8	1 3/16	1 1/4
18	9/16	1	1 5/16	1 7/16
20	5/8	1 1/8	1 7/16	1 9/16
24	3/4	1 1/2	1 3/4	1 7/8

11 1/4° CUT FOR 22 1/2° TURN

SIZE	NO. 1	NO. 2	NO. 3	NO. 4
12	1/2	7/8	1 1/16	1 1/4
14	1/2	1	1 3/16	1 3/8
16	5/8	1 1/8	1 7/16	1 9/16
18	11/16	1 1/4	1 11/16	1 13/16
20	3/4	1 3/8	1 13/16	2
24	1 1/16	1 11/16	2 1/16	2 3/8

12" THROUGH 24" MITER CUTS
MARK PIPE IN SIXTEENTHS

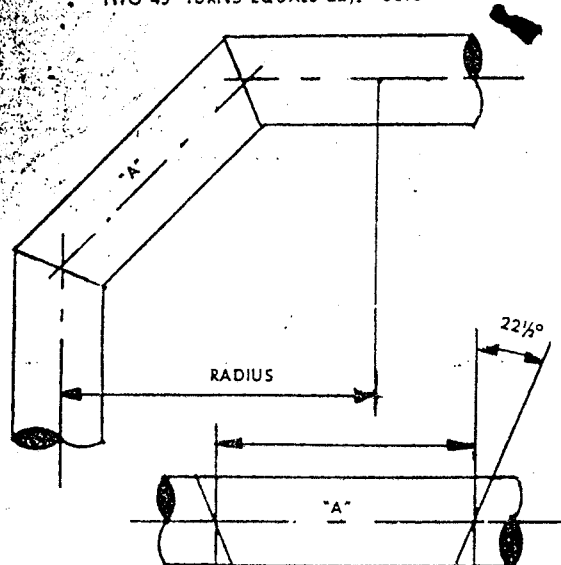
15° CUT FOR 30° TURN				
SIZE	NO. 1	NO. 2	NO. 3	NO. 4
12	$\frac{3}{8}$	$1\frac{1}{16}$	$1\frac{9}{16}$	$1\frac{11}{16}$
14	$\frac{3}{4}$	$1\frac{3}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$
16	$1\frac{1}{8}$	$1\frac{1}{2}$	2	$2\frac{1}{8}$
18	$1\frac{1}{4}$	$1\frac{11}{16}$	$2\frac{1}{4}$	$2\frac{3}{8}$
20	1	$1\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{11}{16}$
24	$1\frac{3}{4}$	$2\frac{1}{4}$	3	$3\frac{1}{4}$
22½° CUT FOR 45° TURN				
SIZE	NO. 1	NO. 2	NO. 3	NO. 4
12	1	$1\frac{7}{8}$	$2\frac{7}{16}$	$2\frac{5}{8}$
14	$1\frac{1}{8}$	$2\frac{1}{16}$	$2\frac{1}{2}$	$2\frac{7}{8}$
16	$1\frac{3}{4}$	$2\frac{3}{8}$	$3\frac{1}{16}$	$3\frac{5}{8}$
18	$1\frac{7}{16}$	$2\frac{3}{8}$	$3\frac{7}{16}$	$3\frac{3}{4}$
20	$1\frac{9}{16}$	$2\frac{15}{16}$	$3\frac{13}{16}$	$4\frac{1}{8}$
24	$1\frac{7}{8}$	$3\frac{1}{2}$	$4\frac{5}{8}$	5
30° CUT FOR 60° TURN				
SIZE	NO. 1	NO. 2	NO. 3	NO. 4
12	$1\frac{3}{8}$	$2\frac{5}{8}$	$3\frac{3}{8}$	$3\frac{11}{16}$
14	$1\frac{9}{16}$	$2\frac{7}{8}$	$3\frac{3}{4}$	$4\frac{1}{16}$
16	$1\frac{3}{4}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$4\frac{5}{8}$
18	2	$3\frac{11}{16}$	$4\frac{13}{16}$	$5\frac{1}{16}$
20	$2\frac{3}{16}$	$4\frac{1}{16}$	$5\frac{5}{16}$	$5\frac{3}{4}$
24	$2\frac{5}{8}$	$4\frac{7}{8}$	$6\frac{3}{8}$	$6\frac{13}{16}$



Formulas for miterpiece turns to form radius and number of degrees desired. 180° shown

1. ANGLE OF CUT EQUALS
Degrees of turn divided by number of welds times 2.
2. LENGTH OF DIMENSION "B"
Equals radius times Tangent of angle of cut.
3. LENGTH OF PIECES "A" EQUAL
Dimension "B" times 2.

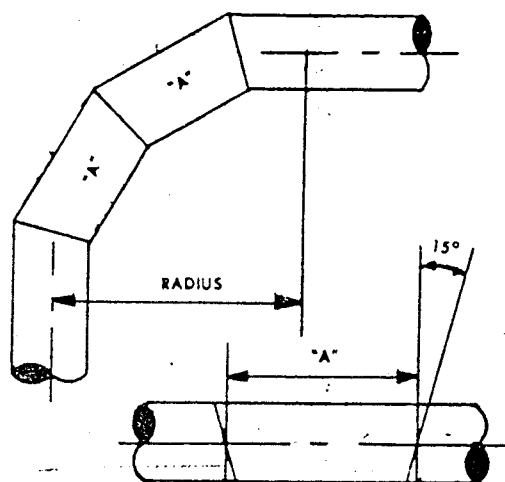
THREE PIECE 90° TURN
TWO 45° TURNS EQUALS 22½° CUTS



LENGTH "A" EQUALS RADIUS X .414 X 2

RADIUS (Inches)	LENGTH "A" (Inches)
12 "	9 ⅜ "
18	14 ¾
24	19 ⅝
30	24 ⅞
36	29 ⅞
42	34 ⅜
48	39 ¼

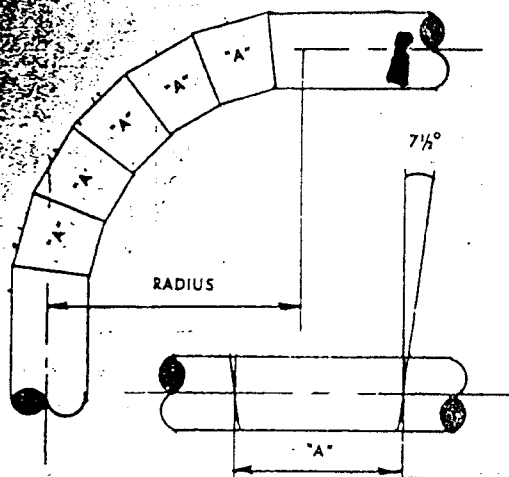
FOUR PIECE 90° TURN
THREE 30° TURNS W/15° CUTS



LENGTH "A" EQUALS RADIUS X .2679 X 2

RADIUS (Inches)	LENGTH "A" (Inches)
24 "	12 ⅞ "
30	16 ⅞
36	19 ⅞
42	22 ½
48	25 ¼
60	32 ⅞
72	38 ⅞
84	45
96	51 ⅞

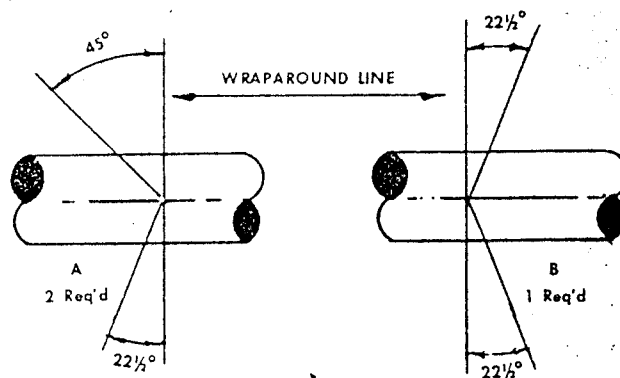
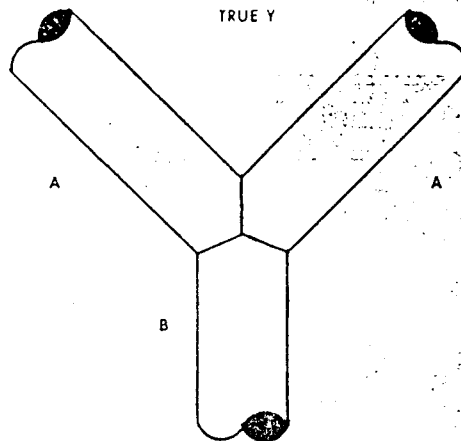
SEVEN PIECE 90° TURN
SIX 15° TURNS EQUALS 7½° CUTS



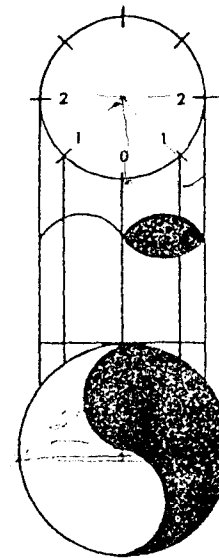
LENGTH "A" EQUALS RADIUS X .1316 X 2

RADIUS (Feet)	LENGTH "A" (Inches)
5	15 $\frac{11}{16}$ "
6	18 $\frac{15}{16}$
7	22 $\frac{3}{8}$
8	25 $\frac{1}{4}$
9	28 $\frac{7}{16}$
10	31 $\frac{9}{16}$
11	34 $\frac{3}{4}$
12	37 $\frac{13}{16}$
13	41 $\frac{1}{16}$
14	44 $\frac{1}{4}$
15	47 $\frac{3}{8}$
20	63 $\frac{3}{16}$

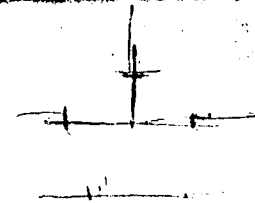
TRUE Y



Refer to layout for miter cuts in this book for pipe size to be used.



EIGHTHS



SIXTEENTHS

M-DARKI : JL. JAMBU 01 RT3 RW2 MLOMAY. REJOSO. 64453,
NGANJUK.

90° SADDLE ON
STANDARD WEIGHT PIPE
PIPE MARKED IN EIGHTHS
SIZE OF HEADER

	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	NO
3"	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	1
Riser	$\frac{15}{16}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{1}{8}$	2
4"		$\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	1
Riser		$1\frac{1}{4}$	$\frac{11}{16}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	2
6"			$\frac{13}{16}$	$\frac{9}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{16}$	$\frac{1}{16}$	1
Riser			2	$1\frac{1}{4}$	$\frac{15}{16}$	$\frac{3}{4}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{16}$	$\frac{3}{8}$	2
8"				$1\frac{1}{16}$	$\frac{13}{16}$	$\frac{11}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{5}{16}$	1
Riser				$2\frac{11}{16}$	$1\frac{3}{4}$	$1\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{1}{16}$	$\frac{15}{16}$	$\frac{13}{16}$	$\frac{3}{4}$	$\frac{11}{16}$	2
10"					$1\frac{3}{8}$	$1\frac{1}{16}$	$\frac{13}{16}$	$\frac{13}{16}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{9}{16}$	$\frac{9}{16}$	1
Riser					$3\frac{7}{16}$	$2\frac{7}{16}$	$2\frac{1}{8}$	$1\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{1}{16}$	$1\frac{1}{8}$	2

90° SADDLE ON
STANDARD WEIGHT PIPE
PIPE MARKED IN SIXTEENTHS
SIZE OF HEADER

	12"	14"	16"	18"	20"	22"	24"	NO
	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	1
12"	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{15}{16}$	$\frac{7}{8}$	$\frac{3}{4}$	2
Riser	$3\frac{1}{4}$	$2\frac{3}{4}$	$2\frac{1}{4}$	$1\frac{15}{16}$	$1\frac{11}{16}$	$1\frac{1}{2}$	$1\frac{3}{4}$	3
	$4\frac{1}{4}$	$3\frac{3}{8}$	$2\frac{11}{16}$	$2\frac{5}{16}$	2	$1\frac{3}{4}$	$1\frac{5}{8}$	4
		$\frac{1}{2}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	1
14"		$1\frac{13}{16}$	$1\frac{1}{2}$	$1\frac{5}{16}$	$1\frac{3}{16}$	$1\frac{1}{16}$	$1\frac{15}{16}$	2
Riser		$3\frac{3}{8}$	$2\frac{7}{8}$	$2\frac{3}{8}$	$2\frac{1}{16}$	$1\frac{7}{8}$	$1\frac{11}{16}$	3
		$4\frac{3}{4}$	$3\frac{1}{2}$	$2\frac{13}{16}$	$2\frac{1}{2}$	$2\frac{1}{2}$	2	4
			$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	1
16"			$2\frac{1}{16}$	$1\frac{13}{16}$	$1\frac{9}{16}$	$1\frac{7}{16}$	$1\frac{1}{4}$	2
Riser			$4\frac{3}{16}$	$3\frac{3}{8}$	$2\frac{7}{8}$	$2\frac{1}{16}$	$2\frac{3}{16}$	3
			$5\frac{9}{16}$	$4\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{1}{16}$	$2\frac{3}{4}$	4
				$\frac{5}{8}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	1
18"				$2\frac{3}{8}$	$2\frac{1}{16}$	$1\frac{3}{4}$	$1\frac{11}{16}$	2
Riser				$4\frac{13}{16}$	$3\frac{13}{16}$	$3\frac{7}{16}$	3	3
				$5\frac{7}{16}$	$4\frac{13}{16}$	$4\frac{7}{16}$	$3\frac{13}{16}$	4
					$\frac{11}{16}$	$\frac{5}{8}$	$\frac{9}{16}$	1
20"					$2\frac{11}{16}$	$2\frac{3}{8}$	$2\frac{1}{8}$	2
Riser					$5\frac{7}{16}$	$4\frac{1}{2}$	$3\frac{13}{16}$	3
					$7\frac{3}{16}$	$5\frac{11}{16}$	$4\frac{13}{16}$	4
						$\frac{3}{4}$	$\frac{11}{16}$	1
22"						$2\frac{15}{16}$	$2\frac{5}{8}$	2
Riser						$6\frac{1}{16}$	$5\frac{1}{8}$	3
						$8\frac{1}{8}$	$6\frac{7}{16}$	4
							$\frac{7}{8}$	1
24"							$3\frac{1}{4}$	2
Riser							$6\frac{5}{8}$	3
							9	4

OUTSIDE CIRCUMFERENCE
OF PIPE DIVIDED INTO EQUAL PARTS

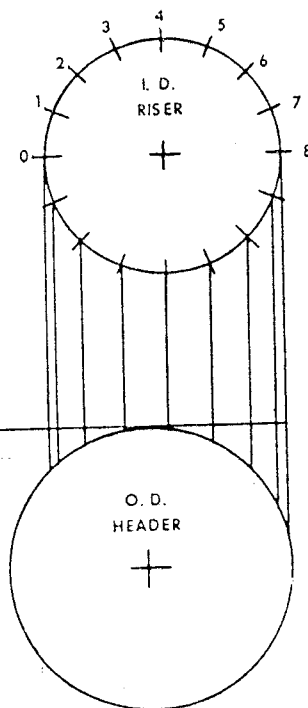
PIPE SIZE	OUT-SIDE DIAM.	CIR.	$\frac{1}{2}$ CIR.	$\frac{1}{4}$ CIR.	$\frac{1}{8}$ CIR.	$\frac{1}{16}$ CIR.
$1\frac{1}{2}$	1.9	$5\frac{1}{2}$	3	$1\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{8}$
2	2.375	$7\frac{1}{2}$	$3\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{1}{8}$	$1\frac{1}{16}$
$2\frac{1}{2}$	2.875	$9\frac{1}{2}$	$4\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{1}{4}$	$\frac{9}{16}$
3	3.5	11	$5\frac{1}{2}$	$2\frac{3}{4}$	$1\frac{3}{8}$	$1\frac{1}{16}$
$3\frac{1}{2}$	4	$12\frac{1}{2}$	$6\frac{1}{2}$	$3\frac{1}{4}$	$1\frac{7}{8}$	$2\frac{1}{16}$
4	4.5	$14\frac{1}{2}$	$7\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{3}{4}$	$\frac{7}{8}$
5	5.563	$17\frac{1}{2}$	$8\frac{3}{4}$	$4\frac{3}{8}$	$2\frac{3}{16}$	$1\frac{3}{32}$
6	6.625	$20\frac{1}{2}$	$10\frac{1}{4}$	$5\frac{1}{4}$	$2\frac{1}{8}$	$1\frac{1}{16}$
8	8.625	$27\frac{1}{2}$	$13\frac{1}{4}$	$6\frac{3}{4}$	$3\frac{3}{8}$	$1\frac{11}{16}$
10	10.75	$33\frac{1}{2}$	$16\frac{1}{2}$	$8\frac{1}{4}$	$4\frac{1}{2}$	$2\frac{1}{8}$
12	12.75	$40\frac{1}{2}$	$20\frac{1}{2}$	10	5	$2\frac{1}{2}$
14	14	44	22	11	$5\frac{1}{2}$	$2\frac{3}{4}$
16	16	50	25	$12\frac{1}{2}$	$6\frac{1}{4}$	$3\frac{1}{8}$
18	18	$56\frac{1}{2}$	$28\frac{1}{2}$	$14\frac{1}{2}$	$7\frac{1}{4}$	$3\frac{1}{2}$
20	20	$62\frac{1}{2}$	$31\frac{1}{2}$	$15\frac{1}{2}$	$7\frac{3}{4}$	$3\frac{15}{16}$
22	22	$69\frac{1}{2}$	$34\frac{1}{2}$	$17\frac{1}{2}$	$8\frac{3}{4}$	$4\frac{1}{8}$
24	24	$75\frac{1}{2}$	$37\frac{1}{2}$	$18\frac{1}{2}$	$9\frac{1}{4}$	$4\frac{23}{32}$
30	30	$94\frac{1}{2}$	$47\frac{1}{2}$	$23\frac{1}{4}$	$11\frac{1}{2}$	$5\frac{1}{8}$
36	36	$113\frac{1}{2}$	$56\frac{1}{2}$	$28\frac{1}{2}$	$14\frac{1}{2}$	$7\frac{1}{8}$

90° SADDLE ON
EXTRA STRONG RISERS
MARK IN EIGHTH'S
SIZE OF HEADER

	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	NO
3"	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	1
Riser	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	2
4"		$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
Riser		$1\frac{1}{16}$	$\frac{5}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	2
6"			$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	1
Riser			$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	2
8"				$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	1
Riser				$2\frac{1}{16}$	$2\frac{1}{16}$	$2\frac{1}{16}$	$2\frac{1}{16}$	$2\frac{1}{16}$	$2\frac{1}{16}$	$2\frac{1}{16}$	$2\frac{1}{16}$	$2\frac{1}{16}$	2
10"					$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	1
Riser					$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	2

EXTRA STRONG RISERS
MARK IN SIXTEENTHS
SIZE OF HEADER

	12"	14"	16"	18"	20"	22"	24"	NO
12"	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{16}$	1
Riser	$1\frac{9}{16}$	$1\frac{3}{8}$	$1\frac{1}{2}$	1	$\frac{7}{8}$	$1\frac{1}{16}$	$\frac{3}{4}$	2
	$3\frac{1}{16}$	$2\frac{7}{16}$	$2\frac{1}{2}$	$1\frac{11}{16}$	$1\frac{3}{8}$	$1\frac{7}{16}$	$1\frac{5}{16}$	3
	$3\frac{7}{8}$	$3\frac{1}{16}$	$2\frac{9}{16}$	$2\frac{1}{16}$	$1\frac{13}{16}$	$1\frac{11}{16}$	$1\frac{9}{16}$	4
14"		$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	1
Riser		$1\frac{1}{4}$	$1\frac{7}{16}$	$1\frac{1}{2}$	$1\frac{3}{8}$	1	$1\frac{15}{16}$	2
		$3\frac{3}{8}$	$2\frac{11}{16}$	$2\frac{1}{16}$	2	$1\frac{11}{16}$	$1\frac{5}{8}$	3
		$4\frac{3}{8}$	$3\frac{3}{16}$	$2\frac{3}{4}$	$2\frac{3}{8}$	$2\frac{1}{8}$	$1\frac{13}{16}$	4
16"			$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	1
Riser			2	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{3}{4}$	2
			4	$3\frac{1}{4}$	$2\frac{11}{16}$	$2\frac{7}{16}$	$2\frac{3}{16}$	3
			$5\frac{3}{16}$	4	$3\frac{3}{8}$	$2\frac{13}{16}$	$2\frac{5}{8}$	4
18"				$\frac{5}{8}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	1
Riser				$2\frac{5}{16}$	2	$1\frac{13}{16}$	$1\frac{5}{8}$	2
				$4\frac{5}{8}$	$3\frac{13}{16}$	$3\frac{3}{16}$	$2\frac{13}{16}$	3
				$6\frac{1}{16}$	$4\frac{3}{4}$	4	$3\frac{1}{2}$	4
20"					$1\frac{11}{16}$	$\frac{5}{8}$	$\frac{9}{16}$	1
Riser					$2\frac{7}{16}$	$2\frac{5}{16}$	$2\frac{1}{16}$	2
					$5\frac{1}{16}$	$4\frac{3}{8}$	$3\frac{13}{16}$	3
					$6\frac{7}{8}$	$5\frac{7}{16}$	$4\frac{11}{16}$	4
22"						$\frac{3}{4}$	$1\frac{1}{16}$	1
Riser						$2\frac{7}{8}$	$2\frac{9}{16}$	2
						$5\frac{13}{16}$	$4\frac{15}{16}$	3
						$7\frac{3}{4}$	$6\frac{3}{16}$	4
24"							$1\frac{13}{16}$	1
Riser							$3\frac{3}{16}$	2
							$6\frac{7}{16}$	3
							$8\frac{1}{16}$	4



ECCENTRIC RISERS
MARK IN SIXTEENTH'S

NOTE: These lengths given are for fit up of inside diameters after cuts are made.

90° ECCENTRIC PIPE RISERS
STANDARD WEIGHT RISERS
MARK IN SIXTEENTH'S
SIZE OF HEADER

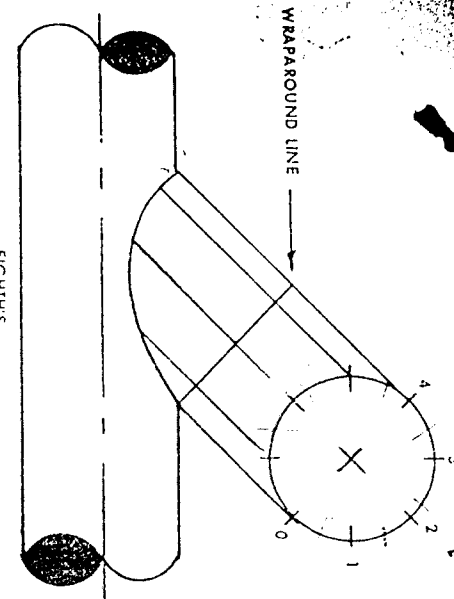
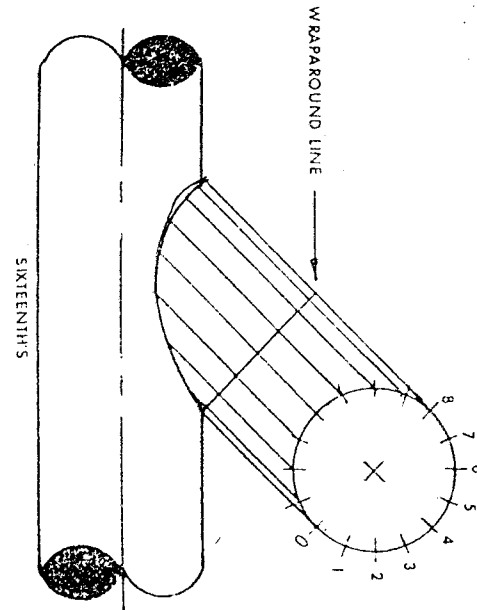
	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	NO
3" Riser	0	0	1	1	1	1	1	1	1	1	1	0
	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1
	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2
	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3
	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4
	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5
	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6
	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7
4" Riser	0	0	1	1	1	1	1	1	1	1	1	0
	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1
	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2
	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3
	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4
	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5
	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6
	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7
6" Riser	0	0	1	1	1	1	1	1	1	1	1	0
	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1
	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2/16	2
	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3
	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4/16	4
	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5
	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6/16	6
	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7

MARK IN SIXTEENTH'S
SIZE OF HEADER

	10"	12"	14"	16"	18"	20"	22"	24"	NO
8" Riser	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	0	0	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	0
	$\frac{11}{16}$	$\frac{1}{4}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1
	$\frac{5}{16}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1	2
	0	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{9}{16}$	$\frac{7}{8}$	$1\frac{1}{4}$	$1\frac{11}{16}$	3
	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	4
	$\frac{5}{8}$	$1\frac{1}{16}$	$1\frac{3}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	3	$3\frac{3}{8}$	$4\frac{1}{4}$	5
	$1\frac{5}{8}$	$2\frac{1}{16}$	$2\frac{3}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$4\frac{11}{16}$	$5\frac{3}{8}$	$6\frac{1}{2}$	6
	$2\frac{1}{4}$	$3\frac{1}{2}$	4	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{2}$	8	7
	$3\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{4}$	$5\frac{3}{4}$	$6\frac{3}{4}$	$7\frac{3}{4}$	$8\frac{1}{2}$	9	8
	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$10\frac{1}{2}$	$11\frac{1}{2}$	9
10" Riser	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	0	0	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	0
	$\frac{11}{16}$	$\frac{1}{4}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1
	$\frac{5}{16}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1	2
	0	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{9}{16}$	$\frac{7}{8}$	$1\frac{1}{4}$	$1\frac{11}{16}$	3
	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	4
	$\frac{5}{8}$	$1\frac{1}{16}$	$1\frac{3}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	3	$3\frac{3}{8}$	$4\frac{1}{4}$	5
	$1\frac{5}{8}$	$2\frac{1}{16}$	$2\frac{3}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$4\frac{11}{16}$	$5\frac{3}{8}$	$6\frac{1}{2}$	6
	$2\frac{1}{4}$	$3\frac{1}{2}$	4	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{2}$	$8\frac{1}{2}$	7
	$3\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{4}$	$5\frac{3}{4}$	$6\frac{3}{4}$	$7\frac{3}{4}$	$8\frac{1}{2}$	9	8
	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$10\frac{1}{2}$	$11\frac{1}{2}$	9
12" Riser	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	0	0	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	0
	$\frac{11}{16}$	$\frac{1}{4}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1
	$\frac{5}{16}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1	2
	0	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{9}{16}$	$\frac{7}{8}$	$1\frac{1}{4}$	$1\frac{11}{16}$	3
	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	4
	$\frac{5}{8}$	$1\frac{1}{16}$	$1\frac{3}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	3	$3\frac{3}{8}$	$4\frac{1}{4}$	5
	$1\frac{5}{8}$	$2\frac{1}{16}$	$2\frac{3}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$4\frac{11}{16}$	$5\frac{3}{8}$	$6\frac{1}{2}$	6
	$2\frac{1}{4}$	$3\frac{1}{2}$	4	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{2}$	$8\frac{1}{2}$	7
	$3\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{4}$	$5\frac{3}{4}$	$6\frac{3}{4}$	$7\frac{3}{4}$	$8\frac{1}{2}$	9	8
	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$10\frac{1}{2}$	$11\frac{1}{2}$	9
14" Riser	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	0	0	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	0
	$\frac{11}{16}$	$\frac{1}{4}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1
	$\frac{5}{16}$	$\frac{1}{16}$	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{3}{8}$	$\frac{11}{16}$	1	2
	0	0	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{9}{16}$	$\frac{7}{8}$	$1\frac{1}{4}$	$1\frac{11}{16}$	3
	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	4
	$\frac{5}{8}$	$1\frac{1}{16}$	$1\frac{3}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	3	$3\frac{3}{8}$	$4\frac{1}{4}$	5
	$1\frac{5}{8}$	$2\frac{1}{16}$	$2\frac{3}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$4\frac{11}{16}$	$5\frac{3}{8}$	$6\frac{1}{2}$	6
	$2\frac{1}{4}$	$3\frac{1}{2}$	4	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{2}$	$8\frac{1}{2}$	7
	$3\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{4}$	$5\frac{3}{4}$	$6\frac{3}{4}$	$7\frac{3}{4}$	$8\frac{1}{2}$	9	8
	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$10\frac{1}{2}$	$11\frac{1}{2}$	9

SIZE OF HEADER

	20"	22"	24"	No
16" Riser	$2\frac{13}{16}$	$1\frac{3}{4}$	$\frac{9}{16}$	0
	$2\frac{5}{8}$	$1\frac{3}{8}$	$\frac{3}{4}$	1
	$1\frac{1}{8}$	$\frac{7}{16}$	$\frac{1}{4}$	2
	$\frac{3}{8}$	$\frac{1}{16}$	0	3
	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	4
	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{3}{4}$	5
	$2\frac{11}{16}$	$3\frac{3}{4}$	$3\frac{3}{8}$	6
	$4\frac{11}{16}$	$5\frac{3}{4}$	$6\frac{1}{2}$	7
	$6\frac{7}{8}$	$7\frac{3}{4}$	$8\frac{1}{2}$	8
	$8\frac{1}{2}$	$9\frac{1}{2}$	$10\frac{1}{2}$	9
18" Riser	$3\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{3}{8}$	0
	$2\frac{13}{16}$	$1\frac{3}{4}$	$1\frac{1}{16}$	1
	$1\frac{1}{8}$	$\frac{13}{16}$	$\frac{7}{16}$	2
	$\frac{1}{4}$	$\frac{1}{16}$	0	3
	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{8}$	4
	1	$1\frac{1}{8}$	$1\frac{13}{16}$	5
	$2\frac{13}{16}$	$3\frac{3}{8}$	$4\frac{1}{16}$	6
	$5\frac{9}{16}$	$6\frac{3}{8}$	$7\frac{3}{8}$	7
	$7\frac{5}{8}$	$8\frac{1}{2}$	9	8
	$9\frac{1}{2}$	$10\frac{1}{2}$	$11\frac{1}{2}$	9
20" Riser	$4\frac{3}{8}$	$2\frac{3}{4}$	$1\frac{3}{8}$	0
	$3\frac{3}{8}$	$2\frac{1}{16}$	$1\frac{1}{16}$	1
	$1\frac{11}{16}$	1	$\frac{1}{2}$	2
	$\frac{3}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	3
	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{8}$	4
	$1\frac{1}{8}$	$1\frac{1}{16}$	$1\frac{1}{16}$	5
	$3\frac{1}{4}$	$3\frac{7}{8}$	$4\frac{1}{8}$	6
	$6\frac{1}{4}$	$6\frac{13}{16}$	$7\frac{1}{2}$	7
	$8\frac{1}{4}$	9	$10\frac{1}{4}$	8
	$10\frac{1}{2}$	$11\frac{1}{2}$	$12\frac{1}{2}$	9
22" Riser	$4\frac{13}{16}$	$2\frac{3}{4}$	$1\frac{3}{8}$	0
	$3\frac{7}{8}$	$2\frac{1}{16}$	$1\frac{1}{16}$	1
	$1\frac{15}{16}$	1	$\frac{1}{2}$	2
	$\frac{3}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	3
	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{8}$	4
	$1\frac{1}{8}$	$1\frac{1}{16}$	$1\frac{1}{16}$	5
	$3\frac{1}{4}$	$3\frac{7}{8}$	$4\frac{1}{8}$	6
	$6\frac{1}{4}$	$6\frac{13}{16}$	$7\frac{1}{2}$	7
	$8\frac{1}{4}$	9	$10\frac{1}{4}$	8
	$10\frac{1}{2}$	$11\frac{1}{2}$	$12\frac{1}{2}$	9



45° LATERALS
STANDARD WEIGHT RISERS
MARK IN EIGHTH'S
SIZE OF HEADER

	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"	NO
3" Riser	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	1
	$2\frac{11}{16}$	$2\frac{3}{8}$	$2\frac{1}{2}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{11}{16}$	2
	$3\frac{1}{2}$	3	$2\frac{7}{8}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{11}{16}$	3
	$3\frac{11}{16}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{16}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{1}{4}$	4
4" Riser		$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	1
		$3\frac{3}{4}$	3	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{11}{16}$	$2\frac{3}{4}$	$2\frac{11}{16}$	2
		$4\frac{1}{8}$	$3\frac{7}{8}$	$3\frac{3}{4}$	$3\frac{11}{16}$	$3\frac{1}{2}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{3}{8}$	$3\frac{1}{2}$	3
		4	4	4	4	4	4	4	4	4	4	4	4
6" Riser			2	$1\frac{11}{16}$	$1\frac{1}{2}$	$1\frac{7}{16}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{11}{16}$	$1\frac{3}{8}$	$1\frac{1}{2}$	1
			$5\frac{13}{16}$	$4\frac{11}{16}$	$4\frac{3}{8}$	$4\frac{1}{8}$	4	$3\frac{3}{8}$	$3\frac{3}{4}$	$3\frac{11}{16}$	$3\frac{3}{8}$	$3\frac{1}{2}$	2
			$6\frac{5}{16}$	6	$5\frac{13}{16}$	$5\frac{1}{2}$	$5\frac{1}{8}$	$5\frac{1}{2}$	$5\frac{1}{8}$	$5\frac{1}{2}$	$5\frac{1}{8}$	$5\frac{1}{2}$	3
			$6\frac{1}{16}$	$6\frac{1}{4}$	$6\frac{1}{8}$	$6\frac{1}{16}$	$6\frac{1}{8}$	$6\frac{1}{16}$	$6\frac{1}{8}$	$6\frac{1}{16}$	$6\frac{1}{8}$	$6\frac{1}{16}$	4
8" Riser				$2\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{3}{8}$	2	$1\frac{7}{8}$	$1\frac{11}{16}$	$1\frac{3}{4}$	$1\frac{11}{16}$	$1\frac{3}{8}$	1
				$7\frac{3}{4}$	$6\frac{1}{2}$	6	$5\frac{3}{4}$	$5\frac{1}{2}$	$5\frac{3}{8}$	$5\frac{1}{2}$	$5\frac{3}{8}$	$4\frac{15}{16}$	2
				$8\frac{5}{16}$	$7\frac{15}{16}$	$7\frac{3}{4}$	$7\frac{3}{8}$	$7\frac{1}{2}$	$7\frac{1}{8}$	$7\frac{1}{2}$	$7\frac{1}{8}$	$7\frac{1}{2}$	3
				8	8	8	8	8	8	8	8	8	4

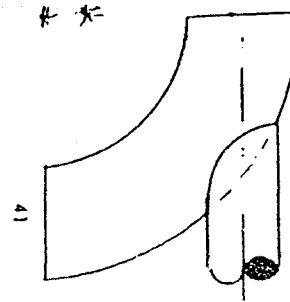
45° LATERALS
STANDARD WEIGHT RISERS
MARK IN SIXTEENTH'S
SIZE OF HEADER

	10"	12"	14"	16"	18"	20"	22"	24"	NO
10" Riser	$7\frac{1}{8}$	$11\frac{1}{8}$	$3\frac{1}{2}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$5\frac{1}{8}$	$5\frac{1}{8}$	$5\frac{1}{8}$	1
	$3\frac{1}{2}$	3	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	2
	$6\frac{1}{8}$	$5\frac{1}{8}$	$5\frac{1}{8}$	$5\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{1}{8}$	3
	$9\frac{1}{8}$	$8\frac{1}{8}$	8	$7\frac{1}{8}$	$7\frac{1}{8}$	$6\frac{1}{8}$	$6\frac{1}{8}$	$6\frac{1}{8}$	4
	$10\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	9	$8\frac{1}{8}$	$8\frac{1}{8}$	$8\frac{1}{8}$	$8\frac{1}{8}$	5
	$10\frac{1}{8}$	$10\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	6
	$10\frac{1}{8}$	$10\frac{1}{8}$	10	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	7
	10	10	10	10	10	10	10	10	8
12" Riser	$11\frac{1}{8}$	1	$11\frac{1}{8}$	$7\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$7\frac{1}{8}$	$7\frac{1}{8}$	1
	$4\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$2\frac{1}{8}$	$2\frac{1}{8}$	$2\frac{1}{8}$	2
	$8\frac{1}{8}$	$7\frac{1}{8}$	$6\frac{1}{8}$	$6\frac{1}{8}$	$6\frac{1}{8}$	$5\frac{1}{8}$	$5\frac{1}{8}$	$5\frac{1}{8}$	3
	$12\frac{1}{8}$	$10\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	$8\frac{1}{8}$	$8\frac{1}{8}$	$8\frac{1}{8}$	$8\frac{1}{8}$	4
	$12\frac{1}{8}$	$12\frac{1}{8}$	$11\frac{1}{8}$	11	$10\frac{1}{8}$	$10\frac{1}{8}$	$10\frac{1}{8}$	$10\frac{1}{8}$	5
	$12\frac{1}{8}$	$12\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	6
	$12\frac{1}{8}$	$12\frac{1}{8}$	12	$11\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	7
	12	12	12	12	12	12	12	12	8
14" Riser			$1\frac{1}{8}$	$1\frac{1}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	1
			$4\frac{1}{8}$	$4\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{8}$	2
			$9\frac{1}{8}$	$8\frac{1}{8}$	$7\frac{1}{8}$	$7\frac{1}{8}$	$6\frac{1}{8}$	$6\frac{1}{8}$	3
			$13\frac{1}{8}$	$11\frac{1}{8}$	$10\frac{1}{8}$	$10\frac{1}{8}$	$9\frac{1}{8}$	$9\frac{1}{8}$	4
			$14\frac{1}{8}$	$13\frac{1}{8}$	$12\frac{1}{8}$	$12\frac{1}{8}$	$11\frac{1}{8}$	$11\frac{1}{8}$	5
			$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	$12\frac{1}{8}$	$12\frac{1}{8}$	$12\frac{1}{8}$	6
			$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	7
			$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	$13\frac{1}{8}$	8
16" Riser				$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	1
				$5\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{1}{8}$	2
				$10\frac{1}{8}$	$9\frac{1}{8}$	$8\frac{1}{8}$	$8\frac{1}{8}$	$7\frac{1}{8}$	3
				$15\frac{1}{8}$	$13\frac{1}{8}$	$12\frac{1}{8}$	12	$11\frac{1}{8}$	4
				$16\frac{1}{8}$	$15\frac{1}{8}$	$14\frac{1}{8}$	$14\frac{1}{8}$	$13\frac{1}{8}$	5
				16	$15\frac{1}{8}$	$15\frac{1}{8}$	15	$14\frac{1}{8}$	6
				$15\frac{1}{8}$	$15\frac{1}{8}$	$15\frac{1}{8}$	$15\frac{1}{8}$	$15\frac{1}{8}$	7
				$15\frac{1}{8}$	$15\frac{1}{8}$	$15\frac{1}{8}$	$15\frac{1}{8}$	$15\frac{1}{8}$	8

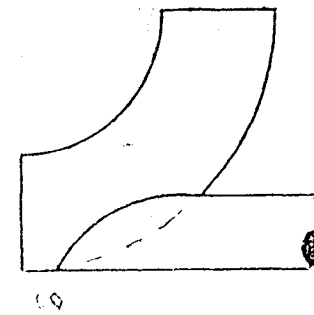
45° LATERALS
STANDARD WEIGHT RISERS
MARK IN SIXTEENTH'S
SIZE OF HEADER

		20"	22"	24"	No
18" Riser	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	1
	$5\frac{1}{8}$	$5\frac{1}{8}$	$5\frac{1}{8}$	$4\frac{1}{8}$	2
	$12\frac{1}{8}$	$10\frac{1}{8}$	$10\frac{1}{8}$	$9\frac{1}{8}$	3
	$17\frac{1}{8}$	$15\frac{1}{8}$	$14\frac{1}{8}$	$13\frac{1}{8}$	4
	$18\frac{1}{8}$	$17\frac{1}{8}$	$16\frac{1}{8}$	$16\frac{1}{8}$	5
	$18\frac{1}{8}$	$17\frac{1}{8}$	$17\frac{1}{8}$	$17\frac{1}{8}$	6
	$17\frac{1}{8}$	$17\frac{1}{8}$	$17\frac{1}{8}$	$17\frac{1}{8}$	7
	$17\frac{1}{8}$	$17\frac{1}{8}$	$17\frac{1}{8}$	$17\frac{1}{8}$	8
20" Riser		$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	1
		$6\frac{1}{8}$	$6\frac{1}{8}$	$5\frac{1}{8}$	2
		$13\frac{1}{8}$	$12\frac{1}{8}$	$11\frac{1}{8}$	3
		$19\frac{1}{8}$	$17\frac{1}{8}$	$16\frac{1}{8}$	4
		21	$19\frac{1}{8}$	$18\frac{1}{8}$	5
		$20\frac{1}{8}$	$19\frac{1}{8}$	$19\frac{1}{8}$	6
		$19\frac{1}{8}$	$19\frac{1}{8}$	$19\frac{1}{8}$	7
		$19\frac{1}{8}$	$19\frac{1}{8}$	$19\frac{1}{8}$	8
22" Riser			$1\frac{1}{8}$	$1\frac{1}{8}$	1
			$7\frac{1}{8}$	$6\frac{1}{8}$	2
			$15\frac{1}{8}$	$13\frac{1}{8}$	3
			$22\frac{1}{8}$	$19\frac{1}{8}$	4
			$23\frac{1}{8}$	$21\frac{1}{8}$	5
			$22\frac{1}{8}$	$21\frac{1}{8}$	6
			$21\frac{1}{8}$	$21\frac{1}{8}$	7
			$21\frac{1}{8}$	$21\frac{1}{8}$	8
24" Riser				$2\frac{1}{8}$	1
				8	2
				$16\frac{1}{8}$	3
				$24\frac{1}{8}$	4
				$25\frac{1}{8}$	5
				$24\frac{1}{8}$	6
				$23\frac{1}{8}$	7
				$23\frac{1}{8}$	8

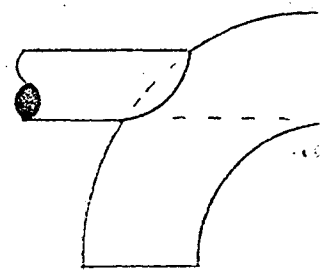
TYPE #1
CONCENTRIC ON
CENTERLINE RADIUS
OF ELBOW



TYPE #2
ECCENTRIC ON
OUTSIDE RADIUS
OF ELBOW



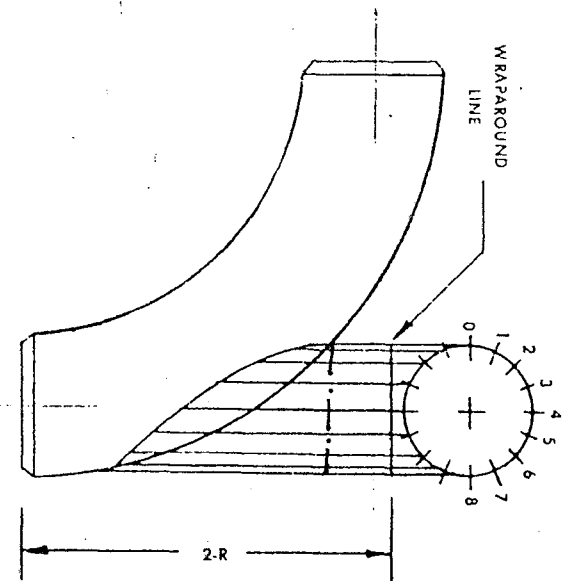
TYPE #3
ECCENTRIC ON
INSIDE RADIUS
OF ELBOW



THESE THREE TYPES OF SUPPORTS ON 90° LONG RADIUS WELDELLS REQUIRE DIFFERENT DIMENSIONS.

THE LAYOUT FOR EACH TYPE HOWEVER IS COMMON AND IS SHOWN ON THE FOLLOWING PAGE. TO MARK THE SMALLER SIZES IN EIGHTHS USE ORDINATE "0-2-4-6-8."

LAYOUT FOR A CONCENTRIC OR AN
ECCENTRIC SUPPORT ON BACK OF
A 90 DEGREE LONG RADIUS ELBOW



Mark in sixteenths the welds are from a wraparound line that is the length of two radii from the end of the elbow. Example: A 6' long radius elbow has a radius of 3' so you would mark 1' from the end of the 18"

TYPE 17, STANDARD WEIGHT
C/L OF SUPPORT LINES WITH C/L OF ELBOW

		SIZE OF ELBOW							No
		2"	3"	4"	6"	8"	10"	12"	
2" Pipe	2 1/8	3 1/8	5 1/8	8 1/8	11 1/8	15 1/8	18 1/8	0	
	2 1/4	3 1/4	5 1/4	8 1/4	12	15 1/4	18 1/4	1	
	2 3/8	4 3/8	5 3/8	9	12 3/8	15 3/8	18 3/8	2	
	3	4 1/2	6 1/2	9 1/2	12 1/2	15 1/2	19 1/2	3	
	3 1/8	5 1/8	6 1/8	9 1/8	13 1/8	16 1/8	19 1/8	4	
	3 1/4	5 1/4	7 1/4	10 1/4	13 1/4	16 1/4	20 1/4	5	
	3 3/8	5 3/8	7 3/8	10 3/8	13 3/8	17 3/8	20 3/8	6	
	4	6 1/2	7 1/2	10 1/2	14 1/2	17 1/2	20 1/2	7	
3" Pipe	4 1/8	6 1/8	7 1/8	10 1/8	14 1/8	17 1/8	20 1/8	8	
		3 1/2	5 1/2	8 1/2	11 1/2	14 1/2	18	0	
		3 3/4	5 3/4	8 3/4	11 3/4	14 3/4	18 3/4	1	
		4 1/4	5 1/4	8 1/4	11 1/4	14 1/4	18 1/4	2	
		5 1/8	6 1/8	9 1/8	12 1/8	15 1/8	19 1/8	3	
		6 1/8	7 1/8	10 1/8	13 1/8	16 1/8	19 1/8	4	
		6 3/8	7 3/8	10 3/8	13 3/8	16 3/8	20 3/8	5	
		7 1/8	8 1/8	11 1/8	14 1/8	17 1/8	21 1/8	6	
4" Pipe		7 3/8	8 3/8	11 3/8	14 3/8	18	21 3/8	7	
		7 1/2	8 1/2	11 1/2	14 1/2	18 1/2	21 1/2	8	
			4 3/4	7 3/4	11 3/4	14 3/4	17 3/4	0	
			5	8 1/2	11 1/2	14 1/2	17 1/2	1	
			5 1/4	8 1/4	11 1/4	15 1/4	18 1/4	2	
			6 1/8	9 1/8	12 1/8	15 1/8	19 1/8	3	
			8 1/8	10 1/8	13 1/8	16 1/8	20 1/8	4	
			9 1/8	11 1/8	14 1/8	17 1/8	20 1/8	5	
6" Pipe			9 3/8	12 3/8	15 3/8	18 3/8	21 3/8	6	
			10	12 1/2	15 1/2	18 1/2	21 1/2	7	
			10 3/8	12 3/8	15 3/8	18 3/8	22 3/8	8	
				7 1/4	10 1/4	13 1/4	16 1/4	0	
				7 3/8	10 3/8	13 3/8	17 3/8	1	
				8 1/4	11 1/4	14 1/4	18	2	
				10 1/8	13 1/8	16 1/8	19 1/8	3	
				12 1/8	14 1/8	17 1/8	20 1/8	4	
6" Pipe				14 1/8	16 1/8	18 1/8	22 1/8	5	
				15 1/8	17 1/8	19 1/8	22 1/8	6	
				15 3/8	17 3/8	20 3/8	23 3/8	7	
				15 1/2	17 1/2	20 1/2	23 1/2	8	
				15 3/4	17 3/4	20 3/4	23 3/4	8	

TYPE 17, STANDARD WEIGHT
C/L OF SUPPORT LINES WITH C/L OF ELBOW

		SIZE OF ELBOW							No
		8"	10"	12"	14"	16"	18"	20"	
8" Pipe		9 1/2	12 1/2	16 1/2	19 1/2	23	26 1/2	29 1/2	0
		10 1/8	13 1/8	16 1/8	20 1/8	23 1/8	26 1/8	30	1
		11 1/8	14 1/8	17 1/8	21 1/8	24 1/8	27 1/8	31 1/8	2
		14 1/8	16 1/8	19 1/8	23 1/8	26 1/8	29 1/8	32 1/8	3
		17 1/8	19	21 1/8	25 1/8	28 1/8	31 1/8	34 1/8	4
		19 1/8	20 1/8	23 1/8	27 1/8	30 1/8	33 1/8	36 1/8	5
		20 1/8	21 1/8	24 1/8	28 1/8	31 1/8	34 1/8	37 1/8	6
		20 1/4	22 1/4	25 1/4	29 1/4	32 1/4	35 1/4	38 1/4	7
10" Pipe		20 3/8	22 3/8	25 3/8	29 3/8	32 3/8	35 3/8	38 3/8	8
	0	12 1/4	15 1/4	19	22 1/4	25 1/4	28 1/4	0	
	1	12 3/8	16	19 3/8	22 3/8	26 3/8	29 3/8	1	
	2	14 1/8	17 1/8	21 1/8	24 1/8	27 1/8	30 1/8	2	
	3	18	20 1/8	24	26 1/8	30	33 1/8	3	
	4	22 1/8	23 1/8	26 1/8	29 1/8	32 1/8	35 1/8	4	
	5	24 1/8	25 1/8	29 1/8	31 1/8	34 1/8	37 1/8	5	
	6	25 1/8	27 1/8	30 1/8	33 1/8	36 1/8	39 1/8	6	
12" Pipe	7	26 1/8	27 1/8	31 1/8	34 1/8	37 1/8	40 1/8	7	
	8	26 3/8	27 3/8	31 3/8	34 3/8	37 3/8	40 3/8	8	
			14 1/2	18 1/2	21 1/2	24 1/2	28	0	
			15 1/2	19 1/2	22 1/2	25 1/2	28 1/2	1	
			17 1/2	21 1/2	24 1/2	27 1/2	30 1/2	2	
			21 1/2	25	27 1/2	30 1/2	33 1/2	3	
			26 1/2	29 1/2	31 1/2	33 1/2	36 1/2	4	
			30 1/2	32 1/2	34 1/2	36 1/2	39 1/2	5	
14" Pipe			31 1/2	33 1/2	35 1/2	38 1/2	41 1/2	6	
			31 3/8	34 3/8	36 3/8	39 3/8	42 3/8	7	
			31 1/4	34 1/4	36 1/4	39 1/4	42 1/4	8	
				18	21 1/2	24 1/2	27 1/2	0	
				18 1/2	21 1/2	25 1/2	28 1/2	1	
				21 1/2	24 1/2	27 1/2	30 1/2	2	
				26 1/2	28 1/2	31	33 1/2	3	
				32	32 1/2	34 1/2	37 1/2	4	
14" Pipe				35 1/2	35 1/2	38	40 1/2	5	
				36 1/2	37 1/2	39 1/2	42 1/2	6	
				37 1/2	38 1/2	40 1/2	43 1/2	7	
				37 1/4	38 1/4	41 1/4	43 1/4	8	
				37 3/4	38 3/4	41 3/4	43 3/4	8	

(TYPE #1) STANDARD WEIGHT PIPE
C/L OF SUPPORT LINES WITH C/L OF ELBOW

SIZE OF ELBOW						
	16"	18"	20"	22"	24"	No
16" Pipe	20 $\frac{1}{2}$	23 $\frac{1}{2}$	26 $\frac{1}{2}$	30 $\frac{1}{2}$	33 $\frac{1}{2}$	0
	21 $\frac{1}{2}$	24 $\frac{1}{2}$	27 $\frac{1}{2}$	30 $\frac{1}{2}$	34 $\frac{1}{2}$	1
	24 $\frac{1}{2}$	27 $\frac{1}{2}$	30 $\frac{1}{2}$	33 $\frac{1}{2}$	36 $\frac{1}{2}$	2
	29 $\frac{1}{2}$	32	34 $\frac{1}{2}$	37 $\frac{1}{2}$	40 $\frac{1}{2}$	3
	36 $\frac{1}{2}$	37 $\frac{1}{2}$	39 $\frac{1}{2}$	41 $\frac{1}{2}$	44 $\frac{1}{2}$	4
	41 $\frac{1}{2}$	41 $\frac{1}{2}$	42 $\frac{1}{2}$	45 $\frac{1}{2}$	48	5
	42 $\frac{1}{2}$	43	45 $\frac{1}{2}$	47 $\frac{1}{2}$	50 $\frac{1}{2}$	6
	43	43 $\frac{1}{2}$	46 $\frac{1}{2}$	48 $\frac{1}{2}$	51 $\frac{1}{2}$	7
18" Pipe	43 $\frac{1}{2}$	44 $\frac{1}{2}$	46 $\frac{1}{2}$	49 $\frac{1}{2}$	52	8
		23 $\frac{1}{2}$	26 $\frac{1}{2}$	29 $\frac{1}{2}$	32 $\frac{1}{2}$	0
		24 $\frac{1}{2}$	27 $\frac{1}{2}$	30 $\frac{1}{2}$	33 $\frac{1}{2}$	1
		27 $\frac{1}{2}$	30 $\frac{1}{2}$	33 $\frac{1}{2}$	36 $\frac{1}{2}$	2
		33 $\frac{1}{2}$	35 $\frac{1}{2}$	38 $\frac{1}{2}$	41 $\frac{1}{2}$	3
		41 $\frac{1}{2}$	41 $\frac{1}{2}$	43 $\frac{1}{2}$	46 $\frac{1}{2}$	4
		46 $\frac{1}{2}$	46 $\frac{1}{2}$	47 $\frac{1}{2}$	50 $\frac{1}{2}$	5
		48 $\frac{1}{2}$	48 $\frac{1}{2}$	50 $\frac{1}{2}$	52 $\frac{1}{2}$	6
20" Pipe		48 $\frac{1}{2}$	49 $\frac{1}{2}$	51 $\frac{1}{2}$	53 $\frac{1}{2}$	7
		48 $\frac{1}{2}$	49 $\frac{1}{2}$	51 $\frac{1}{2}$	54 $\frac{1}{2}$	8
			25 $\frac{1}{2}$	28 $\frac{1}{2}$	31 $\frac{1}{2}$	0
			26 $\frac{1}{2}$	29 $\frac{1}{2}$	33 $\frac{1}{2}$	1
			30 $\frac{1}{2}$	33 $\frac{1}{2}$	36 $\frac{1}{2}$	2
			37 $\frac{1}{2}$	39 $\frac{1}{2}$	42 $\frac{1}{2}$	3
			46 $\frac{1}{2}$	46 $\frac{1}{2}$	48 $\frac{1}{2}$	4
			52 $\frac{1}{2}$	51 $\frac{1}{2}$	52 $\frac{1}{2}$	5
22" Pipe			53 $\frac{1}{2}$	53 $\frac{1}{2}$	55 $\frac{1}{2}$	6
			54 $\frac{1}{2}$	54 $\frac{1}{2}$	56 $\frac{1}{2}$	7
			54 $\frac{1}{2}$	55 $\frac{1}{2}$	57 $\frac{1}{2}$	8
				28 $\frac{1}{2}$	31 $\frac{1}{2}$	0
				29 $\frac{1}{2}$	32 $\frac{1}{2}$	1
				33 $\frac{1}{2}$	36 $\frac{1}{2}$	2
				41 $\frac{1}{2}$	43 $\frac{1}{2}$	3
				52	51 $\frac{1}{2}$	4
				57 $\frac{1}{2}$	56 $\frac{1}{2}$	5
				59 $\frac{1}{2}$	59 $\frac{1}{2}$	6
				60 $\frac{1}{2}$	60 $\frac{1}{2}$	7
				60 $\frac{1}{2}$	60 $\frac{1}{2}$	8

B. O. P. LINES WITH OUTSIDE RADIUS OF ELBOW

SIZE OF ELBOW							
	3"	4"	6"	8"	10"	12"	NO
2" Pipe	4 $\frac{1}{2}$	6 $\frac{1}{2}$	10 $\frac{1}{2}$	15 $\frac{1}{2}$	20 $\frac{1}{2}$	25 $\frac{1}{2}$	0
	4 $\frac{1}{2}$	6 $\frac{1}{2}$	11 $\frac{1}{2}$	15 $\frac{1}{2}$	20 $\frac{1}{2}$	26 $\frac{1}{2}$	1
	4 $\frac{1}{2}$	6 $\frac{1}{2}$	11 $\frac{1}{2}$	16 $\frac{1}{2}$	21 $\frac{1}{2}$	26 $\frac{1}{2}$	2
	5 $\frac{1}{2}$	7 $\frac{1}{2}$	12 $\frac{1}{2}$	17 $\frac{1}{2}$	22 $\frac{1}{2}$	27 $\frac{1}{2}$	3
	5 $\frac{1}{2}$	8 $\frac{1}{2}$	13 $\frac{1}{2}$	18 $\frac{1}{2}$	23 $\frac{1}{2}$	28 $\frac{1}{2}$	4
	6 $\frac{1}{2}$	9	14 $\frac{1}{2}$	19 $\frac{1}{2}$	24 $\frac{1}{2}$	30 $\frac{1}{2}$	5
	7 $\frac{1}{2}$	9 $\frac{1}{2}$	15	20 $\frac{1}{2}$	25 $\frac{1}{2}$	31 $\frac{1}{2}$	6
	7 $\frac{1}{2}$	10 $\frac{1}{2}$	15 $\frac{1}{2}$	21 $\frac{1}{2}$	27	32 $\frac{1}{2}$	7
3" Pipe	7 $\frac{1}{2}$	10 $\frac{1}{2}$	16 $\frac{1}{2}$	21 $\frac{1}{2}$	27 $\frac{1}{2}$	33 $\frac{1}{2}$	8
		5 $\frac{1}{2}$	9 $\frac{1}{2}$	14 $\frac{1}{2}$	18 $\frac{1}{2}$	23 $\frac{1}{2}$	0
		5 $\frac{1}{2}$	9 $\frac{1}{2}$	14 $\frac{1}{2}$	19 $\frac{1}{2}$	24 $\frac{1}{2}$	1
		6 $\frac{1}{2}$	10 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	24 $\frac{1}{2}$	2
		7	11 $\frac{1}{2}$	16 $\frac{1}{2}$	20 $\frac{1}{2}$	25 $\frac{1}{2}$	3
		8	12 $\frac{1}{2}$	17 $\frac{1}{2}$	22 $\frac{1}{2}$	27 $\frac{1}{2}$	4
		8 $\frac{1}{2}$	13 $\frac{1}{2}$	18 $\frac{1}{2}$	23 $\frac{1}{2}$	29 $\frac{1}{2}$	5
		9 $\frac{1}{2}$	14 $\frac{1}{2}$	19 $\frac{1}{2}$	25 $\frac{1}{2}$	30 $\frac{1}{2}$	6
4" Pipe		10	15 $\frac{1}{2}$	20 $\frac{1}{2}$	26 $\frac{1}{2}$	32 $\frac{1}{2}$	7
		10 $\frac{1}{2}$	15 $\frac{1}{2}$	21 $\frac{1}{2}$	27 $\frac{1}{2}$	32 $\frac{1}{2}$	8
			8 $\frac{1}{2}$	13 $\frac{1}{2}$	17 $\frac{1}{2}$	22 $\frac{1}{2}$	0
			8 $\frac{1}{2}$	13 $\frac{1}{2}$	17 $\frac{1}{2}$	22 $\frac{1}{2}$	1
			9 $\frac{1}{2}$	14 $\frac{1}{2}$	18 $\frac{1}{2}$	23 $\frac{1}{2}$	2
			10 $\frac{1}{2}$	15 $\frac{1}{2}$	20	24 $\frac{1}{2}$	3
			12 $\frac{1}{2}$	16 $\frac{1}{2}$	21 $\frac{1}{2}$	26 $\frac{1}{2}$	4
			13 $\frac{1}{2}$	18 $\frac{1}{2}$	23 $\frac{1}{2}$	28 $\frac{1}{2}$	5
6" Pipe			14 $\frac{1}{2}$	19 $\frac{1}{2}$	25	30 $\frac{1}{2}$	6
			15 $\frac{1}{2}$	20 $\frac{1}{2}$	26 $\frac{1}{2}$	31 $\frac{1}{2}$	7
			15 $\frac{1}{2}$	21 $\frac{1}{2}$	26 $\frac{1}{2}$	32 $\frac{1}{2}$	8
				11 $\frac{1}{2}$	15 $\frac{1}{2}$	19 $\frac{1}{2}$	0
				11 $\frac{1}{2}$	15 $\frac{1}{2}$	20	1
				12 $\frac{1}{2}$	16 $\frac{1}{2}$	21 $\frac{1}{2}$	2
				14 $\frac{1}{2}$	18 $\frac{1}{2}$	23 $\frac{1}{2}$	3
				16 $\frac{1}{2}$	20 $\frac{1}{2}$	25 $\frac{1}{2}$	4
				18 $\frac{1}{2}$	22 $\frac{1}{2}$	27 $\frac{1}{2}$	5
				19 $\frac{1}{2}$	24 $\frac{1}{2}$	29 $\frac{1}{2}$	6
				20 $\frac{1}{2}$	26 $\frac{1}{2}$	31 $\frac{1}{2}$	7
				21	26 $\frac{1}{2}$	32 $\frac{1}{2}$	8

B. O. P. LINES WITH OUTSIDE RADIUS OF ELBOW

		SIZE OF ELBOW					
		10"	12"	14"	16"	18"	20"
8" Pipe		13 $\frac{1}{4}$	17 $\frac{1}{4}$	22 $\frac{1}{2}$	26 $\frac{1}{2}$	31	35 $\frac{1}{2}$
		14 $\frac{1}{2}$	18 $\frac{1}{4}$	22 $\frac{3}{4}$	27 $\frac{1}{4}$	31 $\frac{3}{4}$	36 $\frac{1}{4}$
		15 $\frac{1}{4}$	19 $\frac{1}{4}$	24 $\frac{1}{4}$	28 $\frac{1}{4}$	33 $\frac{1}{4}$	37 $\frac{1}{4}$
		17 $\frac{1}{4}$	22 $\frac{1}{4}$	26 $\frac{1}{4}$	31 $\frac{1}{4}$	35 $\frac{1}{4}$	40 $\frac{1}{4}$
		20 $\frac{1}{4}$	24 $\frac{1}{4}$	29 $\frac{1}{4}$	34 $\frac{1}{4}$	39	43 $\frac{1}{4}$
		23 $\frac{1}{4}$	27 $\frac{1}{4}$	32 $\frac{1}{4}$	37 $\frac{1}{4}$	42 $\frac{1}{4}$	47 $\frac{1}{4}$
		24 $\frac{1}{4}$	29 $\frac{1}{4}$	35 $\frac{1}{4}$	40 $\frac{1}{4}$	45 $\frac{1}{4}$	50 $\frac{1}{4}$
		26	31 $\frac{1}{4}$	37	42 $\frac{1}{4}$	48 $\frac{1}{4}$	53 $\frac{1}{4}$
		26 $\frac{1}{4}$	32 $\frac{1}{4}$	37 $\frac{3}{4}$	43 $\frac{1}{4}$	49 $\frac{1}{4}$	54 $\frac{1}{4}$
10" Pipe			16 $\frac{1}{4}$	20 $\frac{1}{4}$	24 $\frac{1}{4}$	28 $\frac{1}{4}$	33 $\frac{1}{4}$
			16 $\frac{1}{4}$	20 $\frac{1}{4}$	25 $\frac{1}{4}$	29 $\frac{1}{4}$	33 $\frac{1}{4}$
			18 $\frac{1}{4}$	22 $\frac{1}{4}$	27 $\frac{1}{4}$	31 $\frac{1}{4}$	35 $\frac{1}{4}$
			21 $\frac{1}{4}$	25 $\frac{1}{4}$	30 $\frac{1}{4}$	34 $\frac{1}{4}$	39
			25	29 $\frac{1}{4}$	33 $\frac{1}{4}$	38 $\frac{1}{4}$	42 $\frac{1}{4}$
			28 $\frac{1}{4}$	32 $\frac{1}{4}$	37 $\frac{1}{4}$	41 $\frac{1}{4}$	46 $\frac{1}{4}$
			30 $\frac{1}{4}$	35 $\frac{1}{4}$	40 $\frac{1}{4}$	45 $\frac{1}{4}$	50 $\frac{1}{4}$
			31 $\frac{1}{4}$	36 $\frac{1}{4}$	42 $\frac{1}{4}$	47 $\frac{1}{4}$	53 $\frac{1}{4}$
12" Pipe				18 $\frac{1}{4}$	22 $\frac{1}{4}$	26 $\frac{1}{4}$	31 $\frac{1}{4}$
				19 $\frac{1}{4}$	23 $\frac{1}{4}$	27 $\frac{1}{4}$	31 $\frac{1}{4}$
				21 $\frac{1}{4}$	25 $\frac{1}{4}$	30	34 $\frac{1}{4}$
				25 $\frac{1}{4}$	29 $\frac{1}{4}$	33 $\frac{1}{4}$	37 $\frac{1}{4}$
				30 $\frac{1}{4}$	33 $\frac{1}{4}$	37 $\frac{1}{4}$	42 $\frac{1}{4}$
				33 $\frac{1}{4}$	37 $\frac{1}{4}$	42 $\frac{1}{4}$	46 $\frac{1}{4}$
				35 $\frac{1}{4}$	40 $\frac{1}{4}$	45 $\frac{1}{4}$	50 $\frac{1}{4}$
				37 $\frac{1}{4}$	42 $\frac{1}{4}$	47 $\frac{1}{4}$	53 $\frac{1}{4}$
14" Pipe				37 $\frac{1}{4}$	43 $\frac{1}{4}$	48 $\frac{1}{4}$	54 $\frac{1}{4}$
					21 $\frac{1}{4}$	25 $\frac{1}{4}$	29 $\frac{1}{4}$
					22 $\frac{1}{4}$	26 $\frac{1}{4}$	30 $\frac{1}{4}$
					25 $\frac{1}{4}$	29 $\frac{1}{4}$	33 $\frac{1}{4}$
					29 $\frac{1}{4}$	33 $\frac{1}{4}$	37 $\frac{1}{4}$
					34 $\frac{1}{4}$	38 $\frac{1}{4}$	42 $\frac{1}{4}$
					38 $\frac{1}{4}$	42 $\frac{1}{4}$	46 $\frac{1}{4}$
					41 $\frac{1}{4}$	45 $\frac{1}{4}$	50 $\frac{1}{4}$
					42 $\frac{1}{4}$	47 $\frac{1}{4}$	53 $\frac{1}{4}$
					43 $\frac{1}{4}$	48 $\frac{1}{4}$	54 $\frac{1}{4}$

B. O. P. LINES WITH OUTSIDE RADIUS OF ELBOW

		SIZE OF ELBOW			
		18"	20"	22"	No
16" Pipe		24 $\frac{1}{4}$	28 $\frac{1}{4}$	32 $\frac{1}{4}$	0
		25 $\frac{1}{4}$	29 $\frac{1}{4}$	33 $\frac{1}{4}$	1
		28 $\frac{1}{4}$	32 $\frac{1}{4}$	36 $\frac{1}{4}$	2
		33 $\frac{1}{4}$	36 $\frac{1}{4}$	41	3
		38 $\frac{1}{4}$	42 $\frac{1}{4}$	46 $\frac{1}{4}$	4
		43 $\frac{1}{4}$	47 $\frac{1}{4}$	51 $\frac{1}{4}$	5
		46 $\frac{1}{4}$	51 $\frac{1}{4}$	56	6
		48 $\frac{1}{4}$	53 $\frac{1}{4}$	59	7
		48 $\frac{1}{4}$	54 $\frac{1}{4}$	60 $\frac{1}{4}$	8
18" Pipe			26 $\frac{1}{4}$	30 $\frac{1}{4}$	0
			28	31 $\frac{1}{4}$	1
			31 $\frac{1}{4}$	35 $\frac{1}{4}$	2
			36 $\frac{1}{4}$	40 $\frac{1}{4}$	3
			43 $\frac{1}{4}$	47	4
			48 $\frac{1}{4}$	52 $\frac{1}{4}$	5
			52 $\frac{1}{4}$	56 $\frac{1}{4}$	6
			53 $\frac{1}{4}$	59 $\frac{1}{4}$	7
20" Pipe			54 $\frac{1}{4}$	60 $\frac{1}{4}$	8
				29 $\frac{1}{4}$	0
				30 $\frac{1}{4}$	1
				34 $\frac{1}{4}$	2
				40 $\frac{1}{4}$	3
				48 $\frac{1}{4}$	4
				54 $\frac{1}{4}$	5
				57 $\frac{1}{4}$	6
22" Pipe				59 $\frac{1}{4}$	7
				60 $\frac{1}{4}$	8
				31 $\frac{1}{4}$	0
				33 $\frac{1}{4}$	1
				37 $\frac{1}{4}$	2
				44 $\frac{1}{4}$	3
				53 $\frac{1}{4}$	4
				59 $\frac{1}{4}$	5
				63 $\frac{1}{4}$	6
				65 $\frac{1}{4}$	7
				66	8

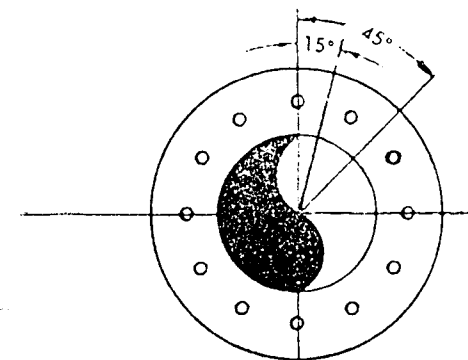
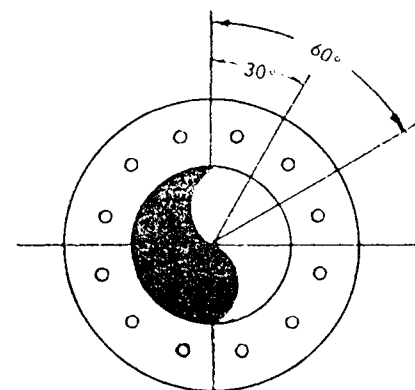
B.O.P. LINES WITH INSIDE RADIUS OF ELBOW

		SIZE OF ELBOW						No.
		3"	4"	6"	8"	10"	12"	
2"	PIPE	3 $\frac{1}{16}$ "	4 $\frac{1}{16}$ "	7 $\frac{1}{16}$ "	9 $\frac{1}{16}$ "	12 $\frac{1}{16}$ "	14 $\frac{1}{16}$ "	0
		3 $\frac{1}{8}$ "	4 $\frac{1}{8}$ "	7 $\frac{1}{8}$ "	9 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	1
		3 $\frac{1}{4}$ "	5 $\frac{1}{16}$ "	7 $\frac{1}{4}$ "	9 $\frac{1}{4}$ "	12 $\frac{1}{4}$ "	14 $\frac{1}{4}$ "	2
		4 $\frac{1}{16}$ "	5 $\frac{1}{8}$ "	7 $\frac{1}{2}$ "	10 $\frac{1}{16}$ "	12 $\frac{1}{2}$ "	15 $\frac{1}{16}$ "	3
		4 $\frac{1}{8}$ "	5 $\frac{1}{4}$ "	8"	10 $\frac{1}{8}$ "	12 $\frac{1}{4}$ "	15 $\frac{1}{8}$ "	4
		4 $\frac{1}{4}$ "	6"	8 $\frac{1}{4}$ "	10 $\frac{1}{4}$ "	13 $\frac{1}{16}$ "	15 $\frac{1}{4}$ "	5
		5 $\frac{1}{16}$ "	6 $\frac{1}{16}$ "	8 $\frac{1}{8}$ "	10 $\frac{1}{8}$ "	13 $\frac{1}{8}$ "	15 $\frac{1}{8}$ "	6
		5 $\frac{1}{8}$ "	6 $\frac{1}{4}$ "	8 $\frac{1}{2}$ "	11"	13 $\frac{1}{4}$ "	15 $\frac{1}{2}$ "	7
3"	PIPE	5 $\frac{1}{4}$ "	6 $\frac{1}{8}$ "	8 $\frac{1}{4}$ "	11 $\frac{1}{16}$ "	13 $\frac{1}{16}$ "	15 $\frac{1}{16}$ "	8
		4 $\frac{1}{8}$ "	7 $\frac{1}{16}$ "	9 $\frac{1}{16}$ "	12 $\frac{1}{16}$ "	14 $\frac{1}{16}$ "	16 $\frac{1}{16}$ "	0
		4 $\frac{1}{4}$ "	7 $\frac{1}{8}$ "	9 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	16 $\frac{1}{8}$ "	1
		5 $\frac{1}{8}$ "	7 $\frac{1}{4}$ "	10 $\frac{1}{16}$ "	12 $\frac{1}{4}$ "	15 $\frac{1}{16}$ "	17 $\frac{1}{16}$ "	2
		6"	8 $\frac{1}{8}$ "	10 $\frac{1}{8}$ "	12 $\frac{1}{4}$ "	15 $\frac{1}{4}$ "	17 $\frac{1}{4}$ "	3
		6 $\frac{1}{16}$ "	8 $\frac{1}{16}$ "	11 $\frac{1}{16}$ "	13 $\frac{1}{16}$ "	15 $\frac{1}{16}$ "	17 $\frac{1}{16}$ "	4
		7 $\frac{1}{16}$ "	9 $\frac{1}{16}$ "	11 $\frac{1}{8}$ "	13 $\frac{1}{8}$ "	16 $\frac{1}{16}$ "	18 $\frac{1}{16}$ "	5
		7 $\frac{1}{8}$ "	9 $\frac{1}{4}$ "	11 $\frac{1}{4}$ "	14"	16 $\frac{1}{2}$ "	18 $\frac{1}{2}$ "	6
4"	PIPE	7 $\frac{1}{4}$ "	9 $\frac{1}{2}$ "	11 $\frac{1}{2}$ "	14"	16 $\frac{1}{2}$ "	18 $\frac{1}{2}$ "	7
		7 $\frac{1}{2}$ "	9 $\frac{3}{4}$ "	11 $\frac{3}{4}$ "	14 $\frac{1}{4}$ "	16 $\frac{1}{4}$ "	18 $\frac{1}{4}$ "	8
		7 $\frac{3}{16}$ "	9 $\frac{1}{4}$ "	11 $\frac{3}{16}$ "	14 $\frac{1}{8}$ "	16 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	0
		7 $\frac{1}{2}$ "	9 $\frac{1}{2}$ "	11 $\frac{1}{2}$ "	12 $\frac{1}{2}$ "	14 $\frac{1}{2}$ "	16 $\frac{1}{2}$ "	1
		7 $\frac{1}{4}$ "	9 $\frac{1}{4}$ "	10 $\frac{1}{4}$ "	12 $\frac{1}{4}$ "	15 $\frac{1}{4}$ "	17 $\frac{1}{4}$ "	2
		8 $\frac{1}{16}$ "	11"	13 $\frac{1}{16}$ "	15 $\frac{1}{16}$ "	17 $\frac{1}{16}$ "	19 $\frac{1}{16}$ "	3
		9 $\frac{1}{16}$ "	11 $\frac{1}{16}$ "	13 $\frac{1}{16}$ "	16 $\frac{1}{16}$ "	18 $\frac{1}{16}$ "	20 $\frac{1}{16}$ "	4
		10 $\frac{1}{16}$ "	12 $\frac{1}{16}$ "	14 $\frac{1}{16}$ "	16 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	20 $\frac{1}{8}$ "	5
6"	PIPE	10 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	17 $\frac{1}{8}$ "	19 $\frac{1}{8}$ "	21 $\frac{1}{8}$ "	6
		10 $\frac{1}{4}$ "	12 $\frac{1}{4}$ "	15"	17 $\frac{1}{4}$ "	19 $\frac{1}{4}$ "	21 $\frac{1}{4}$ "	7
		10 $\frac{1}{2}$ "	12 $\frac{1}{2}$ "	15 $\frac{1}{2}$ "	17 $\frac{1}{2}$ "	19 $\frac{1}{2}$ "	21 $\frac{1}{2}$ "	8
		9 $\frac{1}{8}$ "	12 $\frac{1}{8}$ "	14 $\frac{1}{8}$ "	17 $\frac{1}{8}$ "	19 $\frac{1}{8}$ "	21 $\frac{1}{8}$ "	0
		10 $\frac{1}{16}$ "	12 $\frac{1}{16}$ "	15"	17 $\frac{1}{16}$ "	19 $\frac{1}{16}$ "	21 $\frac{1}{16}$ "	1
		11"	13 $\frac{1}{8}$ "	15 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	20 $\frac{1}{8}$ "	22 $\frac{1}{8}$ "	2
		12 $\frac{1}{16}$ "	14 $\frac{1}{16}$ "	16 $\frac{1}{16}$ "	18 $\frac{1}{16}$ "	20 $\frac{1}{16}$ "	22 $\frac{1}{16}$ "	3
		13 $\frac{1}{16}$ "	15 $\frac{1}{16}$ "	17 $\frac{1}{16}$ "	19 $\frac{1}{16}$ "	21 $\frac{1}{16}$ "	23 $\frac{1}{16}$ "	4

B.O.P. LINES WITH INSIDE RADIUS OF ELBOW

		SIZE OF ELBOW						No.
		10"	12"	14"	16"	18"	20"	
8"	PIPE	12 $\frac{1}{16}$ "	14 $\frac{1}{16}$ "	17 $\frac{1}{16}$ "	20 $\frac{1}{16}$ "	23"	25 $\frac{1}{16}$ "	0
		12 $\frac{1}{8}$ "	15 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	20 $\frac{1}{8}$ "	23 $\frac{1}{8}$ "	25 $\frac{1}{8}$ "	1
		13 $\frac{1}{16}$ "	16 $\frac{1}{16}$ "	19 $\frac{1}{16}$ "	21 $\frac{1}{16}$ "	24 $\frac{1}{16}$ "	26 $\frac{1}{16}$ "	2
		15 $\frac{1}{16}$ "	17 $\frac{1}{16}$ "	20 $\frac{1}{16}$ "	23 $\frac{1}{16}$ "	25 $\frac{1}{16}$ "	28"	3
		17 $\frac{1}{16}$ "	19 $\frac{1}{16}$ "	22 $\frac{1}{16}$ "	24 $\frac{1}{16}$ "	26 $\frac{1}{16}$ "	29 $\frac{1}{16}$ "	4
		19 $\frac{1}{16}$ "	20 $\frac{1}{16}$ "	23 $\frac{1}{16}$ "	25 $\frac{1}{16}$ "	28 $\frac{1}{16}$ "	30 $\frac{1}{16}$ "	5
		19 $\frac{1}{8}$ "	21 $\frac{1}{8}$ "	24 $\frac{1}{8}$ "	26 $\frac{1}{8}$ "	28 $\frac{1}{8}$ "	31 $\frac{1}{8}$ "	6
		20 $\frac{1}{16}$ "	21 $\frac{1}{16}$ "	24 $\frac{1}{16}$ "	27 $\frac{1}{16}$ "	29 $\frac{1}{16}$ "	31 $\frac{1}{16}$ "	7
10"	PIPE	20 $\frac{1}{8}$ "	21 $\frac{1}{8}$ "	25 $\frac{1}{8}$ "	27 $\frac{1}{8}$ "	29 $\frac{1}{8}$ "	31 $\frac{1}{8}$ "	8
		14 $\frac{1}{8}$ "	17 $\frac{1}{8}$ "	20 $\frac{1}{8}$ "	23 $\frac{1}{8}$ "	25 $\frac{1}{8}$ "	28 $\frac{1}{8}$ "	0
		15 $\frac{1}{8}$ "	18 $\frac{1}{8}$ "	21	23 $\frac{1}{4}$ "	26	28 $\frac{1}{4}$ "	1
		17"	20 $\frac{1}{8}$ "	22 $\frac{1}{4}$ "	24 $\frac{1}{4}$ "	27 $\frac{1}{4}$ "	29 $\frac{1}{4}$ "	2
		19 $\frac{1}{8}$ "	22 $\frac{1}{8}$ "	24 $\frac{1}{2}$ "	26 $\frac{1}{2}$ "	29	31 $\frac{1}{2}$ "	3
		22 $\frac{1}{8}$ "	24 $\frac{1}{4}$ "	26 $\frac{1}{2}$ "	28 $\frac{1}{2}$ "	30 $\frac{1}{2}$ "	32 $\frac{1}{2}$ "	4
		24 $\frac{1}{8}$ "	26 $\frac{1}{4}$ "	28 $\frac{1}{2}$ "	30 $\frac{1}{2}$ "	32 $\frac{1}{2}$ "	34 $\frac{1}{2}$ "	5
		25	27 $\frac{1}{4}$ "	29 $\frac{1}{2}$ "	31 $\frac{1}{2}$ "	33 $\frac{1}{2}$ "	35 $\frac{1}{2}$ "	6
12"	PIPE	25 $\frac{1}{4}$ "	28 $\frac{1}{4}$ "	29 $\frac{1}{2}$ "	31 $\frac{1}{2}$ "	33 $\frac{1}{2}$ "	35 $\frac{1}{2}$ "	7
		25 $\frac{1}{2}$ "	28 $\frac{1}{2}$ "	29 $\frac{3}{4}$ "	31 $\frac{3}{4}$ "	34	36 $\frac{3}{4}$ "	8
		18"	20 $\frac{1}{4}$ "	23 $\frac{1}{4}$ "	25 $\frac{1}{4}$ "	28 $\frac{1}{4}$ "	30 $\frac{1}{4}$ "	0
		18 $\frac{1}{16}$ "	21 $\frac{1}{16}$ "	23 $\frac{1}{16}$ "	26 $\frac{1}{16}$ "	28 $\frac{1}{16}$ "	31 $\frac{1}{16}$ "	1
		20 $\frac{1}{16}$ "	23 $\frac{1}{16}$ "	25 $\frac{1}{16}$ "	27 $\frac{1}{16}$ "	29 $\frac{1}{16}$ "	31 $\frac{1}{16}$ "	2
		24 $\frac{1}{16}$ "	26	28	30 $\frac{1}{16}$ "	32 $\frac{1}{16}$ "	34 $\frac{1}{16}$ "	3
		28 $\frac{1}{16}$ "	29 $\frac{1}{16}$ "	30 $\frac{1}{16}$ "	32 $\frac{1}{16}$ "	34 $\frac{1}{16}$ "	36 $\frac{1}{16}$ "	4
		30 $\frac{1}{16}$ "	31 $\frac{1}{16}$ "	32 $\frac{1}{16}$ "	34 $\frac{1}{16}$ "	36 $\frac{1}{16}$ "	38 $\frac{1}{16}$ "	5
14"	PIPE	32	32 $\frac{1}{16}$ "	33 $\frac{1}{16}$ "	35 $\frac{1}{16}$ "	37 $\frac{1}{16}$ "	39 $\frac{1}{16}$ "	6
		32 $\frac{1}{2}$ "	33 $\frac{1}{2}$ "	34 $\frac{1}{2}$ "	36 $\frac{1}{2}$ "	38 $\frac{1}{2}$ "	40 $\frac{1}{2}$ "	7
		32 $\frac{1}{4}$ "	33 $\frac{1}{4}$ "	34 $\frac{1}{4}$ "	36 $\frac{1}{4}$ "	38 $\frac{1}{4}$ "	40 $\frac{1}{4}$ "	8
		20 $\frac{1}{2}$ "	23 $\frac{1}{2}$ "	25 $\frac{1}{2}$ "	28 $\frac{1}{2}$ "	30 $\frac{1}{2}$ "	33 $\frac{1}{2}$ "	0
		21 $\frac{1}{16}$ "	23 $\frac{1}{16}$ "	26 $\frac{1}{16}$ "	28 $\frac{1}{16}$ "	30 $\frac{1}{16}$ "	32 $\frac{1}{16}$ "	1
		23 $\frac{1}{8}$ "	25 $\frac{1}{8}$ "	28 $\frac{1}{8}$ "	30 $\frac{1}{8}$ "	32 $\frac{1}{8}$ "	34 $\frac{1}{8}$ "	2
		27 $\frac{1}{8}$ "	29	31 $\frac{1}{8}$ "	33 $\frac{1}{8}$ "	35 $\frac{1}{8}$ "	37 $\frac{1}{8}$ "	3
		31 $\frac{1}{8}$ "	32 $\frac{1}{8}$ "	34	36 $\frac{1}{8}$ "	38 $\frac{1}{8}$ "	40 $\frac{1}{8}$ "	4

PIPE	SIZE OF ELBOW				No.
	18"	20"	22"	24"	
16"	23 1/4"	25 1/4"	28 1/4"	30 3/4"	0
	23 1/4"	25 1/4"	28 1/4"	31 1/4"	1
	26 1/4"	28 1/4"	31 1/4"	33 1/4"	2
	31	33 1/4"	34 1/4"	36 1/4"	3
	35 1/4"	36 1/4"	38 1/4"	40	4
	38 1/4"	39 1/4"	42 1/4"	42 1/2"	5
	40 3/4"	41	42 3/4"	44	6
	41	41 1/4"	43	44 1/4"	7
18"	41 1/4"	41 1/4"	43 1/4"	44 1/4"	5
	25 1/4"	28 1/4"	30 3/4"	30 3/4"	0
	28 1/4"	29 1/4"	31 1/4"	31 1/4"	1
	29 1/4"	32	34 1/4"	34 1/4"	2
	31 1/4"	36 1/4"	38 1/4"	38 1/4"	3
	40 3/4"	41	42 3/4"	42 3/4"	4
	44	44 1/4"	45 1/4"	45 1/4"	5
	45 1/4"	46"	47 1/4"	47 1/4"	6
20"	46 1/4"	46 1/4"	47 1/4"	47 1/4"	7
	46 1/4"	46 1/4"	48 1/4"	48 1/4"	8
	28 1/4"	28 1/4"	30 3/4"	30 3/4"	0
	29 1/4"	31 1/4"	31 1/4"	31 1/4"	1
	32 1/4"	35 1/4"	35 1/4"	35 1/4"	2
	38 1/4"	40 1/4"	40 1/4"	40 1/4"	3
	44 1/4"	45 1/4"	49 1/4"	49 1/4"	4
	49 1/4"	50 1/4"	51 1/4"	51 1/4"	5
22"	50 1/4"	51 1/4"	51 1/4"	51 1/4"	6
	51 1/4"	51 1/4"	52	52	7
	30 3/4"	30 3/4"	30 3/4"	30 3/4"	8
	32	32	35 1/4"	35 1/4"	0
	35 1/4"	35 1/4"	42 1/4"	42 1/4"	1
	42 1/4"	42 1/4"	49 1/4"	49 1/4"	2
	49 1/4"	54 1/4"	54 1/4"	54 1/4"	3
	54 1/4"	56 1/4"	56 1/4"	56 1/4"	4
24"	56 1/4"	56 1/4"	56 1/4"	56 1/4"	5
	56 1/4"	57 1/4"	57 1/4"	57 1/4"	6
	57 1/4"	57 1/4"	57 1/4"	57 1/4"	7
	57 1/4"	57 1/4"	57 1/4"	57 1/4"	8



ANGLES BETWEEN BOLT HOLES OF FLANGES

BOLT HOLES STRADDLE C/L	BOLT HOLES ON C/L
4 HOLES 90°	4 HOLES 45°
8 HOLES 45°	8 HOLES 22 1/2°
12 HOLES 30°	12 HOLES 15° - 45°
16 HOLES 22 1/2° - 45°	16 HOLES 11 1/4° - 33 3/4°
20 HOLES 18° - 36°	20 HOLES 9° - 27° - 45°
24 HOLES 15° - 30° - 45°	24 HOLES 7 1/2° - 22 1/2° - 37 1/2°

PIPE TEMPLATE LAYOUT USING ORDINATE LENGTHS FROM TABLES IN THIS BOOK.

1. Use a piece of drawing paper or heavier material that is wider than the pipe circumference.

The length should be the dimension of the longest ordinate plus an allowance 2" or more for dimension "A" shown in drawings. The length of templates for support on elbows are an exception and should be the length of the end to center of 2 L.R. bows as shown.

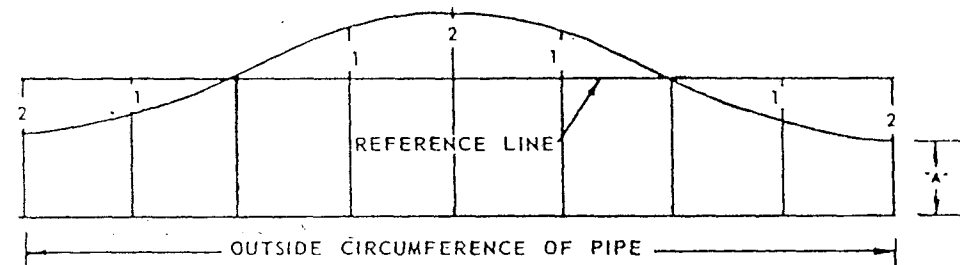
2. Fit this paper around the pipe and cut it so that the ends of the paper just meet. Be sure that it is kept square with the pipe.

3. Draw the wraparound or reference line and draw the ordinate lines in eighths or sixteenths.

Layout the ordinate lengths from tables in this book. Draw the template curve shown being sure to contact at least 3 or more points or ordinate lines at all times. A french curve or irregular curve is helpful in drawing so that there will be a smooth cut for better accuracy. The use of sixteen ordinate lines is more accurate than eighths.

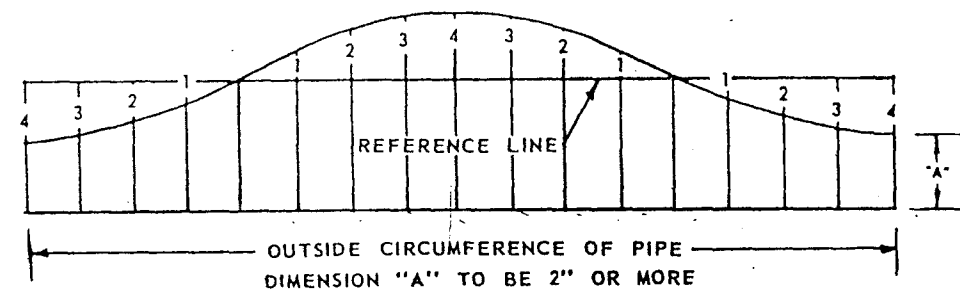
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TEMPLATE FOR MITER CUT IN EIGHTHS

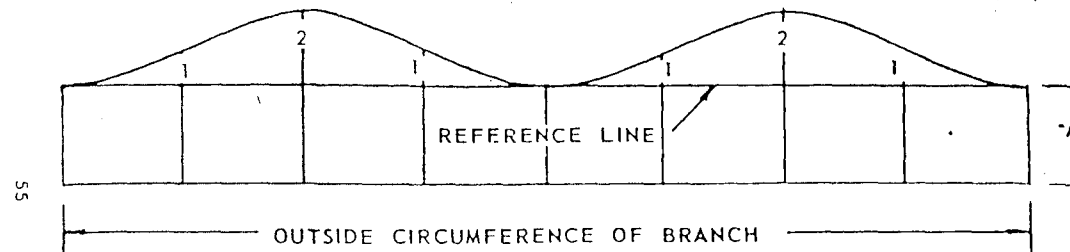


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TEMPLATE FOR MITER CUT IN SIXTEENTHS

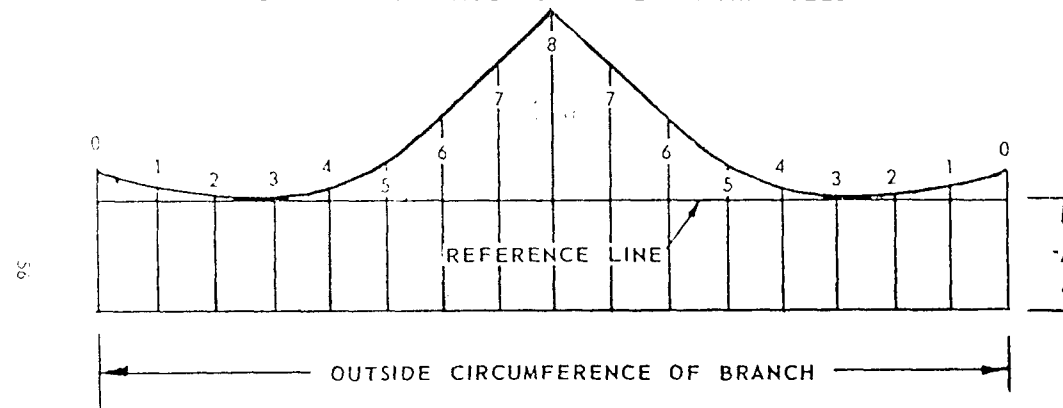


BRANCH TEMPLATE FOR SADDLE ON TEE



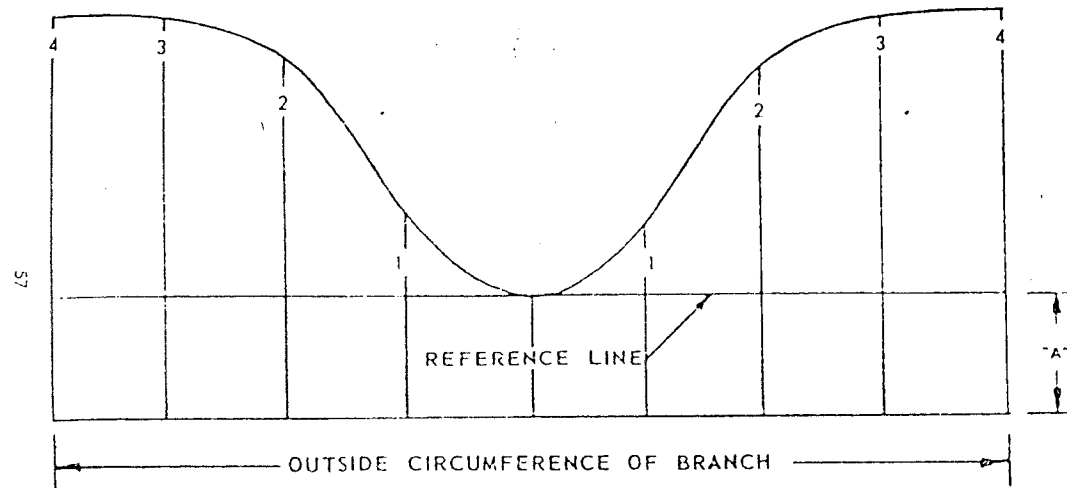
DIMENSION "A" TO BE 2" OR MORE
KEEP CUTTING TIP POINTED TO CENTER OF PIPE
AT ALL TIMES WHEN CUTTING.

BRANCH TEMPLATE FOR 90° ECCENTRIC TEES



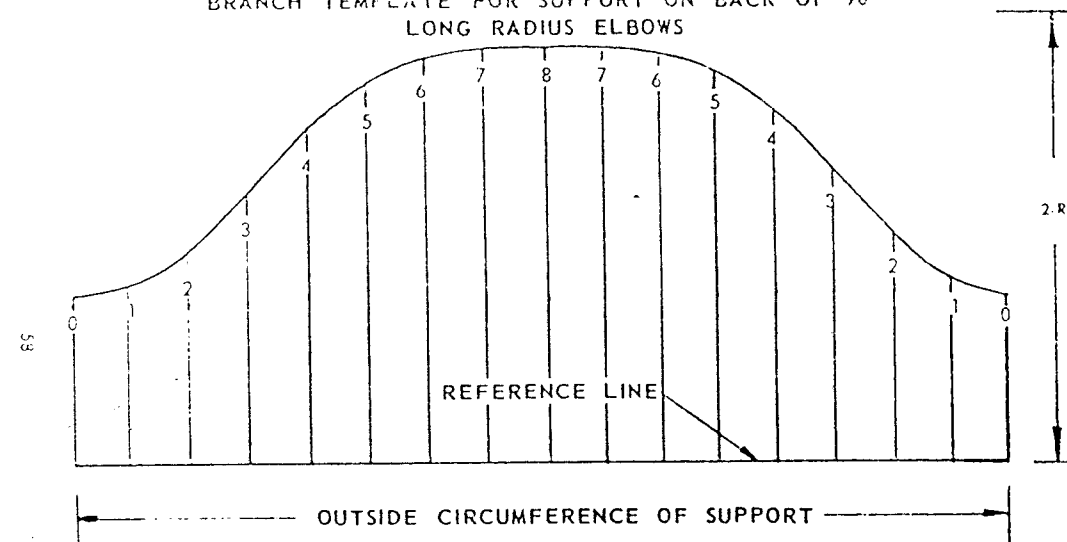
DIMENSION "A" TO BE 2" OR MORE
KEEP CUTTING TIP POINTED TO CENTER OF PIPE
AT ALL TIMES WHEN CUTTING.

BRANCH TEMPLATE FOR LATERALS

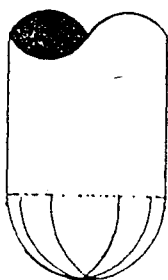


DIMENSION "A" TO BE 2" OR MORE
KEEP CUTTING TIP POINTED TO CENTER OF PIPE
AT ALL TIMES WHEN CUTTING.

BRANCH TEMPLATE FOR SUPPORT ON BACK OF 90° LONG RADIUS ELBOWS



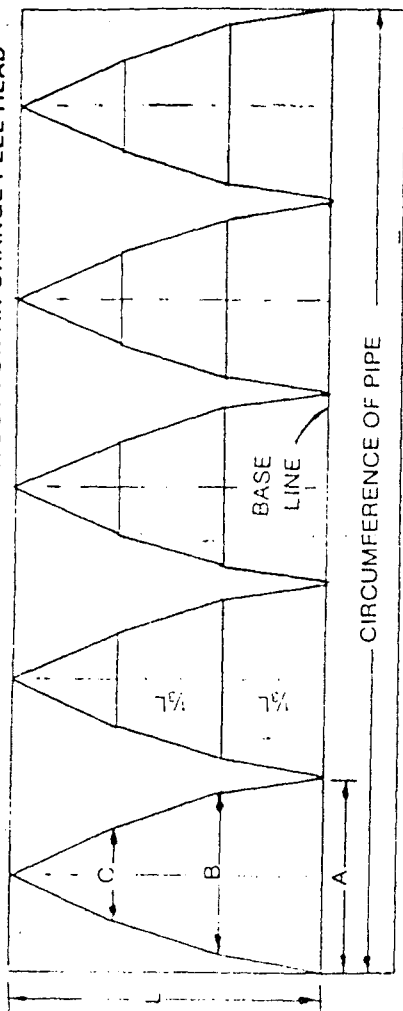
DIMENSION 2-R TO BE THE LENGTH OF 2 RADII OF
ELBOW
KEEP CUTTING TIP POINTED TO CENTER OF PIPE
AT ALL TIMES WHEN CUTTING



ORANGE PEEL HEAD

1. Draw base line on template.
2. Layout dimensions "L" & $\frac{1}{3}L$
3. Layout dimensions "A" for No. of arms
4. Draw centerlines between each arm
5. Layout dimensions "B" & "C"
6. Draw lines to connect points "A", "B" & "C"

TEMPLATE LAYOUT FOR AN ORANGE PEEL HEAD

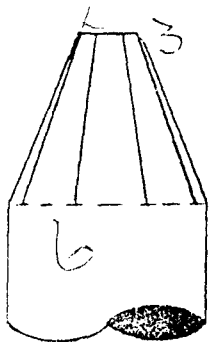
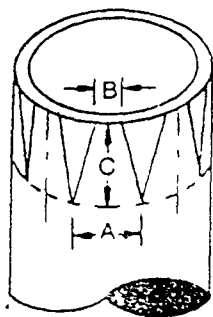


ORANGE PEEL HEAD (Inches)

Pipe Size	No. of Arms	A	B	C	L	$\frac{1}{3}L$
2	5	$1\frac{1}{2}$	$1\frac{5}{16}$	$\frac{3}{4}$	$1\frac{7}{8}$	$\frac{5}{8}$
$2\frac{1}{2}$	5	$1\frac{13}{16}$	$1\frac{9}{16}$	$\frac{7}{8}$	$2\frac{1}{4}$	$\frac{3}{4}$
3	5	$2\frac{3}{16}$	$1\frac{5}{16}$	$1\frac{3}{32}$	$2\frac{3}{4}$	$1\frac{5}{16}$
$3\frac{1}{2}$	5	$2\frac{1}{2}$	$2\frac{3}{16}$	$1\frac{1}{4}$	$3\frac{3}{16}$	$1\frac{1}{16}$
4	5	$2\frac{13}{16}$	$2\frac{5}{32}$	$1\frac{7}{16}$	$3\frac{9}{16}$	$1\frac{3}{16}$
5	5	$3\frac{1}{2}$	$3\frac{1}{16}$	$1\frac{3}{4}$	$4\frac{3}{8}$	$1\frac{7}{16}$
6	5	$4\frac{3}{16}$	$3\frac{5}{8}$	$2\frac{1}{16}$	$5\frac{1}{4}$	$1\frac{3}{4}$
8	6	$4\frac{1}{2}$	$3\frac{15}{16}$	$2\frac{1}{4}$	$6\frac{3}{4}$	$2\frac{1}{4}$
10	7	$4\frac{13}{16}$	$4\frac{7}{32}$	$2\frac{13}{32}$	$8\frac{7}{16}$	$2\frac{13}{16}$
12	8	5	$4\frac{3}{8}$	$2\frac{1}{2}$	10	$3\frac{5}{16}$

FORMULA USED

- A = CIRCUMFERENCE OF PIPE O.D.
DIVIDED BY NUMBER OF ARMS
- B = DIMENSION "A" x .875
- C = DIMENSION "A" x .5
- L = CIRCUMFERENCE OF PIPE O.D.
DIVIDED BY 4
- NUMBER OF ARMS = CIRCUMFERENCE
OF PIPE O.D. DIVIDED BY 5
- FIVE ARMS TO BE MINIMUM
- USE A RADIAL CUT.



CONCENTRIC REDUCER LAYOUT

"A" = Circumference of large pipe divided by No. of arms.

"B" = Circumference of small pipe divided by No. of arms

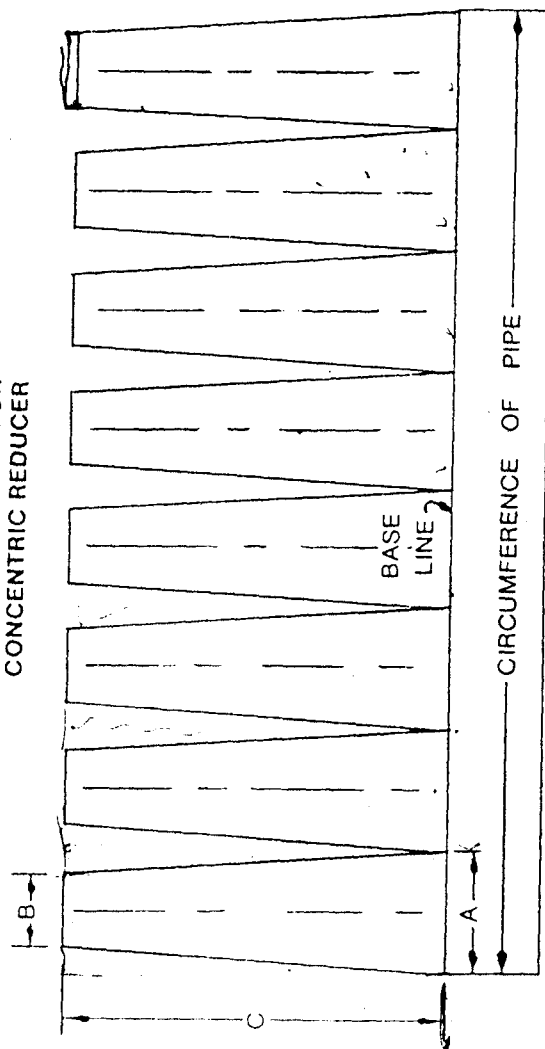
"C" = Difference of pipe O. D.'s x 1.3

"N" = Number of arms = difference of pipe O. D.'s x

1.33 Minimum 4 arms.

1. Draw wraparound line on pipe equal to dimension "C".
2. On this line mark off divisions per dimension "A".
3. Draw lines on pipe halfway between each dimension "A".
4. Mark off dimension "B" on these lines at end of pipe with $\frac{1}{2}$ on each side of line.
5. Draw lines to connect points "B" to points at wrap-around line.
6. Burn out sections between arms using a radial cut, then bevel arms.

TEMPLATE LAYOUT FOR CONCENTRIC REDUCER



Pipe Size	No. of Arms	A	B	C	Pipe Size	No. of Arms	A	B	C
2 x 1½	5	1½	1⅜	5/8	4 x 3½	5	2⅜	2½	1⅞
2 x 1¼	5	1½	1⅞	15/16	4 x 3	5	2⅜	2⅞	1⅞
2 x 1	5	1½	1⅜	1⅜	4 x 2½	5	2⅜	1⅜	2⅞
2½ x 2	5	1⅜	1½	1⅞	4 x 2	5	2⅜	1½	2¾
2½ x 1½	5	1⅜	1⅜	1¼	4 x 1½	5	2⅜	1⅜	3⅞
2½ x 1¼	5	1⅜	1⅞	19/16	4 x 1¼	5	2⅜	1⅞	3⅞
2½ x 1	5	1⅜	1⅜	2	4 x 1	5	2⅜	1⅜	4⅞
3 x 2½	5	2⅜	1⅜	1⅜	5 x 4	5	3½	2⅜	1⅞
3 x 2	5	2⅜	1½	1½	5 x 3½	5	3½	2½	2⅞
3 x 1½	5	2⅜	1⅜	2⅞	5 x 3	5	3½	2⅜	2⅞
3 x 1¼	5	2⅜	1⅞	2⅞	5 x 2½	5	3½	1⅜	3½
3 x 1	5	2⅜	1⅜	2⅞	5 x 2	5	3½	1½	4⅞
3½ x 3	5	2½	2⅜	1⅞	5 x 1½	5	3½	1⅜	4¾
3½ x 2½	5	2½	1⅜	1½	5 x 1¼	5	3½	1⅞	5⅞
3½ x 2	5	2½	1½	2⅞	5 x 1	5	3½	1⅜	5½
3½ x 1½	5	2½	1⅜	2¾					
3½ x 1¼	5	2½	1⅞	3⅞					
3½ x 1	5	2½	1⅜	3½					

[illegible]

TEMPLATE LAYOUT FOR AN ECCENTRIC REDUCER

The use of a template for an eccentric reducer is simpler and more accurate than marking off the pipe. Use sheet metal or gasket material about $\frac{1}{32}$ " thick. The material should be slightly longer than the pipe circumference. The width should be about 4" more than dimension "E". Check the material and be sure it is exactly square. Fit the material around the circumference of the pipe and mark and cut it so that the ends of material just meet on the pipe. The steps below should be followed.

1. Draw a base line on the template 3" up from the edge.
2. Draw a center line on the template in the exact center for arm #1.
3. At this centerline on the base line mark off $\frac{1}{8}$ circumferences on each side of template.

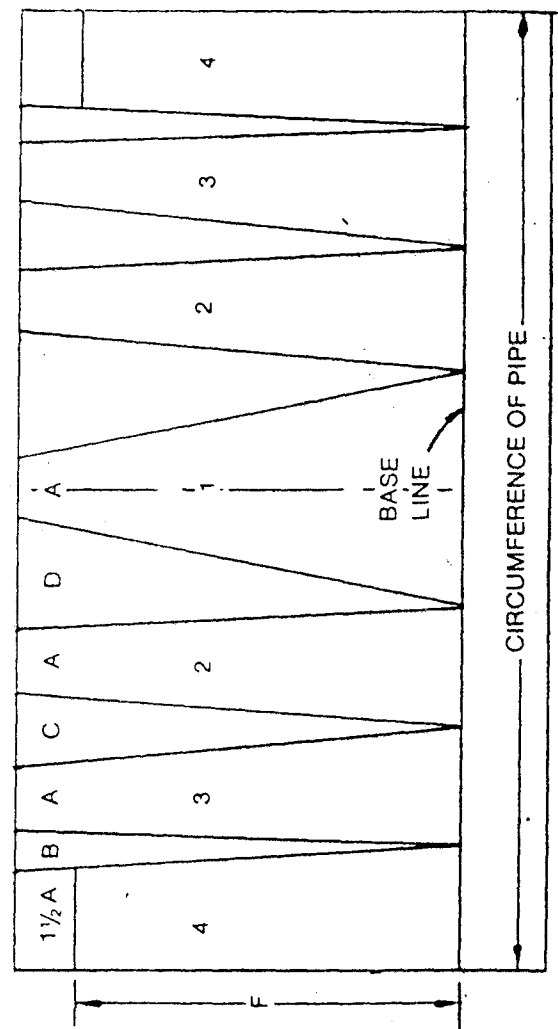
START THESE STEPS AT THE LEFT SIDE OF TEMPLATE AND REPEAT EACH STEP FOR THE RIGHT SIDE.

1. At left edge of template mark dimension "F" from base line.
2. At this point mark off dimension $1\frac{1}{2}$ A for arm #4.
3. Mark off dimension "B".
4. Mark off dimension "A" for arm #3.
5. Mark off dimension "C".
6. Mark off dimension "A" for arm #2.
7. At centerline of template mark off $\frac{1}{2}$ of dimension "A" on each side for arm #1.
8. Draw in lines for each arm to points marked on base line.

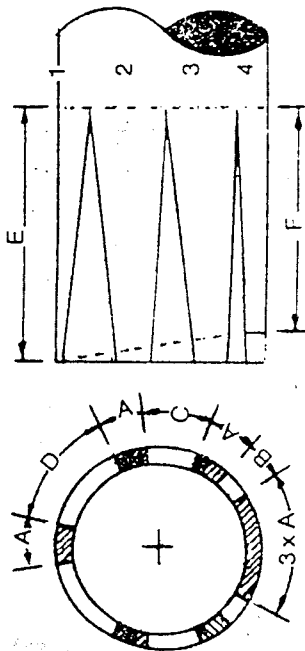
Use a radial cut and bevel each arm after cutting. Heat and shape the bottom arm first, then heat the remaining arms so that they may be pulled down as well as in.

These eccentric reducers can be cut back for each larger size of pipe as required.

TEMPLATE LAYOUT FOR ECCENTRIC REDUCERS



ECCENTRIC REDUCER



FORMULA

"A" = $\frac{1}{8}$ of small pipe circumference.
 "B" = Difference of outside circumferences x .0833
 "C" = Difference of outside circumferences x .1666
 "D" = Difference of outside circumferences x .25
 "E" = $1\frac{1}{2}$ x O.D. of larger pipe
 "F" = Dimension "E" x .866

Use a radial cut.

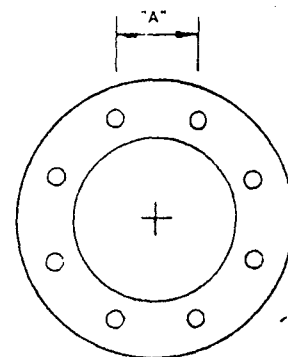
ECCENTRIC REDUCERS (Inches)

3 x 2		3 1/2 x 2	
A =	15/16	A =	15/16
B =	5/16	B =	7/16
C =	9/16	C =	7/8
D =	7/8	D =	1 1/4
E =	5 1/4	E =	6
F =	4 9/16	F =	5 3/16
1 1/2 A =	1 13/32	1 1/2 A =	1 13/32
3" Pipe Circum =	11"	3 1/2" Pipe Circum =	12 9/16"
1/8 Circum =	1 3/8"	1/8 Circum =	1 9/16"

ECCENTRIC REDUCERS (Inches)

4 x 2		5 x 2 1/2	
A =	15/16	A =	1 1/8
B =	9/16	B =	1 1/16
C =	1 1/8	C =	1 3/8
D =	1 11/16	D =	2 1/8
E =	6 3/4	E =	8 3/8
F =	5 7/8	F =	7 1/4
1 1/2 A =	1 13/32	1 1/2 A =	1 11/16
4" Pipe Circum =	14 1/8"	5" Pipe Circum =	17 1/2"
1/8 Circum =	1 3/4"	1/8 Circum =	2 3/16"

ECCENTRIC REDUCER (Inches)			
6 x 3		8 x 4	
A =	$1\frac{3}{5}$	A =	$1\frac{3}{4}$
B =	$1\frac{3}{16}$	B =	$1\frac{1}{16}$
C =	$1\frac{5}{8}$	C =	$2\frac{1}{8}$
D =	$2\frac{7}{16}$	D =	$3\frac{1}{4}$
E =	10	E =	13
F =	$8\frac{1}{16}$	F =	$11\frac{1}{4}$
$1\frac{1}{2}$ A =	$2\frac{7}{16}$	$1\frac{1}{2}$ A =	$2\frac{5}{8}$
6" Pipe Circum =	$20\frac{13}{16}$	8" Pipe Circum =	$27\frac{1}{8}$
$\frac{1}{8}$ Circum =	$2\frac{5}{8}$	$\frac{1}{8}$ Circum =	$3\frac{3}{8}$



LAYING OUT HOLES IN FLANGES

FORMULA: For finding Dim. "A", multiply the bolt circle diameter times the SINE of one half of the angle between the holes. 45° minus $22\frac{1}{2}^\circ$ shown.

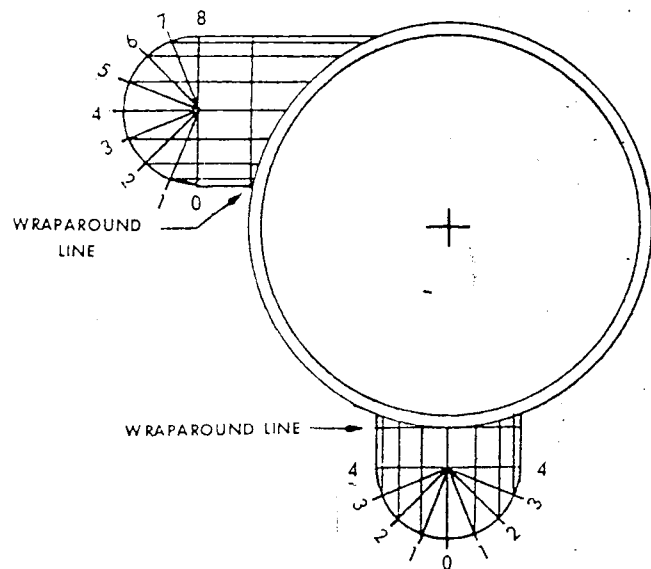
ECCENTRIC REDUCERS (Inches)			
10 x 6		12 x 6	
A =	$2\frac{5}{8}$	A =	$2\frac{5}{8}$
B =	$1\frac{1}{16}$	B =	$1\frac{5}{8}$
C =	$2\frac{1}{8}$	C =	$3\frac{3}{16}$
D =	$3\frac{1}{4}$	D =	$4\frac{13}{16}$
E =	$16\frac{1}{8}$	E =	$19\frac{1}{8}$
F =	14	F =	$16\frac{9}{16}$
$1\frac{1}{2}$ A =	$3\frac{15}{16}$	$1\frac{1}{2}$ A =	$3\frac{15}{16}$
10" Pipe Circum =	$33\frac{3}{4}$	12" Pipe Circum =	$40\frac{1}{16}$
$\frac{1}{8}$ Circum =	$4\frac{7}{32}$	$\frac{1}{8}$ Circum =	5"

NO OF HOLES	BOLT CIRCLE DIAM X	NO OF HOLES	BOLT CIRCLE DIAM X
4	.7071	20	.1564
6	.500	24	.1305
8	.3827	28	.1120
12	.2588	32	.0980
16	.1951	36	.0871

HOW TO LAY OUT ORDINATE LINES AND LENGTHS FOR A CONCENTRIC OR A TANGENTIAL NOZZLE

1. Set a pair of dividers to a radius that will equal the I.D. of the nozzle when it is to be fitted to the outside wall of the vessel. Set dividers for the O.D. of the nozzle if it is to fit the inside wall of the vessel.
2. With dividers correctly set scribe an arc of 180° on a piece of gasket material or sheet metal and draw a line across this half circle.
3. Draw lines #0 and #4 the length of this material.
4. Use dividers to step off each half of the semi-circle into 4 equal sections of $22\frac{1}{2}^\circ$. At these points on half circle draw the lines #1, #2, and #3 as before.
5. On a table or other surface scribe an arc at a radius that will equal the O.D. or the I.D. of the vessel wall that you will fit the nozzle to.
6. Place marked off material in exact position you want on this arc and make sure it is square with the vessel. If you are making a tangential type nozzle be sure that the O.D. of the nozzle does not extend beyond the outside wall of the vessel.
7. Hold material in position and at high point of vessel wall draw a reference or wraparound line onto the material. Sometimes line #0 has a length so be sure you have the high point.
8. Scribe the vessel radius onto the material. You now have the ordinate lengths on the material.

The template layout for either of these types is shown in the template layout section of this book.



ORDINATE LINES AND LENGTHS

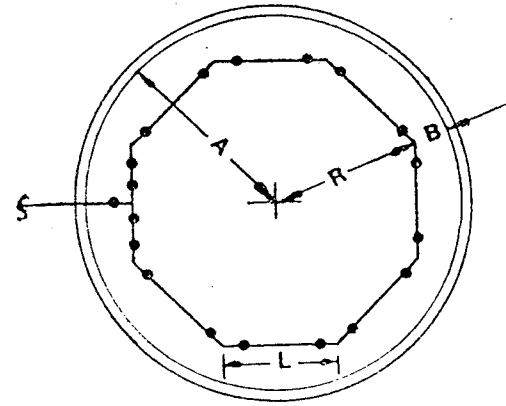
Spacing ordinate lines with dividers is recommended, however these spacings can also be calculated. Line numbers below are from concentric type.

Line #4 = $\frac{1}{2}$ the I.D. or the O.D. of the pipe or nozzle.

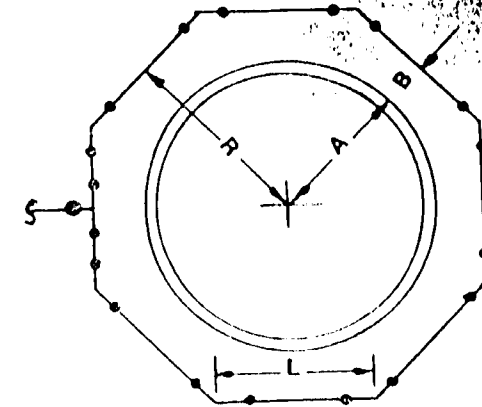
Line #1 = Dimension #4 \times .3827

Line #2 = Dimension #4 \times .707

Line #3 = Dimension #4 \times .9239



PIPE COIL INSIDE TANK
FORMULA FOR DIMENSION "L"
 $"R" \times 2 \times \text{SINE of } \frac{1}{2}$
degrees of sector.



PIPE COIL OUTSIDE TANK
FORMULA FOR DIMENSION "L"
 $"R" \times 2 \times \text{TANGENT of } \frac{1}{2}$
degrees of sector.

TANK COILS

COIL INSIDE TANK			COIL OUTSIDE TANK		
A = Inside radius of tank			A = Outside radius of tank		
B = Clearance inside tank			B = Clearance outside tank		
R = Radius of coil			R = Radius of coil		
L = Center to center length			L = Center to center length		
Angle of Fitting	No. of Pipes per Coil	Sine	Angle of Fitting	No. of Pipes per Coil	Tangent
90°	4	.707	90°	4	1.000
60°	6	.500	60°	6	.577
45°	8	.3827	45°	8	.414
30°	12	.2588	30°	12	.2679
22½°	16	.195	22½°	16	.1989
11¼°	32	.098	11¼°	32	.0985



DIMENSIONS FOR THE LAYOUT OF ANGLE IRON MITER CUTS

11 1/4° CUT FOR 22 1/2° TURN = WIDTH X .1989			30° CUT FOR 60° TURN = WIDTH X .5773		
Size	One Piece "D"	Two Piece "E"	Size	One Piece "D"	Two Piece "E"
1/8" X 1"	3/16"	3/16"	1/8" X 1"	1/2"	9/16"
1/4" X 1 1/2"	1/4"	5/16"	1/4" X 1 1/2"	3/4"	7/8"
1/4" X 2"	5/16"	3/8"	1/4" X 2"	1"	1 1/8"
3/8" X 2 1/2"	7/16"	1/2"	3/8" X 2 1/2"	1 1/4"	1 7/8"
1/2" X 3"	1/2"	9/16"	3/8" X 3"	1 1/2"	1 3/4"
3/4" X 4"	3/4"	13/16"	3/8" X 4"	2 1/16"	2 5/16"
15° CUT FOR 30° TURN = WIDTH X .2679			45° CUT FOR 90° TURN = WIDTH X 1.000		
Size	One Piece "D"	Two Piece "E"	Size	One Piece "D"	Two Piece "E"
1/8" X 1"	1/4"	1/4"	1/8" X 1"	7/8"	1"
1/4" X 1 1/2"	5/16"	3/8"	1/4" X 1 1/2"	1 1/4"	1 1/2"
1/4" X 2"	7/16"	1/2"	1/4" X 2"	1 3/4"	2"
3/8" X 2 1/2"	9/16"	11/16"	3/8" X 2 1/2"	2 1/8"	2 1/2"
3/8" X 3"	11/16"	13/16"	3/8" X 3"	2 5/8"	3"
3/8" X 4"	1"	1 1/16"	3/8" X 4"	3 5/8"	4"
22 1/2° CUT FOR 45° TURN = WIDTH X .414			67 1/2° CUT FOR 135° TURN = WIDTH X 2.414		
Size	One Piece "D"	Two Piece "E"	Size	One Piece "D"	Two Piece "E"
1/8" X 1"	3/8"	7/16"	1/8" X 1"	2 1/8"	2 7/16"
1/4" X 1 1/2"	1/2"	5/8"	1/4" X 1 1/2"	3"	3 3/8"
1/4" X 2"	3/4"	13/16"	1/4" X 2"	4 1/4"	4 13/16"
3/8" X 2 1/2"	7/8"	1"	3/8" X 2 1/2"	5 5/8"	6"
3/8" X 3"	1 1/16"	1 1/4"	3/8" X 3"	6 5/16"	7 1/4"
3/8" X 4"	1 1/2"	1 5/8"	3/8" X 4"	8 3/4"	9 3/8"

SPECIAL OFFSETS (DRAWING #1)

Special offsets when the degree of rise & turn are known.

FORMULA: The cosine of degree of rise times the cosine of degree of turn equals the cosine of degree of elbow.

Find the degree of the bottom elbow:

The cosine of 45° rise is .707 times .866 the cosine of 30° turn equals .6123 the cosine of degree of elbow. From the trig tables the degree that has .6123 for its cosine is $52^\circ - 14'$. This is the degree of the bottom elbow.

The top elbow has a turn of 60° and is the complement of turn of the bottom elbow. The degree of rise always is the same for both elbows.

Find the degree of the top elbow:

The cosine of 45° rise is .707 times .500 the cosine of 60° turn equals .3535 the cosine of degree of elbow. From the trig tables the degree that has .3535 for its cosine is $69^\circ - 18'$. This is the degree of the top elbow.

Find the lengths of the sides of the 2 right triangles:

Use the 24" (SET) side of the 45° and figure the remaining sides. See pages 9 & 10 of this book under (ANGLE KNOWN) for method. Note that the (RUN) side of this angle is also the (TRAVEL) side of the 30° angle.

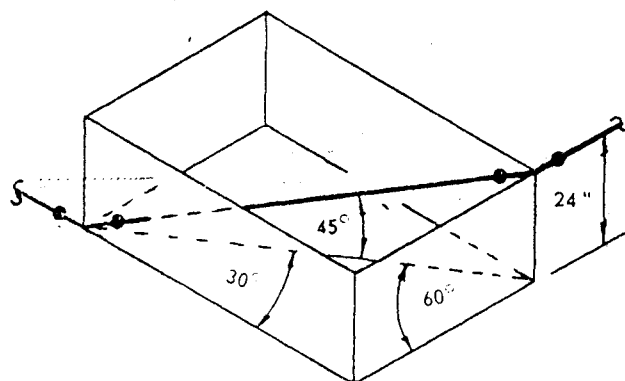
The (TRAVEL) side of the angle of rise is the true length of the offset center to center.

Find the cut length of pipe required:

Refer to pages 7 & 8 of this book and drawing #8 for method of calculating the end to center of above 2 elbows, as these must be subtracted from the center to center of offset to give you the cut length required.

ALL SIMILAR OFFSETS MAY BE CALCULATED USING THIS PROCEDURE.

SPECIAL OFFSETS
DRAWING # 1



Special offsets when the degree of rise & turn are not known.

FORMULA: The cosine of degree of rise times the cosine of degree of turn equals the cosine of degree of elbow.

In this example you will have to use the dimensions of the 2 right triangles to figure the angles of rise and turn. Refer to pages 9 & 10 of this book under "TO FIND ANGLE". You will find that the angle of rise is 30° and the angle of turn is $22^\circ-30'$. Use table (ANGLE KNOWN) for lengths of sides.

Using the cosine times cosine equals cosine formula:

The degree of the bottom elbow is $36^\circ-52'$

The degree of the top elbow is 60°

Note that the top elbow is the complement of rise of the bottom elbow. $90^\circ-30^\circ = 60^\circ$. The degree of the top elbow. The (RUN) side of the 30° angle is also the (TRAVEL) side of the $22^\circ-30'$ angle.

The (TRAVEL) side of the angle of rise is the true length of the offset.

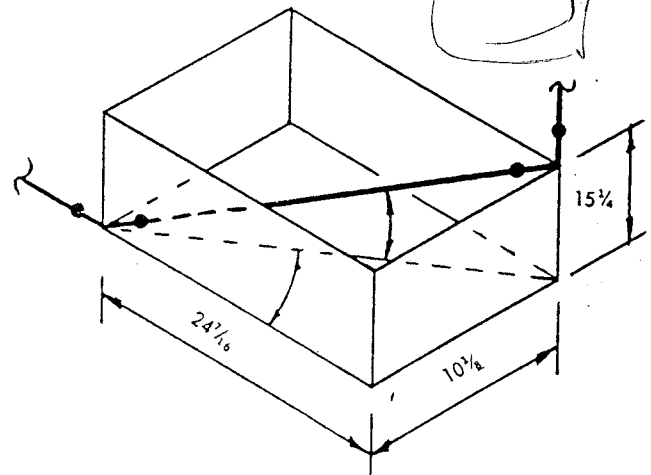
Find the cut length of pipe required:

Refer to pages 7 & 8 of this book drawing #8 for method of calculating the centers of the above 2 elbows as these must be subtracted to give you the cut length required.

All similar offsets may be calculated using this procedure.

Note that any 2 cosines used will call for the same degree of elbow regardless of their relationship.

SPECIAL OFFSETS
DRAWING # 2



For special type offsets, handling, and combinations of special type offsets, it is recommended that the possible lap joint flanges be considered in between the 2 elbows. The fabricator can ignore the complex case according to match bolt holes. On the other hand, the degree of elbow needed for the correct offset.

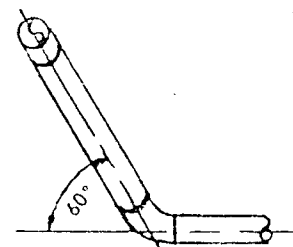
The following shows some standard angle combinations with their cosines multiplied to give the degree of elbow required. Note that the results will be the same regardless of which is the angle of rise and turn.

$22\frac{1}{2}^{\circ}$ $= 31^{\circ}-24'$	30° $= 41^{\circ}-24'$	45° $= 60^{\circ}$
$22\frac{1}{2}^{\circ}$	30°	45°
$22\frac{1}{2}^{\circ}$ $= 36^{\circ}-52'$	30° $= 52^{\circ}-14'$	45° $= 69^{\circ}-18'$
30°	45°	60°
$22\frac{1}{2}^{\circ}$ $= 49^{\circ}-13'$	30° $= 64^{\circ}-20'$	45° $= 74^{\circ}-18'$
45°	60°	$67\frac{1}{2}^{\circ}$
$22\frac{1}{2}^{\circ}$ $= 62^{\circ}-29'$	30° $= 70^{\circ}-39'$	
60°	$67\frac{1}{2}^{\circ}$	
$22\frac{1}{2}^{\circ}$ $= 69^{\circ}-18'$		
$67\frac{1}{2}^{\circ}$		

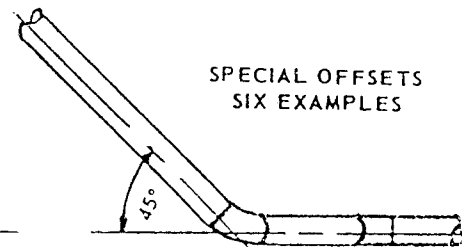
SPECIAL OFFSETS SIX EXAMPLES



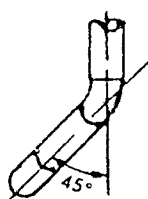
30° TURN - 45° RISE
BOTTOM ELL 52° - 14'
TOP ELL 45°



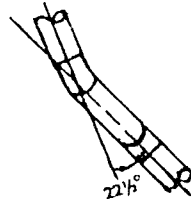
60° TURN - 45° RISE
BOTTOM ELL 69° - 18'
TOP ELL 45°



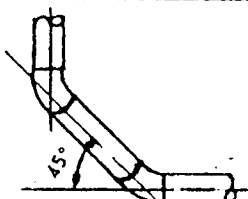
45° TURN - 45° RISE
BOTTOM ELL 45°
TOP ELL 60°



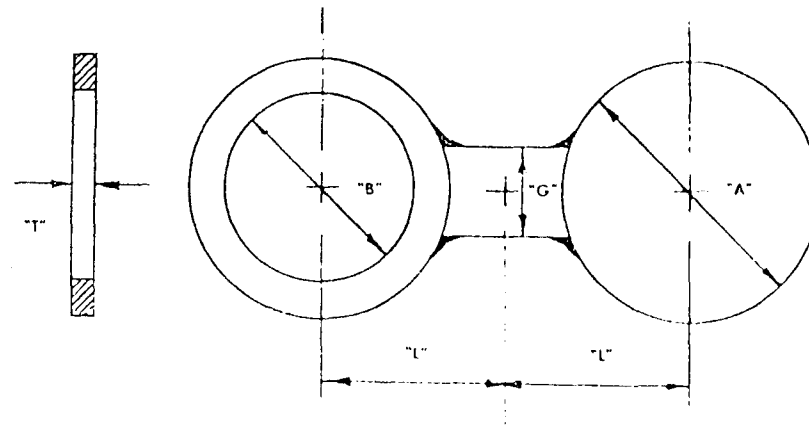
45° TURN - 45° RISE
BOTTOM ELL 45°
TOP ELL 60°



22° - 30' TURN - 22° - 30' RISE
BOTTOM ELL 22° - 30'
TOP ELL 31° - 24'



45° TURN - 45° RISE
BOTTOM ELL 60°
TOP ELL 60°



MATERIAL:

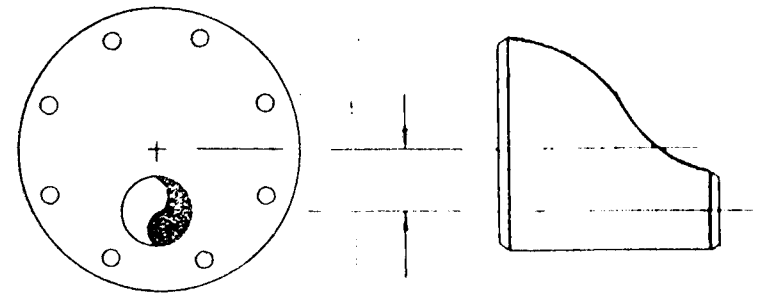
Carbon Steel, A-285-C or equal
Allow minimum of 1/8" for machining when ordering plate.

NOTES:

Thickness is based on formula
(16) in ASA Code B31.3-1959.

SPECTACLE BLINDS 150 & 300# RF FLANGES CARBON STEEL PIPING

PIPE SIZE	150# RF - MAX. PRES. = 275 PSI @ 100° F					300# RF - MAX. PRES. = 720 PSI @ 100° F				
	A	B	T	L	G	A	B	T	L	G
1	2 1/2	1 1/8	1/4	1 1/8	1 1/4	2 3/4	1 1/8	1/4	1 3/4	1 1/2
1 1/2	3 1/4	1 5/8	1/4	1 11/16	1 1/2	3 5/8	1 5/8	1/4	2 1/4	1 1/2
2	4	2 1/32	1/4	2 1/8	1 1/2	4 1/4	2 1/32	1/4	2 1/2	1
2 1/2	4 3/4	2 1/32	1/4	2 1/4	1 1/2	5	2 1/32	1/4	2 15/16	1 1/2
3	5 1/4	3 1/2	1/4	3	1 1/2	5 3/4	3 1/2	3/8	3 1/8	1 1/2
4	6 1/4	4 1/32	1/4	3 3/4	1 1/2	7	4 1/32	1/2	3 15/16	1 1/2
6	8 3/8	6 1/32	3/8	4 1/4	2	9 3/4	6 1/32	5/8	5 5/8	1 3/4
8	10 7/8	8	1/2	5 7/8	2	12	8	3/4	6 1/2	2
10	13 1/4	10 1/32	5/8	7 1/8	2 1/2	14 1/8	10 1/32	1	7 5/8	1 1/2
12	16	12	1	8 1/2	2 1/2	16 1/2	12	1 1/8	8 3/4	2
14	17 3/8	13 1/4	1 1/4	9 1/8	2 3/4	19	13 1/4	1 1/4	10 3/8	1 5/8
16	20 3/8	15 1/4	7/8	10 3/8	2 1/4	21 1/8	15 1/4	1 3/8	11 1/4	1 3/4
18	21 1/2	17 1/4	1	11 3/8	2 3/4	23 3/8	17 1/4	1 5/8	12 3/8	1 1/2
20	23 3/4	19 1/4	1 1/8	12 1/2	2 1/4	25 5/8	19 1/4	1 3/4	13 1/2	1 3/4
24	28 3/8	23 3/4	1 3/8	14 3/4	2 3/4	30 3/8	23 3/4	2 1/4	16	2 1/4

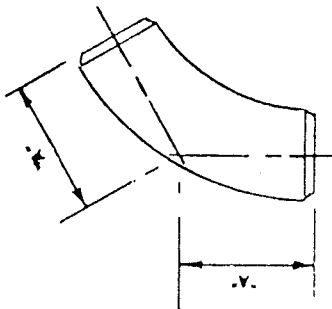


CENTER TO CENTER DIMENSIONS OF ECCENTRIC REDUCERS
AND ECCENTRIC REDUCING FLANGES MADE FROM BLIND
FLANGES.

CENTER TO CENTER DIMENSIONS OF ECCENTRIC B.W. REDUCERS AND
DIMENSIONS FOR LAYING OUT CUTS FOR ECCENTRIC BLIND FLANGES

2 BY	1 = $\frac{1}{2}$	6 BY	$2\frac{1}{2}$ = $1\frac{1}{6}$	14 BY	6 = $3\frac{1}{6}$
	$1\frac{1}{2}$ = $\frac{1}{2}$		3 = $1\frac{5}{6}$		8 = $2\frac{1}{6}$
$2\frac{1}{2}$ BY	1 = $\frac{3}{4}$	8 BY	4 = $1\frac{1}{6}$		10 = $1\frac{5}{6}$
	$1\frac{1}{2}$ = $\frac{1}{2}$		3 = $2\frac{5}{6}$		12 = $\frac{3}{6}$
3 BY	2 = $\frac{1}{4}$		4 = $2\frac{1}{6}$	16 BY	6 = $4\frac{1}{6}$
	$1\frac{1}{2}$ = $1\frac{1}{6}$	10 BY	6 = 1		8 = $3\frac{1}{6}$
	2 = $\frac{5}{6}$		4 = $3\frac{1}{6}$		10 = $2\frac{5}{6}$
	$2\frac{1}{2}$ = $\frac{5}{6}$		6 = $2\frac{1}{6}$		12 = $1\frac{5}{6}$
4 BY	$1\frac{1}{2}$ = $1\frac{1}{6}$	12 BY	8 = $1\frac{1}{6}$	18 BY	14 = 1
	2 = $1\frac{1}{6}$		6 = $3\frac{1}{6}$		8 = $4\frac{1}{6}$
	$2\frac{1}{2}$ = $1\frac{5}{6}$		8 = $2\frac{1}{6}$		10 = $3\frac{5}{6}$
	3 = $\frac{1}{2}$		10 = 1		12 = $2\frac{5}{6}$
					14 = 2
					16 = 1

SIZE	15°	22½°	30°	60°
ELL	"A"	"A"	"A"	"A"
1½	5/16	7/16	5/8	1 1/16
2	3/8	5/8	1 1/16	1 3/4
2½	1/2	3/4	1	2 1/16
3	5/8	7/8	1 1/16	2 3/8
4	1 1/16	1 1/16	1 3/8	3 1/16
6	1 1/16	1 1/16	2 1/16	5 1/16
8	1 7/16	2 1/8	3 1/16	6 11/16
10	2	3	4	8 11/16
12	2 3/8	3 3/16	4 11/16	10 1/2
14	2 3/4	4 1/16	5 3/8	12 1/8
16	3 1/16	4 3/4	6 1/16	13 7/8
18	3 3/16	5 3/8	7 1/4	15 1/16
20	3 5/16	6	8 1/16	17 1/16
22	4 3/8	6 7/16	8 7/8	19 1/16
24	4 3/4	7 1/16	9 5/8	20 3/4

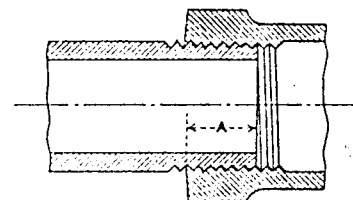


LAYING LENGTHS OF ELLS
CUT FROM LONG RADIUS
90 DEGREE BUTTWELD ELLS

15 DEGREES equals RADIUS X .1316
22½ DEGREES equals RADIUS X .1989
30 DEGREES equals RADIUS X .2679
60 DEGREES equals RADIUS X .5771

LENGTH OF THREAD ON PIPE

LENGTH OF THREAD ON PIPE
THAT IS SCREWED INTO VALVES OR
FITTINGS TO MAKE A TIGHT JOINT



THREAD TAPER 1/16" PER INCH

PIPE SIZE	THREADS INCH	THREAD LENGTH	LENGTH "A"
1/8	27	7/16	5/16
1/4	18	5/8	7/16
3/8	18	5/8	7/16
1/2	14	1 1/16	9/16
3/4	14	1 1/16	9/16
1	11 1/2	1	1 1/16
1 1/4	11 1/2	1	1 1/16
1 1/2	11 1/2	1 1/32	1 1/16
2	11 1/2	1 1/16	3/4
2 1/2	8	1 9/16	1 1/16
3	8	1 5/8	1 1/8
4	8	1 3/4	1 3/16
6	8	1 15/16	1 3/8
8	8	2 1/16	1 7/16
10	8	2 3/8	1 5/8
12	8	2 9/16	1 3/4

WELDOLETS
SCHEDULE 40
MAKEUP - CENTER TO END
SIZE OF RUN

OUTLET SIZE		2	3	4	6	8	10	12
1	2 1/4	2 1/4	2 1/4	3 1/4	4 1/4	5 1/4	6 7/8	7 7/8
1 1/2	2 1/2	3 1/4	3 1/4	4 1/4	5 1/4	6 1/4	6 11/16	7 11/16
2	2 11/16	3 1/4	3 1/4	4 1/4	5 1/4	6 1/4	6 7/8	7 7/8
2 1/2		3 1/4	3 1/4	4 1/4	5 1/4	6 1/4	7	8
3			4	5 1/4	6 1/4	7 1/4	8 1/4	
4				5 1/4	6 1/4	7 1/4	8 1/4	
6					6 11/16	7 1/4	8 1/4	
8						8 1/4	9 1/4	
10							8 7/8	9 7/8

WELDOLETS
SCHEDULE 80

OUTLET SIZE		2	3	4	6	8	10	12
1	2 1/4	2 1/4	2 1/4	3 1/4	4 1/4	5 1/4	6 7/8	7 7/8
1 1/2	2 1/2	3 1/4	3 1/4	4 1/4	5 1/4	6 1/4	6 11/16	7 11/16
2	2 11/16	3 1/4	3 1/4	4 1/4	5 1/4	6 1/4	6 7/8	7 7/8
2 1/2		3 1/4	3 1/4	4 1/4	5 1/4	6 1/4	7	8
3			4	5 1/4	6 1/4	7 1/4	8 1/4	
4				5 1/4	6 1/4	7 1/4	8 1/4	
6					6 11/16	7 1/4	8 1/4	
8						8 1/4	9 1/4	
10							9 1/4	10 1/4

SOCKET WELD
ELLS, TEES, AND CROSSES
CENTER TO END AND LAYING LENGTHS

	CENTER TO END						LAYING LENGTH					
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
2000#	1 1/8	1 1/4	1 1/2	1 3/4	2	2 3/8	5/8	3/4	7/8	1 1/4	1 1/2	1 3/4
3000#	1 1/8	1 1/4	1 1/2	1 3/4	2	2 3/8	5/8	3/4	7/8	1 1/4	1 1/2	1 3/4
4000#	1 3/8	1 1/2	1 3/4	2	2 3/8	2 1/2	3/4	7/8	1 1/4	1 1/4	1 1/2	1 3/4
6000#	1 1/4	1 1/2	1 3/4	2	2 3/8	2 1/2	3/4	7/8	1 1/4	1 1/4	1 1/2	1 3/4

SCREWED
ELLS, TEES, AND CROSSES
CENTER TO END AND LAYING LENGTHS

	CENTER TO END						LAYING LENGTH					
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
2000#	1 1/8	1 1/4	1 1/2	1 3/4	2	2 3/8	5/8	3/4	7/8	1 1/4	1 1/2	1 3/4
3000#	1 3/8	1 1/2	1 3/4	2	2 3/8	2 1/2	3/4	7/8	1 1/4	1 1/4	1 1/2	1 3/4
6000#	1 1/2	1 3/4	2	2 3/8	2 1/2	3 1/4	1 1/8	1 1/4	1 1/2	1 3/4	1 3/4	2 1/2

FLANGED CAST STEEL VALVES
ASA FACE TO FACE DIMENSIONS, INCHES

CLASS	SIZE	GATE	GLOBE	ANGLE TO FACE	TYPES OF VALVES			BALL
					CHECK	SHORT	REGULAR	
150 LB. 1/4" R.F.	1 1/2	6 1/2	6 1/2	3 1/2	6 1/2	6 1/2		6 1/2
	2	7	8	4	8	7		7
	2 1/2	7 1/2	8 1/2	4 1/2	8 1/2	7 1/2		
	3	8	9 1/2	4 1/2	9 1/2	8		8
	3 1/2	8 1/2	10 1/2	5 1/2	10 1/2	9		9
	4	9	11 1/2	6	11 1/2	10 1/2		10 1/2
	4 1/2	10	12 1/2	6 1/2	12 1/2	11 1/2		11 1/2
	5	10 1/2	13 1/2	7	13 1/2	12 1/2		12 1/2
	6	11 1/2	14 1/2	7 1/2	14 1/2	13 1/2		13 1/2
	8	13	16 1/2	8 1/2	16 1/2	15 1/2		15 1/2
	10	14 1/2	18 1/2	9 1/2	18 1/2	16 1/2		16 1/2
	12	16	20 1/2	10 1/2	20 1/2	18 1/2		18 1/2
300 LB. 1/4" R.F.	1 1/2	7 1/2	9	4 1/2	9 1/2	7 1/2		7 1/2
	2	8 1/2	10 1/2	5 1/2	10 1/2	8 1/2		8 1/2
	2 1/2	9 1/2	11 1/2	5 1/2	11 1/2	9 1/2		9 1/2
	3	10 1/2	12 1/2	6 1/2	12 1/2	10 1/2		10 1/2
	3 1/2	11 1/2	13 1/2	6 1/2	13 1/2	11 1/2		11 1/2
	4	12 1/2	14 1/2	7	14 1/2	12 1/2		12 1/2
	4 1/2	13 1/2	15 1/2	7 1/2	15 1/2	13 1/2		13 1/2
	5	14 1/2	16 1/2	8 1/2	16 1/2	14 1/2		14 1/2
	6	15 1/2	17 1/2	8 1/2	17 1/2	15 1/2		15 1/2
	8	17 1/2	19 1/2	9 1/2	19 1/2	16 1/2		16 1/2
	10	19 1/2	21 1/2	10 1/2	21 1/2	18 1/2		18 1/2
	12	21 1/2	23 1/2	11 1/2	23 1/2	20 1/2		20 1/2
600 LB. 1/4" R.F.	1 1/2	9 1/2	11 1/2	5 1/2	11 1/2	9 1/2		9 1/2
	2	10 1/2	12 1/2	6 1/2	12 1/2	10 1/2		10 1/2
	2 1/2	11 1/2	13 1/2	6 1/2	13 1/2	11 1/2		11 1/2
	3	12 1/2	14 1/2	7	14 1/2	12 1/2		12 1/2
	3 1/2	13 1/2	15 1/2	7 1/2	15 1/2	13 1/2		13 1/2
	4	14 1/2	16 1/2	8 1/2	16 1/2	14 1/2		14 1/2
	4 1/2	15 1/2	17 1/2	8 1/2	17 1/2	15 1/2		15 1/2
	5	16 1/2	18 1/2	9 1/2	18 1/2	16 1/2		16 1/2
	6	17 1/2	19 1/2	9 1/2	19 1/2	17 1/2		17 1/2
	8	20 1/2	21 1/2	10 1/2	21 1/2	18 1/2		18 1/2
	10	22 1/2	23 1/2	11 1/2	23 1/2	20 1/2		20 1/2
	12	24 1/2	25 1/2	12 1/2	25 1/2	22 1/2		22 1/2

CAST STEEL FLANGED FITTINGS
ELBOWS, TEES, & CROSSES

150 LB.		300 LB.	
SIZE	CENTER TO FACE	SIZE	CENTER TO FACE
1 1/2	4	1 1/2	4 1/2
2	4 1/2	2	5
2 1/2	5	2 1/2	5 1/2
3	5 1/2	3	6
3 1/2	6	3 1/2	6 1/2
4	6 1/2	4	7
5	7 1/2	5	8
6	8	6	8 1/2
8	9	8	10
10	11	10	11 1/2
12	12	12	13
14	14	14	15
16	15	16	16 1/2
18	16 1/2	18	18
20	18	20	19 1/2
24	22	24	22 1/2

COMMERCIAL PIPE SIZES

NOMINAL PIPE SIZE	OUT- SIDE DIAM.	NOMINAL WALL					
		SCHED. 5S	SCHED. 10S	SCHED. 10	SCHED. 20	SCHED. 30	STAND- ARD ⁽²⁾
1/8	0.405	—	0.049	—	—	—	0.068
1/4	0.540	—	0.065	—	—	—	0.088
3/8	0.675	—	0.065	—	—	—	0.091
1/2	0.840	0.065	0.083	—	—	—	0.109
3/4	1.050	0.065	0.083	—	—	—	0.113
1	1.315	0.065	0.109	—	—	—	0.133
1 1/4	1.660	0.065	0.109	—	—	—	0.140
1 1/2	1.900	0.065	0.109	—	—	—	0.146
2	2.375	0.065	0.109	—	—	—	0.154
2 1/2	2.875	0.083	0.120	—	—	—	0.203
3	3.5	0.083	0.120	—	—	—	0.216
3 1/2	4.0	0.083	0.120	—	—	—	0.226
4	4.5	0.083	0.120	—	—	—	0.237
5	5.563	0.109	0.134	—	—	—	0.258
6	6.625	0.109	0.134	—	—	—	0.280
8	8.625	0.109	0.148	—	0.250	0.277	0.322
10	10.75	0.134	0.165	—	0.250	0.307	0.365
12	12.75	0.156	0.180	—	0.250	0.330	0.375
14 O.D.	14.0	0.156	0.188	0.250	0.312	0.375	0.375
16 O.D.	16.0	0.165	0.188	0.250	0.312	0.375	0.375
18 O.D.	18.0	0.165	0.188	0.250	0.312	0.438	0.375
20 O.D.	20.0	0.188	0.218	0.250	0.375	0.500	0.375
22 O.D.	22.0	0.188	0.218	0.250	0.375	0.500	0.375
24 O.D.	24.0	0.218	0.250	0.250	0.375	0.562	0.375
26 O.D.	26.0	—	—	0.312	0.500	—	0.375
28 O.D.	28.0	—	—	0.312	0.500	0.625	0.375
30 O.D.	30.0	0.250	0.312	0.312	0.500	0.625	0.375
32 O.D.	32.0	—	—	0.312	0.500	0.625	0.375
34 O.D.	34.0	—	—	0.312	0.500	0.625	0.375
36 O.D.	36.0	—	—	0.312	0.500	0.625	0.375
42 O.D.	42.0	—	—	—	—	—	0.375

NOTES:

- ① Schedules 5s and 10s are available in corrosion-resistant materials and Schedule 10s is also available in carbon steel in sizes 12" and smaller.
- ② Thicknesses shown in italics are also available in stainless steel under the designation Schedules 5S.

AND WALL THICKNESSES

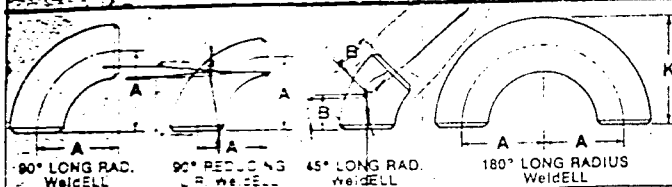
ASA-B36.10 and B36.19

THICKNESS FOR								
SCHED. 40	SCHED. 60 ⁽³⁾	XS ④	SCHED. 80	SCHED. 100	SCHED. 120	SCHED. 140	SCHED. 160	XX STRONG
0.068	—	0.095	0.095	—	—	—	—	—
0.088	—	0.119	0.119	—	—	—	—	—
0.091	—	0.126	0.126	—	—	—	—	—
0.109	—	0.147	0.147	—	—	—	0.188	0.294
0.113	—	0.154	0.154	—	—	—	0.219	0.308
0.133	—	0.179	0.179	—	—	—	0.250	0.358
0.140	—	0.191	0.191	—	—	—	0.250	0.382
0.145	—	0.200	0.200	—	—	—	0.281	0.400
0.154	—	0.218	0.218	—	—	—	0.344	0.436
0.203	—	0.276	0.276	—	—	—	0.375	0.552
0.216	—	0.300	0.300	—	—	—	0.438	0.600
0.226	—	0.318	0.318	—	—	—	—	—
0.237	—	0.337	0.337	—	0.438	—	0.531	0.674
0.258	—	0.375	0.375	—	0.500	—	0.625	0.750
0.280	—	0.432	0.432	—	0.562	—	0.719	0.864
0.322	0.406	0.500	0.500	0.594	0.719	0.812	0.906	0.875
0.365	0.500	0.500	0.594	0.719	0.844	1.000	1.125	1.000
0.406	0.562	0.500	0.688	0.844	1.000	1.125	1.312	1.000
0.438	0.594	0.500	0.750	0.938	1.094	1.250	1.406	—
0.500	0.656	0.500	0.844	1.031	1.219	1.438	1.594	—
0.562	0.750	0.500	0.938	1.156	1.375	1.562	1.781	—
0.594	0.812	0.500	1.031	1.281	1.500	1.750	1.969	—
—	0.875	0.500	1.125	1.375	1.625	1.875	2.125	—
0.688	0.969	0.500	1.218	1.531	1.812	2.062	2.344	—
—	—	0.500	—	—	—	—	—	—
—	—	0.500	—	—	—	—	—	—
—	—	0.500	—	—	—	—	—	—
0.688	—	0.500	—	—	—	—	—	—
0.688	—	0.500	—	—	—	—	—	—
0.750	—	0.500	—	—	—	—	—	—
—	—	0.500	—	—	—	—	—	—

③ Thicknesses shown in light face for Schedule 60 and heavier pipe are not currently shown by the mills, unless a certain minimum tonnage is ordered.

④ Thicknesses shown in italics are also available in stainless steel under the designation Schedules 80s.

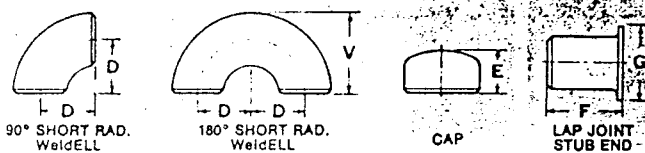
General Dimensions for



Nom. Pipe Size	Outside Diam.	Nom. Wall Thicknesses				A	B
		STD	AS	160	XXS		
1/2	0.840	.119	.147	.187	.294	1 1/2	9/8
3/4	1.315	.119	.147	.218	.308	1 1/2	7/8
1	1.315	.119	.147	.250	.358	1 1/2	7/8
1 1/4	1.660	.147	.187	.250	.382	1 1/2	1
1 1/2	1.900	.145	.187	.281	.400	2 1/4	1 1/4
2	2.375	.154	.194	.343	.436	3	1 3/8
2 1/2	2.875	.173	.216	.375	.552	3 1/2	1 1/2
3	3.500	.216	.260	.438	.600	4 1/2	2
3 1/2	4.000	.226	.273	.536	.636	5 1/4	2 1/4
4	4.500	.257	.317	.614	.750	6	2 1/2
5	5.563	.258	.375	.625	.750	7 1/2	3 1/8
6	6.625	.280	.432	.718	.864	9	3 3/4
8	8.625	.322	.500	.906	.875	12	5
10	10.750	.365	.500	1.125	.....	15	6 1/4
12	12.750	.375	.500	1.312	.....	18	7 1/2
14	14.000	.375	.500	1.406	.....	21	8 1/4
16	16.000	.375	.500	1.593	.....	24	10
18	18.000	.375	.500	1.781	.....	27	11 1/4
20	20.000	.375	.500	1.968	.....	30	12 1/2
22	22.000	.375	.500	2.125	.....	33	13 1/2
24	24.000	.375	.500	2.343	.....	36	15
26 *	26.000	.375	.500	.....	.....	39	16
30 *	30.000	.375	.500	.....	.....	45	18 1/2
36 *	36.000	.375	.500	.....	.....	54	22 1/4

- ① Standard wall thicknesses are the same as stainless steel schedule 40 s in sizes thru 12".
- ② Extra strong wall thicknesses are the same as stainless steel schedule 80 s in sizes thru 12".

Welding Fittings



K	D	V	E ①	E ②	G	F ASA	Nom. Pipe Size
1 1/8	.....	.....	1 1/2	.....	1 1/8	3	1/2
1 1/16	.....	.....	1 1/2	.....	1 1/16	3	3/4
2 1/16	1	1 1/4	1 1/2	1 1/2	2	4	1
2 1/4	1 1/4	2 1/4	1 1/2	1 1/2	2 1/2	4	1 1/4
3 1/4	1 1/2	2 1/4	1 1/2	1 1/2	2 3/4	4	1 1/2
4 1/4	2	3 1/4	1 1/2	1 1/2	3 1/4	6	2
5 1/4	2 1/2	3 3/4	1 1/2	1 1/2	4 1/4	6	2 1/2
6 1/4	3	4 1/4	2	2 1/2	5	6	3
7 1/4	3 1/2	5 1/4	2 1/2	3	5 1/4	6	3 1/2
8 1/4	4	6 1/4	2 1/2	3 1/2	6 1/4	6	4
10 1/4	5	7 1/4	3	3 1/2	7 1/4	8	5
12 1/4	6	8 1/4	3 1/2	4	8 1/4	8	6
15 1/4	8	10 1/4	4	5	10 1/4	8	8
20 1/4	10	14 1/4	5 1/2	6 1/2	14 1/4	10	10
24 1/4	12	18 1/4	6 1/2	7 1/2	18 1/4	12	12
28	14	22 1/4	7 1/2	8 1/2	22 1/4	12	14
32	16	24 1/4	8	9	24 1/4	12	16
36	18	26 1/4	8 1/2	9 1/2	26 1/4	12	18
40	20	30	9	10	30	12	20
48	.....	.....	10	10 1/2	25 1/4	12	22
48	24	36	10 1/2	11	27 1/4	12	24
52	.....	.....	10 1/2	.....	.....	.....	26 *
60	30	45	10 1/2	.....	.....	.....	30 *
.....	36	54	10 1/2	.....	.....	.....	36 *

- ③ Applies for XS wall thickness and less.
- ④ Applies for wall thickness greater than XS.
- * This size not covered by ASA B16.9.
 - This size not covered by ASA B36.10.

General Dimensions for

STRAIGHT TEE									
REDUCING TEE									
Nom. Pipe Size	Outside Diam.	1/2	3/4	1	1 1/4	1 1/2	C	M	H
1/2	1.315	.113	.113	.113	.113	.113	1	1	...
3/4	1.315	.113	.113	.113	.113	.113	1 1/4	1 1/4	1 1/2
1	1.315	.113	.113	.113	.113	.113	1 1/2	1 1/2	2
1 1/4	1.315	.113	.113	.113	.113	.113	2 1/4	2 1/4	2 1/2
1 1/2	1.315	.113	.113	.113	.113	.113	2 1/2	2 1/2	3
2	1.315	.113	.113	.113	.113	.113	3	3	3 1/2
2 1/2	1.315	.113	.113	.113	.113	.113	3 1/2	3 1/2	4

+ This size not covered by ASA B36.10

ASA B16.9

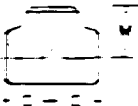
ASA B36.10

Welding Fittings

CONCENTRIC REDUCER									
ECCENTRIC REDUCER									
Nom. Pipe Size	Outside Diam.	1/2	3/4	1	1 1/4	1 1/2	C	M	H
3	3.500	.216	.203	.276	.375	.552	3 3/4	3 3/4	3 3/4
2 1/2	2.875	.203	.154	.218	.343	.436	3 3/4	3	3 3/4
2	2.375	.145	.120	.191	.281	.382	3 3/4	2 1/2	3 3/4
1 1/2	1.900	.140	.119	.154	.218	.281	3 3/4	2 1/2	3 3/4
3 1/2	4.000	.226	.216	.300	.438	.600	4 1/4	4 1/4	4 1/4
3	3.500	.216	.203	.276	.375	.552	4 1/4	4 1/4	4 1/4
2 1/2	2.875	.203	.154	.218	.343	.436	4 1/4	4 1/4	4 1/4
2	2.375	.145	.120	.191	.281	.382	4 1/4	4 1/4	4 1/4
1 1/2	1.900	.140	.119	.154	.218	.281	4 1/4	4 1/4	4 1/4
4	4.500	.237	.226	.318	.468	.636	5 1/4	5 1/4	5 1/4
3 1/2	4.000	.226	.216	.300	.438	.600	5 1/4	5 1/4	5 1/4
3	3.500	.216	.203	.276	.375	.552	5 1/4	5 1/4	5 1/4
2 1/2	2.875	.203	.154	.218	.343	.436	5 1/4	5 1/4	5 1/4
2	2.375	.145	.120	.191	.281	.382	5 1/4	5 1/4	5 1/4
1 1/2	1.900	.140	.119	.154	.218	.281	5 1/4	5 1/4	5 1/4
5	5.563	.258	.237	.337	.531	.750	6 3/4	6 3/4	6 3/4
4 1/2	4.500	.237	.226	.318	.468	.636	6 3/4	6 3/4	6 3/4
4	4.000	.226	.216	.300	.438	.600	6 3/4	6 3/4	6 3/4
3 1/2	3.500	.216	.203	.276	.375	.552	6 3/4	6 3/4	6 3/4
3	2.875	.203	.154	.218	.343	.436	6 3/4	6 3/4	6 3/4
2 1/2	2.375	.145	.120	.191	.281	.382	6 3/4	6 3/4	6 3/4
1 1/2	1.900	.140	.119	.154	.218	.281	6 3/4	6 3/4	6 3/4
6	6.625	.280	.258	.375	.581	.864	7 3/4	7 3/4	7 3/4
5 1/2	5.563	.258	.237	.337	.531	.750	7 3/4	7 3/4	7 3/4
4 1/2	4.500	.237	.226	.318	.468	.636	7 3/4	7 3/4	7 3/4
4	4.000	.226	.216	.300	.438	.600	7 3/4	7 3/4	7 3/4
3 1/2	3.500	.216	.203	.276	.375	.552	7 3/4	7 3/4	7 3/4
3	2.875	.203	.154	.218	.343	.436	7 3/4	7 3/4	7 3/4

General Dimensions for

STRAIGHT
TEE



REDUCING
TEE



Nom. Pipe Size	Outlet	Outside Diam.	Nominal Wall Thickness				C	M	H
			STD	XS	160	XXS			
8	8	8.625	3.75	500	1.312	...	7	7	...
	6	8.625	3.75	500	1.312	...	7	6 1/4	5
	5	8.625	3.75	500	1.312	...	7	6 1/4	6
	4	8.625	3.75	500	1.312	...	7	6 1/4	6
10	10	10.750	3.75	500	1.312	...	8 1/2	8 1/2	...
	8	10.750	3.75	500	1.312	...	8 1/2	8	7
	6	10.750	3.75	500	1.312	...	8 1/2	7 1/4	7
	5	10.750	3.75	500	1.312	...	8 1/2	7 1/4	7
12	12	12.750	3.75	500	1.312	...	10	10	...
	10	12.750	3.75	500	1.312	...	10	9 1/2	8
	8	12.750	3.75	500	1.312	...	10	9	8
	6	12.750	3.75	500	1.312	...	10	8 3/4	8
14	14	14.000	3.75	500	1.312	...	11	11	...
	12	14.000	3.75	500	1.312	...	11	10 1/4	13
	10	14.000	3.75	500	1.312	...	11	10 1/4	13
	8	14.000	3.75	500	1.312	...	11	9 1/4	13
16	16	16.000	3.75	500	1.312	...	12	12	...
	14	16.000	3.75	500	1.312	...	12	12	14
	12	16.000	3.75	500	1.312	...	12	11 1/4	14
	10	16.000	3.75	500	1.312	...	12	11 1/4	14
18	18	18.000	3.75	500	1.312	...	13 1/2	13 1/2	...
	16	18.000	3.75	500	1.312	...	13 1/2	13	15
	14	18.000	3.75	500	1.312	...	13 1/2	13	15

ASA B16.9

ASA B36.10

Welding Fittings

CONCENTRIC
REDUCER



ECCENTRIC
REDUCER

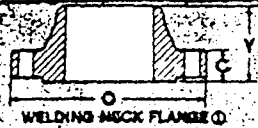


Nom. Pipe Size	Outlet	Outside Diam.	Nominal Wall Thickness				C	M	H
			STD	XS	160	XXS			
18	12	12.750	3.75	500	1.312	...	13 1/2	12 1/4	15
	8	8.625	3.75	500	1.312	...	13 1/2	11 1/4	15
20	20	20.000	3.75	500	1.312	...	15	15	...
	18	18.000	3.75	500	1.312	...	15	14 1/4	20
	16	16.000	3.75	500	1.312	...	15	14	20
	14	14.000	3.75	500	1.312	...	15	14	20
	12	12.750	3.75	500	1.312	...	15	13 1/4	20
	10	10.750	3.75	500	1.312	...	15	13 1/4	20
22	22	22.000	3.75	500	1.312	...	15	12 1/4	20
	20	20.000	3.75	500	1.312	...	15 1/2	16	...
	18	18.000	3.75	500	1.312	...	15 1/2	15 1/2	20
	16	16.000	3.75	500	1.312	...	15 1/2	15	20
	14	14.000	3.75	500	1.312	...	15 1/2	15	20
	12	12.750	3.75	500	1.312	...	15 1/2	14 1/4	...
24	24	24.000	3.75	500	1.312	...	17	17	...
	22	22.000	3.75	500	1.312	...	17	16 1/2	20
	20	20.000	3.75	500	1.312	...	17	16	20
	18	18.000	3.75	500	1.312	...	17	15 1/2	20
	16	16.000	3.75	500	1.312	...	17	15	20
	14	14.000	3.75	500	1.312	...	17	15 1/4	20
30	30	30.000	3.75	500	1.312	...	22	22	...
	24	24.000	3.75	500	1.312	...	22	21	24
	22	22.000	3.75	500	1.312	...	22	20 1/2	24
	20	20.000	3.75	500	1.312	...	22	20	24
	18	18.000	3.75	500	1.312	...	22	19 1/4	...
	16	16.000	3.75	500	1.312	...	22	19	...

* This size not covered by ASA B16.9

† This size not covered by ASA B36.10

General Dimensions for



WELDING NECK FLANGE



SLIP-ON FLANGE

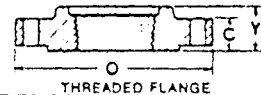
125 lb. LW ASA B16.1 ASA B16.5 A-181-I

Nom. Pipe Size	Flange O.D.	Flange Thick-ness C	Diam. of Raised Face	Length Thru Hub Y		Drilling		Bores	
				Weld- ing Neck	Slip- on	No. & Size of Holes	Bolt Circle	Weld- ing Neck	Slip- on
1/2	...	...	...	...	...	...	...	...	...
3/4	...	...	...	...	...	...	...	...	...
1	4 1/4	3/8	2	1 1/4	...	4 - 3/8	3 1/2	1.05	...
1 1/4	4 3/8	3/8	2 1/4	1 1/4	...	4 - 3/8	3 1/2	1.38	...
1 1/2	5	3/8	2 3/4	1 1/4	...	4 - 3/8	3 1/2	1.61	...
2	6	1/2	3	1 3/4	...	4 - 3/4	4 1/2	2.07	...
2 1/2	7	1/2	3 1/2	1 3/4	...	4 - 3/4	5 1/2	2.47	2.94
3	7 1/2	1/2	4	1 3/4	...	4 - 3/4	6	3.07	3.57
3 1/2	8 1/2	1/2	4 1/4	1 3/4	...	8 - 3/4	7	3.55	...
4	9	1/2	5 1/2	1 3/4	...	8 - 3/4	7 1/2	4.13	4.57
5	10	5/16	6 1/2	1 3/4	...	8 - 3/4	8 1/2	5.05	5.66
6	11	5/16	7 1/2	1 3/4	...	8 - 3/4	9 1/2	6.19	6.72
8	13 1/2	5/16	9 1/2	1 3/4	...	8 - 3/4	11 1/4	8.19	8.72
10	16	1/2	11 1/4	2 1/4	...	12 - 1	14 1/2	10.31	10.88
12	19	1/2	13 1/4	2 1/4	...	12 - 1	17	12.25	12.88
14	21	3/4	...	...	...	12 - 1 1/4	19 1/4	...	14.14
16	23 1/2	3/4	...	...	...	16 - 1 1/4	21 1/4	...	16.16
18	25	3/4	...	...	...	16 - 1 1/4	23 1/4	...	18.18
20	27 1/2	3/4	...	...	...	20 - 1 1/4	25	...	20.20
24	32	1	...	...	...	20 - 1 1/4	29 1/2	...	24.25

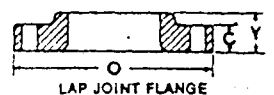
① Welding neck flange sizes 5", 3 1/2" and smaller are bored for standard weight pipe. Sizes 4", 6" and larger are bored to match light wall pipe and gas distribution welding fittings. Slip-on flanges are bored to match O.D. of light wall pipe and gas distribution welding fittings.

② A 1 1/2" are supplied with flat face. A 1 3/4" raised face can be furnished on request.

Forged Steel Flanges



THREADED FLANGE



LAP JOINT FLANGE

ASA B16.5 A-181-I 150 lb.

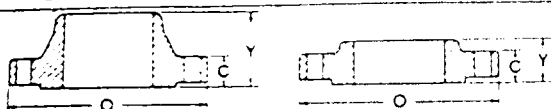
Nom. Pipe Size	Flange O.D.	Flange Thickness	Diam. of Raised Face	Length Thru Hub Y ②			Drilling		Bores	
				Welding Neck &	Slip-on Thred. and Socket	Lap Joint	No. & Size of Holes	Bolt Circle	Slip-on	Lap Joint
1/2	3 1/2	1/8	1 1/8	1 1/8	3/8	3/8	4 - 3/8	2 1/8	.88	.90
3/4	3 3/4	1/8	1 1/8	2 1/8	3/8	3/8	4 - 3/8	2 1/8	1.09	1.11
1	4 1/4	1/8	2	2 1/8	1 1/8	1 1/8	4 - 3/8	3 1/8	1.36	1.38
1 1/4	4 3/8	3/8	2 1/2	2 1/8	1 1/8	1 1/8	4 - 3/8	3 1/8	1.70	1.72
1 1/2	5	1/2	2 3/4	2 1/8	3/8	3/8	4 - 3/8	3 1/8	1.95	1.97
2	6	3/4	3 1/2	2 1/8	1	1	4 - 3/4	4 1/4	2.44	2.46
2 1/2	7	1	4 1/4	2 1/8	1 1/8	1 1/8	4 - 3/4	5 1/4	2.94	2.97
3	7 1/2	1 1/8	5	2 1/8	1 1/8	1 1/8	4 - 3/4	6	3.57	3.60
3 1/2	8 1/2	1 1/8	5 1/2	2 1/8	1 1/8	1 1/8	8 - 3/4	7	4.07	4.10
4	9	1 1/8	6 1/4	3	1 1/8	1 1/8	8 - 3/4	7 1/2	4.57	4.60
5	10	1 1/8	7 1/4	3 1/2	1 1/8	1 1/8	8 - 3/4	8 1/2	5.66	5.69
6	11	1 1/8	8 1/4	3 1/2	1 1/8	1 1/8	8 - 3/4	9 1/2	6.72	6.75
8	13 1/2	1 1/8	10 1/4	4	1 1/8	1 1/8	8 - 3/4	11 1/4	8.72	8.75
10	16	1 1/8	12 1/4	4	1 1/8	1 1/8	12 - 1	14 1/2	10.88	10.92
12	19	1 1/8	15	4	1 1/8	1 1/8	12 - 1	17	12.88	12.92
14	21	1 1/8	16 1/4	5	2 1/8	3	12 - 1 1/4	18 1/4	14.14	14.18
16	23 1/2	1 1/8	18 1/4	5	2 1/8	3	16 - 1 1/4	21 1/4	16.16	16.19
18	25	1 1/8	20	5 1/2	2 1/8	3 1/2	16 - 1 1/4	23 1/4	18.18	18.22
20	27 1/2	1 1/8	23	5 1/2	2 1/8	4 1/2	20 - 1 1/4	25	20.20	20.25
24	32	1 1/8	28 1/4	6	3 1/8	4 1/2	20 - 1 1/4	29 1/2	24.25	24.28

NOTES

1 Always specify bore when ordering.

2 Includes 1/8" raised face in 150# & 300# standards. Does NOT include 1/2" raised face in 400# and heavier standards.

General Dimensions for



WELDING NECK FLANGE

SLIP-ON FLANGE

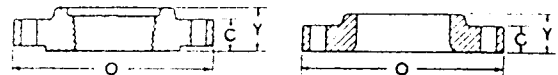
300 lb.

ASA B16.5

A-181-1

Nom. Pipe Size	Flange O.D.	Flange Thickness C	Diam. of Raised Face	Length Thru Hub Y (2)			Drilling			Bore	
				Welding Neck	Slip-on Thread and Socket	Lap Joint	No. & Size of Holes	Bolt Circle	Slip-on	Lap Joint	
1/2	3 1/4	1 1/4	1 1/4	2 1/4	1	1	4 - 3/8	2 1/4	.88	.90	
3/4	4 1/4	1 1/4	1 1/4	2 1/4	1	1	4 - 3/8	3 1/4	1.09	1.11	
1	4 3/4	1 1/4	2	2 1/4	1 1/4	1 1/4	4 - 3/8	3 1/4	1.36	1.38	
1 1/4	5 1/4	1 1/4	2 1/2	2 1/4	1 1/4	1 1/4	4 - 3/8	3 3/4	1.70	1.72	
1 1/2	6 1/4	1 1/4	2 3/4	2 1/4	1 1/4	1 1/4	4 - 3/8	4 1/4	1.95	1.97	
2	6 1/2	1 1/4	3 1/4	2 1/4	1 1/4	1 1/4	8 - 3/8	5	2.44	2.46	
2 1/2	7 1/2	1 1/4	4 1/4	3	1 1/4	1 1/4	8 - 3/8	5 1/4	2.94	2.97	
3	8 1/4	1 1/4	5	3 1/4	1 1/4	1 1/4	8 - 3/8	6 1/4	3.57	3.60	
3 1/2	9	1 1/4	5 1/2	3 1/4	1 1/4	1 1/4	8 - 3/8	7 1/4	4.07	4.10	
4	10	1 1/4	6 1/4	3 1/4	1 1/4	1 1/4	8 - 3/8	7 3/4	4.57	4.60	
5	11	1 1/4	7 1/4	3 1/4	2	2	8 - 3/8	9 1/4	5.66	5.69	
6	12 1/2	1 1/4	8 1/4	3 1/4	2 1/4	2 1/4	12 - 1	10 1/4	6.72	6.75	
8	15	1 1/4	10 1/4	4 1/4	2 1/4	2 1/4	12 - 1	13	8.72	8.75	
10	17 1/2	1 1/4	12 1/4	4 1/4	2 1/4	3 1/4	16 - 1 1/2	15 1/4	10.88	10.92	
12	20 1/2	2	15	5 1/4	2 1/4	4	16 - 1 1/2	17 1/4	12.88	12.92	
14	23	2 1/4	16 1/4	5 1/4	3	4 1/4	20 - 1 1/2	20 1/4	14.14	14.18	
16	25 1/2	2 1/4	18 1/4	5 1/4	3 1/4	4 1/4	20 - 1 1/2	22 1/4	16.16	16.19	
18	28	2 1/4	21	6 1/4	3 1/4	5 1/4	24 - 1 1/2	24 1/4	18.18	18.20	
20	30 1/2	2 1/4	23	6 1/4	3 1/4	5 1/4	24 - 1 1/2	27	20.20	20.25	
24	36	2 1/4	27 1/4	6 1/4	4 1/4	6	24 - 1 1/2	32	24.25	24.25	

Forged Steel Flanges



THREADED FLANGE

LAP JOINT FLANGE

A-105-1

400 lb.

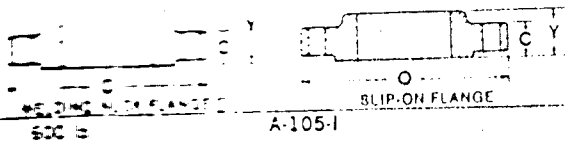
Nom. Pipe Size	Flange O.D.	Flange Thickness C	Diam. of Raised Face	Length Thru Hub Y (2)			Drilling			Bore	
				Welding Neck	Slip-on and Thread.	Lap Joint	No. & Size of Holes	Bolt Circle	Slip-on	Lap Joint	
1/2	3 1/4	1 1/4	1 1/4	2 1/4	1	1	4 - 3/8	2 1/4	.88	.90	
3/4	4 1/4	1 1/4	1 1/4	2 1/4	1	1	4 - 3/8	3 1/4	1.09	1.11	
1	4 3/4	1 1/4	2	2 1/4	1 1/4	1 1/4	4 - 3/8	3 1/4	1.36	1.38	
1 1/4	5 1/4	1 1/4	2 1/2	2 1/4	1 1/4	1 1/4	4 - 3/8	3 3/4	1.70	1.72	
1 1/2	6 1/4	1 1/4	2 3/4	2 1/4	1 1/4	1 1/4	4 - 3/8	4 1/4	1.95	1.97	
2	6 1/2	1 1/4	3 1/4	2 1/4	1 1/4	1 1/4	8 - 3/8	5	2.44	2.46	
2 1/2	7 1/2	1 1/4	4 1/4	3	1 1/4	1 1/4	8 - 3/8	5 1/4	2.94	2.97	
3	8 1/4	1 1/4	5	3 1/4	1 1/4	1 1/4	8 - 3/8	6 1/4	3.57	3.60	
3 1/2	9	1 1/4	5 1/2	3 1/4	1 1/4	1 1/4	8 - 3/8	7 1/4	4.07	4.10	
4	10	1 1/4	6 1/4	3 1/4	2	2	8 - 3/8	7 3/4	4.57	4.60	
5	11	1 1/4	7 1/4	3 1/4	2 1/4	2 1/4	8 - 3/8	9 1/4	5.66	5.69	
6	12 1/2	1 1/4	8 1/4	4 1/4	2 1/4	2 1/4	12 - 1	10 1/4	6.72	6.75	
8	15	1 1/4	10 1/4	4 1/4	2 1/4	2 1/4	12 - 1	13	8.72	8.75	
10	17 1/2	2	12 1/4	4 1/4	2 1/4	4	16 - 1 1/2	15 1/4	10.88	10.92	
12	20 1/2	2 1/4	15	5 1/4	3	4 1/4	16 - 1 1/2	17 1/4	12.88	12.92	
14	23	2 1/4	16 1/4	5 1/4	3 1/4	4 1/4	20 - 1 1/2	20 1/4	14.14	14.18	
16	25 1/2	2 1/4	18 1/4	5 1/4	3 1/4	5	20 - 1 1/2	22 1/4	16.16	16.19	
18	28	2 1/4	21	6 1/4	3 1/4	5 1/4	24 - 1 1/2	24 1/4	18.18	18.20	
20	30 1/2	2 1/4	23	6 1/4	3 1/4	5 1/4	24 - 1 1/2	27	20.20	20.25	
24	36	3	27 1/4	6 1/4	4 1/4	6	24 - 1 1/2	32	24.25	24.25	

NOTES:

1 Always specify bore when ordering.

2 Includes 1/16" raised face in 150# & 300# standards. Does NOT include 1/8" raised face in 400# and heavier standards.

General Dimensions for



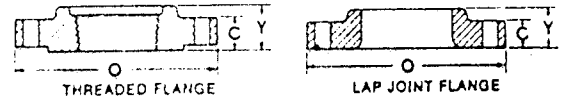
600 lb

A-105-I

SLIP-ON FLANGE

Length Thru Hub Y (2)				Drilling		Bore	
Nom. Pipe Size	Flange O.D.	Flange Thickness C	Diag. of Raised Face	No. & Size of Holes	Bolt Circle	Slip-on	Lap Joint
1/2	4 1/4	3/8	1 1/4	4- 3/8	2 3/8	.88	.90
3/4	5 1/4	1	1 1/4	4- 3/4	3 3/4	1.09	1.11
1	6 1/4	1 1/8	2	4- 3/4	3 3/4	1.36	1.38
1 1/4	7 1/4	1 3/8	2 1/4	4- 3/4	3 3/4	1.70	1.72
1 1/2	8 1/4	1 3/8	2 1/4	4- 3/4	4 1/2	1.95	1.97
2	10 1/4	2	3 1/4	8- 1 1/2	5	2.44	2.46
2 1/2	12 1/4	2 1/8	4 1/4	8- 1 1/2	5 3/8	2.94	2.97
3	14 1/4	2 3/8	5 1/4	8- 1 1/2	6 3/8	3.57	3.60
3 1/2	16 1/4	3	6 1/4	8- 1 1/2	7 3/8	4.07	4.10
4	18 1/4	3 1/2	7 1/4	8- 1 1/2	8 3/8	4.57	4.60
5	20 1/4	4	8 1/4	12- 1 1/2	10 3/8	5.66	5.69
6	22 1/4	4 1/2	9 1/4	12- 1 1/2	11 3/8	6.72	6.75
8	26 1/4	5 1/2	11 1/4	12- 1 1/2	13 3/8	8.72	8.75
10	30 1/4	6 1/2	13 1/4	16- 1 1/2	17	10.88	10.92
12	34 1/4	7 1/2	15 1/4	20- 1 1/2	19 3/8	12.88	12.92
14	38 1/4	8 1/2	17 1/4	20- 1 1/2	20 3/8	14.14	14.18
16	42 1/4	9 1/2	19 1/4	20- 1 1/2	23 3/8	16.16	16.19
18	46 1/4	10 1/2	21 1/4	24- 1 1/2	25 3/8	18.18	18.20
20	50 1/4	11 1/2	23 1/4	24- 1 1/2	28 3/8	20.20	20.25
24	58 1/4	13 1/2	27 1/4	24- 1 1/2	33	24.25	24.25

Forged Steel Flanges



THREADED FLANGE

LAP JOINT FLANGE

ASA B16.5

A-105-II

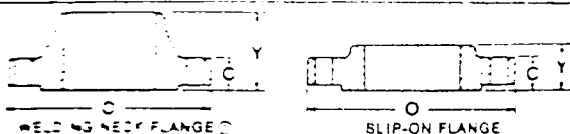
900 lb.

Length Thru Hub Y (2)				Drilling		Bore	
Nom. Pipe Size	Flange O.D.	Flange Thickness C	Diag. of Raised Face	No. & Size of Holes	Bolt Circle	Slip-on	Lap Joint
1/2	4 1/4	3/8	1 1/4	4- 3/8	2 3/8	.88	.90
3/4	5 1/4	1	1 1/4	4- 3/4	3 3/4	1.09	1.11
1	6 1/4	1 1/8	2	4- 3/4	3 3/4	1.36	1.38
1 1/4	7 1/4	1 3/8	2 1/4	4- 3/4	4 1/2	1.70	1.72
1 1/2	8 1/4	1 3/8	2 1/4	4- 3/4	4 1/2	1.95	1.97
2	10 1/4	2	3 1/4	8- 1 1/2	5	2.44	2.46
2 1/2	12 1/4	2 1/8	4 1/4	8- 1 1/2	5 3/8	2.94	2.97
3	14 1/4	2 3/8	5 1/4	8- 1 1/2	6 3/8	3.57	3.60
3 1/2	16 1/4	3	6 1/4	8- 1 1/2	7 3/8	4.07	4.10
4	18 1/4	3 1/2	7 1/4	8- 1 1/2	8 3/8	4.57	4.60
5	20 1/4	4	8 1/4	12- 1 1/2	10 3/8	5.66	5.69
6	22 1/4	4 1/2	9 1/4	12- 1 1/2	11 3/8	6.72	6.75
8	26 1/4	5 1/2	11 1/4	12- 1 1/2	13 3/8	8.72	8.75
10	30 1/4	6 1/2	13 1/4	16- 1 1/2	17	10.88	10.92
12	34 1/4	7 1/2	15 1/4	20- 1 1/2	19 3/8	12.88	12.92
14	38 1/4	8 1/2	17 1/4	20- 1 1/2	20 3/8	14.14	14.18
16	42 1/4	9 1/2	19 1/4	20- 1 1/2	23 3/8	16.16	16.19
18	46 1/4	10 1/2	21 1/4	24- 1 1/2	25 3/8	18.18	18.20
20	50 1/4	11 1/2	23 1/4	24- 1 1/2	28 3/8	20.20	20.25
24	58 1/4	13 1/2	27 1/4	24- 1 1/2	33	24.25	24.25

NOTES:

- Always specify bore when ordering.
- Includes 1/16" raised face in 150# & 300# standards. Does NOT include 1/4" raised face in 400# and heavier standards.

General Dimensions for



WELD-ON NECK FLANGE

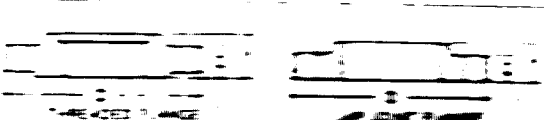
SLIP-ON FLANGE

1500 LB.

A-105-II

Nom. Pipe Size	Flange Face	Flange Neck	Flange Face	Flange Neck	Length Through Hole Y ⁽²⁾			Drilling		Boring	
					Weld Neck	Slip-on Thread and Socket	Lap Joint	No. & Size of Holes	Bolt Circle	Slip-on	Lap Joint
1/2	4 1/4	3 1/2	2 1/4	2 1/4	2 1/4	1 1/4	1 1/4	4- 1/2	3 1/4	.88	.90
3/4	5 1/2	4 1/2	3 1/4	3 1/4	3 1/4	1 1/4	1 1/4	4- 1/2	3 1/2	1.09	1.11
1	5 1/2	4 1/2	3 1/4	3 1/4	3 1/4	1 1/4	1 1/4	4-1	4	1.36	1.38
1 1/4	6 1/4	5 1/4	4 1/4	4 1/4	4 1/4	1 1/4	1 1/4	4-1	4 1/4	1.70	1.72
1 1/2	7	6 1/4	5 1/4	5 1/4	5 1/4	1 1/4	1 1/4	4-1 1/4	4 3/4	1.95	1.97
2	8 1/2	7 1/2	6 1/4	6 1/4	6 1/4	2 1/4	2 1/4	8-1	6 1/2	2.44	2.46
2 1/2	9 1/4	8 1/4	7 1/4	7 1/4	7 1/4	2 1/4	2 1/4	8-1 1/4	7 1/2	2.94	2.97
3	10 1/2	9 1/4	8 1/4	8 1/4	8 1/4	2 1/4	2 1/4	8-1 1/4	8	3.57	3.60
3 1/2	...	...	...	...	...	...	...	...	...	...	...
4	12 1/4	11 1/4	10 1/4	10 1/4	10 1/4	3 1/4	3 1/4	8-1 3/4	9 1/2	4.57	4.60
5	14 1/4	13 1/4	12 1/4	12 1/4	12 1/4	4 1/4	4 1/4	8-1 3/4	11 1/2	5.66	5.69
6	15 1/2	14 1/2	13 1/2	13 1/2	13 1/2	4 1/4	4 1/4	12-1 1/2	12 1/2	6.72	6.75
8	19	18 1/2	17 1/2	17 1/2	17 1/2	5 1/4	5 1/4	12-1 1/4	15 1/2	8.72	8.75
10	23	22 1/4	21 1/4	21 1/4	21 1/4	6 1/4	6 1/4	12-2	19	10.88	10.92
12	26 1/2	25 1/2	24 1/2	24 1/2	24 1/2	7 1/4	7 1/4	16-2 1/4	22 1/2	12.88	12.92
14	29 1/2	28 1/2	27 1/2	27 1/2	27 1/2	8 1/4	8 1/4	16-2 1/4	25	14.14	14.18
16	32 1/2	31 1/2	30 1/2	30 1/2	30 1/2	10 1/4	10 1/4	16-2 1/4	27 1/4	16.16	16.19
18	36	35	34	34	34	10 1/2	10 1/2	16-2 1/4	30 1/2	18.18	18.20
20	38 1/4	37 1/4	36 1/4	36 1/4	36 1/4	11 1/2	11 1/2	16-3 1/4	32 1/4	20.20	20.25
24	46	45	44	44	44	13	13	16-3 1/4	39	24.25	24.25

Forged Steel Flanges



1500 LB.

A-105-II

Nom. Pipe Size	Flange Face	Flange Neck	Flange Face	Flange Neck	Length Through Hole Y ⁽²⁾	Weld Neck	Slip-on Thread and Socket	Lap Joint	No. & Size of Holes	Bolt Circle	Slip-on	Lap Joint
1/2	4 1/4	3 1/2	2 1/4	2 1/4	2 1/4	1 1/4	1 1/4	1 1/4	4- 1/2	3 1/4	.88	.90
3/4	5 1/2	4 1/2	3 1/4	3 1/4	3 1/4	1 1/4	1 1/4	1 1/4	4- 1/2	3 1/2	1.09	1.11
1	5 1/2	4 1/2	3 1/4	3 1/4	3 1/4	1 1/4	1 1/4	1 1/4	4-1	4	1.36	1.38
1 1/4	6 1/4	5 1/4	4 1/4	4 1/4	4 1/4	1 1/4	1 1/4	1 1/4	4-1	4 1/4	1.70	1.72
1 1/2	7	6 1/4	5 1/4	5 1/4	5 1/4	1 1/4	1 1/4	1 1/4	4-1 1/4	4 3/4	1.95	1.97
2	8 1/2	7 1/2	6 1/4	6 1/4	6 1/4	2 1/4	2 1/4	2 1/4	8-1	6 1/2	2.44	2.46
2 1/2	9 1/4	8 1/4	7 1/4	7 1/4	7 1/4	2 1/4	2 1/4	2 1/4	8-1 1/4	7 1/2	2.94	2.97
3	10 1/2	9 1/4	8 1/4	8 1/4	8 1/4	2 1/4	2 1/4	2 1/4	8-1 1/4	8	3.57	3.60
3 1/2	...	...	...	...	...	...	...	...	...	...	...	...
4	12 1/4	11 1/4	10 1/4	10 1/4	10 1/4	3 1/4	3 1/4	3 1/4	8-1 3/4	9 1/2	4.57	4.60
5	14 1/4	13 1/4	12 1/4	12 1/4	12 1/4	4 1/4	4 1/4	4 1/4	8-1 3/4	11 1/2	5.66	5.69
6	15 1/2	14 1/2	13 1/2	13 1/2	13 1/2	4 1/4	4 1/4	4 1/4	12-1 1/2	12 1/2	6.72	6.75
8	19	18 1/2	17 1/2	17 1/2	17 1/2	5 1/4	5 1/4	5 1/4	12-1 1/4	15 1/2	8.72	8.75
10	23	22 1/4	21 1/4	21 1/4	21 1/4	6 1/4	6 1/4	6 1/4	12-2	19	10.88	10.92
12	26 1/2	25 1/2	24 1/2	24 1/2	24 1/2	7 1/4	7 1/4	7 1/4	16-2 1/4	22 1/2	12.88	12.92

NOTES

- Always specify bore when ordering.
- Includes 1/2" raised face in 300 & 600 Standards. Does NOT include 1/2" raised face in 400 and heavier standards.

SERIES 150 FLANGE									
PIPE SIZE	FLANGE BOLTS		RAISED FACE				RING JOINT		
			LENGTH		GASKET		STUD LENGTH	RING NO.	RING GAP
	QT'Y	SIZE	STUD	MACH	I.D.	O.D.			
1/2	4	1/2	2 1/2	1 1/4	3/8	1 1/2			
3/4	4	1/2	2 1/4	2	1 1/16	2 1/4			
1	4	1/2	2 1/2	2	1	2 5/8	3	R-15	1/12
1 1/4	4	1/2	2 3/4	2 1/4	1 1/8	3	3	R-17	-
1 1/2	4	1/2	2 3/4	2 1/4	1 3/8	3 3/4	3 3/4	R-19	-
2	4	5/8	3	2 1/4	2	4 1/8	3 1/2	R-22	-
2 1/2	4	5/8	3 1/4	3	2 1/2	4 7/8	3 3/4	R-25	-
3	4	5/8	3 1/2	3	3	5 1/8	4	R-29	-
3 1/2	8	5/8	3 3/4	3	3 1/2	6 1/8	4	R-33	-
4	8	5/8	3 3/4	3	4	6 1/4	4	R-36	-
5	8	3/4	3 3/4	3 1/4	5	7 1/4	4 1/4	R-40	-
6	8	3/4	3 3/4	3 1/4	6	8 1/4	4 1/4	R-43	-
8	8	3/4	4	3 1/2	8	11	4 1/2	R-48	-
10	12	7/8	4 1/2	3 3/4	10	13 3/4	5	R-52	-
12	12	7/8	4 1/2	4	12	16 1/4	5	R-56	-
14	12	1	5	4 1/4	13 3/4	17 1/4	5 1/2	R-59	1/8
16	16	1	5 1/4	4 1/2	15 1/4	20 1/4	5 1/4	R-64	-
18	16	1 1/8	5 3/4	4 3/4	17 1/4	21 3/4	6 1/4	R-68	-
20	20	1 1/4	6	5 1/4	19 1/4	23 3/4	6 1/2	R-72	-
22	20	1 1/4	6 1/2	5 1/2	21 1/4	26	7	R-80	-
24	20	1 1/4	6 3/4	5 3/4	23 3/4	28 3/4	7 1/4	R-76	-

SERIES 300 FLANGE									
PIPE SIZE	FLANGE BOLTS		RAISED FACE				RING JOINT		
			LENGTH		GASKET		STUD LENGTH	RING NO.	RING GAP
	QT'Y	SIZE	STUD	MACH	I.D.	O.D.			
1/2	4	1/2	2 1/2	2	3/8	2 1/2	3	R-11	1/2
3/4	4	1/2	2 1/4	2 1/2	1 1/16	2 5/8	3 1/4	R-13	1/2
1	4	1/2	3	2 1/2	1	2 5/8	3 1/2	R-16	-
1 1/4	4	1/2	3	2 1/4	1 1/8	3 1/4	3 1/2	R-18	-
1 1/2	4	1/2	3 1/4	3	1 1/8	3 3/4	4	R-20	-
2	8	5/8	3 1/2	3	2	4 1/8	4	R-23	1/2
2 1/2	8	5/8	3 3/4	3 1/4	2 1/2	5 1/8	4 1/2	R-26	-
3	8	5/8	4	3 1/2	3	5 3/8	4 3/4	R-31	-
3 1/2	8	5/8	4 1/4	3 3/4	3 1/2	6 1/8	5	R-34	-
4	8	5/8	4 1/4	3 3/4	4	7 1/8	5	R-37	-
5	8	3/4	4 1/4	4	5	8 1/4	5 1/4	R-41	-
6	12	3/4	4 1/2	4 1/4	6	9 1/4	5 1/2	R-45	-
8	12	3/4	4 3/4	4 1/2	8	12 1/4	6	R-49	-
10	16	1	6	5 1/4	10	14 1/4	6 1/2	R-53	-
12	16	1 1/8	6 1/2	5 1/2	12	16 1/4	7 1/4	R-57	-
14	20	1 1/8	6 3/4	6	14 1/4	19 1/4	7 1/2	R-61	-
16	20	1 1/4	7 1/4	6 1/2	15 1/4	21 1/4	8	R-65	-
18	24	1 1/4	7 3/4	6 3/4	17	23 3/4	8 1/4	R-69	-
20	24	1 1/2	8	7	19	25 3/4	8 3/4	R-73	-
22	24	1 1/2	8 1/2	7 1/2	21	27 1/4	9 1/4	R-81	-
24	24	1 1/2	9	7 3/4	23	30 1/4	10	R-77	1/4

SERIES 400 FLANGE

PIPE SIZE	FLANGE BOLTS		STUD BOLT LENGTH			RING NO.	RING GAP
			RAISED FACE	MALE & FEMALE TONGUE & GROOVE	RING JOINT		
	QT'Y	SIZE					
4	8	$\frac{1}{4}$	$5\frac{1}{4}$	5	$5\frac{1}{2}$	R-37	$\frac{1}{2}$
5	8	$\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	R-41	—
6	12	$\frac{3}{8}$	$5\frac{1}{2}$	$5\frac{1}{2}$	6	R-45	—
8	12	1	$6\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{2}$	R-49	—
10	16	$1\frac{1}{8}$	$7\frac{1}{4}$	7	$7\frac{1}{2}$	R-53	—
12	16	$1\frac{1}{4}$	$7\frac{3}{4}$	$7\frac{1}{2}$	8	R-57	—
14	20	$1\frac{1}{4}$	8	$7\frac{3}{4}$	$8\frac{1}{4}$	R-61	—
16	20	$1\frac{3}{8}$	$8\frac{1}{2}$	$8\frac{1}{4}$	$8\frac{3}{4}$	R-65	—
18	24	$1\frac{3}{8}$	$8\frac{3}{4}$	$8\frac{1}{2}$	9	R-69	—
20	24	$1\frac{1}{2}$	$9\frac{1}{2}$	$9\frac{1}{4}$	$9\frac{3}{4}$	R-73	—
22	24	$1\frac{5}{8}$	10	$9\frac{3}{4}$	$10\frac{1}{2}$	R-81	$\frac{3}{16}$
24	24	$1\frac{3}{4}$	$10\frac{1}{2}$	$10\frac{1}{4}$	11	R-77	$\frac{1}{4}$

*Series 300, 400 & 600 use same ring numbers.

SERIES 600 FLANGE

PIPE SIZE	FLANGE BOLTS		STUD BOLT LENGTH			RING NO.	RING GAP
			RAISED FACE	MALE & FEMALE TONGUE & GROOVE	RING JOINT		
	QT'Y	SIZE					
$\frac{1}{2}$	4	$\frac{1}{2}$	3	$2\frac{1}{4}$	3	R-11	$\frac{1}{8}$
$\frac{3}{4}$	4	$\frac{5}{8}$	$3\frac{1}{4}$	3	$3\frac{1}{4}$	R-13	$\frac{3}{16}$
1	4	$\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{2}$	R-16	—
$1\frac{1}{4}$	4	$\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	R-18	—
$1\frac{1}{2}$	4	$\frac{3}{4}$	4	$3\frac{3}{4}$	4	R-20	—
2	8	$\frac{5}{8}$	4	$3\frac{3}{4}$	$4\frac{1}{4}$	R-23	$\frac{1}{16}$
$2\frac{1}{2}$	8	$\frac{3}{4}$	$4\frac{1}{2}$	$4\frac{1}{4}$	$4\frac{1}{2}$	R-26	—
3	8	$\frac{3}{4}$	$4\frac{3}{4}$	$4\frac{1}{2}$	5	R-31	—
$3\frac{1}{2}$	8	$\frac{7}{8}$	$5\frac{1}{4}$	5	$5\frac{1}{2}$	R-34	—
4	8	1	$5\frac{1}{2}$	$5\frac{1}{4}$	$5\frac{1}{2}$	R-37	—
5	8	1	$5\frac{3}{4}$	5	$5\frac{3}{4}$	R-41	—
6	12	1	$5\frac{3}{4}$	5	$5\frac{3}{4}$	R-45	—
8	12	1	$7\frac{1}{4}$	5	$7\frac{1}{4}$	R-49	—
10	16	$1\frac{1}{4}$	$8\frac{1}{4}$	5	$8\frac{1}{4}$	R-53	—
12	20	$1\frac{1}{4}$	$8\frac{1}{2}$	5	$8\frac{1}{2}$	R-57	—
14	20	$1\frac{1}{2}$	9	$8\frac{1}{2}$	$8\frac{1}{2}$	R-61	—
16	20	$1\frac{1}{2}$	$9\frac{1}{4}$	$8\frac{1}{2}$	10	R-65	—
18	20	$1\frac{5}{8}$	$10\frac{1}{4}$	$10\frac{1}{4}$	$10\frac{1}{4}$	R-69	—
20	24	$1\frac{5}{8}$	$11\frac{1}{4}$	11	$11\frac{1}{2}$	R-73	—
22	24	$1\frac{3}{4}$	12	$11\frac{1}{4}$	$12\frac{1}{2}$	R-81	—
24	24	$1\frac{3}{4}$	$12\frac{3}{4}$	$12\frac{1}{2}$	$13\frac{1}{4}$	R-77	$\frac{1}{8}$

*Series 300, 400 & 600 use same ring numbers.

SERIES 900 FLANGE

PIPE SIZE	FLANGE BOLTS		STUD BOLT LENGTH			RING NO.	RING GAP
			RAISED FACE	MALE & FEMALE TONGUE & GROOVE	RING JOINT		
	QT'Y	SIZE					
3	8	$\frac{7}{8}$	$5\frac{1}{2}$	$5\frac{1}{4}$	$5\frac{1}{2}$	R-31	$\frac{1}{32}$
4	8	$1\frac{1}{8}$	$6\frac{1}{2}$	$6\frac{1}{4}$	$6\frac{3}{4}$	R-37	—
5	8	$1\frac{1}{8}$	$7\frac{1}{2}$	7	$7\frac{1}{2}$	R-41	—
6	12	$1\frac{1}{8}$	$7\frac{1}{2}$	$7\frac{1}{4}$	$7\frac{1}{2}$	R-45	—
8	12	$1\frac{1}{8}$	$8\frac{1}{2}$	$8\frac{1}{4}$	$8\frac{3}{4}$	R-49	—
10	16	$1\frac{1}{8}$	9	$8\frac{3}{4}$	$9\frac{1}{4}$	R-53	—
12	20	$1\frac{1}{8}$	$9\frac{1}{4}$	$9\frac{1}{2}$	10	R-57	—
14	20	$1\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{4}$	11	R-62	—
16	20	$1\frac{1}{8}$	11	$10\frac{3}{4}$	$11\frac{1}{2}$	R-66	—
18	20	$1\frac{1}{8}$	$12\frac{1}{4}$	$12\frac{1}{2}$	$13\frac{1}{4}$	R-70	$\frac{1}{16}$
20	20	2	$13\frac{1}{2}$	$13\frac{1}{4}$	14	R-74	—
24	20	$2\frac{1}{2}$	17	$16\frac{3}{4}$	$17\frac{3}{4}$	R-78	$\frac{1}{32}$

SERIES 1500 FLANGE

PIPE SIZE	FLANGE BOLTS		STUD BOLT LENGTH			RING NO.	RING GAP
			RAISED FACE	MALE & FEMALE TONGUE & GROOVE	RING JOINT		
	QT'Y	SIZE					
½	4	¾	4	3¾	4	R-12	⅜
¾	4	¾	4¼	4	4¼	R-14	—
1	4	⅞	4¾	4½	4¾	R-16	—
1¼	4	⅞	4¾	4½	4¾	R-18	—
1½	4	1	5¼	5	5¼	R-20	—
2	8	⅞	5½	5¼	5½	R-24	⅜
2½	8	1	6	5¾	6¼	R-27	—
3	8	1¼	6¾	6¾	7	R-35	—
4	8	1¼	7½	7¼	7½	R-39	—
5	8	1½	9½	9¼	9½	R-44	—
6	12	1½	10	9¾	10½	R-48	—
8	12	1¾	11¼	10¾	11½	R-50	⅜
10	12	1¾	13¼	12¾	13½	R-54	—
12	16	2	14¾	14¾	15¼	R-58	⅜
14	16	2¼	16	15¾	16½	R-63	⅜
1½	16	2½	17½	17¼	18½	R-67	¾
18	16	2¾	19¼	19	20¼	R-71	—
20	16	3	21	20¾	22¼	R-75	¾
24	16	3½	24	23¼	25½	R-79	¾

SERIES 2500 FLANGE

PIPE SIZE	FLANGE BOLTS		STUD BOLT LENGTH			RING NO.	RING GAP
			RAISED FACE	MALE & FEMALE TONGUE & GROOVE	RING JOINT		
	QT'Y	SIZE					
½	4	¾	4¾	4½	4¾	R-13	⅜
¾	4	¾	4¾	4½	4¾	R-16	—
1	4	7⁄8	5¼	5	5¼	R-18	—
1¼	4	1	5¾	5½	6	R-21	⅞
1½	4	1⅛	6½	6¼	6¾	R-23	—
2	8	1	6¾	6½	7	R-26	—
2½	8	1⅞	7½	7¼	7¾	R-28	—
3	8	1¼	8½	8¼	8¾	R-32	—
4	8	1½	9¾	9½	10¼	R-38	⅜
5	8	1¾	11½	11¼	12¼	R-42	—
6	8	2	13½	13¼	14	R-47	—
8	12	2	15	14¾	15½	R-51	⅜
10	12	2½	19	18¾	20	R-55	¼
12	12	2¾	21	20¾	22	R-60	⅝

WRENCH SIZES

BOLT DIAM	WRENCH SIZE	BOLT DIAM	WRENCH SIZE
1/2	7	1 1/2	2 3/4
5/8	1 1/2	1 3/4	2 3/4
3/4	1 3/4	1 7/8	2 3/4
7/8	1 7/8	2	3 1/4
1	1 7/8	2 1/4	3 1/2
1 1/8	1 3/2	2 1/2	3 1/2
1 1/4	2	2 3/4	4 1/2
1 3/8	2 1/8	3	4 1/2
1 1/2	2 3/8	3 1/2	5 1/2

DRILL SIZES FOR PIPE TAPS

Size of Tap in Inches	No. of Threads Per Inch	Diam. of Drill	Size of Tap in Inches	No. of Threads Per Inch	Diam. of Drill
1/8	27	11/32	2	11 1/2	2 1/8
1/4	18	1/2	2 1/2	8	2 1/4
3/8	18	11/16	3	8	2 1/4
1/2	14	3/4	3 1/2	8	2 1/4
5/8	14	7/8	4	8	2 1/4
3/4	12	1	4 1/2	8	2 1/4
1	12	1 1/8	5	8	2 1/4
1 1/4	12	1 1/2	5 1/2	8	2 1/4
1 1/2	12	1 5/8	6	8	2 1/4

**TAP AND DRILL SIZES
American Standard Coarse**

Size of Drill	Size of Tap	Threads Per Inch	Size of Drill	Size of Tap	Threads Per Inch
7	7	10	1 1/2	1 1/2	8
F	5/16	18	1 3/4	1 3/4	8
5/16	3/8	16	2	2	8
U	7/16	14	2 1/4	2 1/4	7
27/64	1/2	13	2 3/4	2 3/4	7
31/64	5/8	12	3 1/4	3 1/4	6
17/32	3/4	11	3 1/2	3 1/2	6
19/32	7/8	11	4	4	5 1/2
21/32	1	10	4 1/2	4 1/2	5
23/32	1 1/8	10	5	5	4 1/2
	1 1/4		5 1/2	5 1/2	4 1/2

BOLT CHART FOR 300 LB. & 400 LB. ORIFICE FLANGES									
NOM PIPE SIZE	FLANGE BOLTS		300 LB. ORIFICE STUD LENGTH		NOM PIPE SIZE	FLANGE BOLTS		400 LB. ORIFICE STUD LENGTH	
	QT'Y	SIZE	RF	RTJ		QT'Y	SIZE	RF	RTJ
1	4	$\frac{3}{8}$	4	4 $\frac{1}{4}$					
1 $\frac{1}{4}$	4	$\frac{3}{8}$	4	4 $\frac{1}{4}$					
1 $\frac{1}{2}$	4	$\frac{3}{8}$	4 $\frac{1}{4}$	5					
2	8	$\frac{3}{8}$	4	4 $\frac{1}{4}$	4	8	$\frac{1}{2}$	5 $\frac{1}{4}$	6
2 $\frac{1}{2}$	8	$\frac{3}{8}$	4 $\frac{1}{4}$	5	5	8	$\frac{1}{2}$	5 $\frac{1}{4}$	6 $\frac{1}{4}$
3	8	$\frac{3}{8}$	4 $\frac{1}{4}$	5	6	12	$\frac{1}{2}$	6 $\frac{1}{4}$	6 $\frac{1}{2}$
4	8	$\frac{3}{8}$	4 $\frac{1}{4}$	5	8	12	1	6 $\frac{1}{4}$	7 $\frac{1}{4}$
5	8	$\frac{3}{8}$	4 $\frac{1}{4}$	5 $\frac{1}{2}$	10	16	1 $\frac{1}{4}$	7 $\frac{1}{4}$	8
6	12	$\frac{3}{8}$	4 $\frac{1}{4}$	5 $\frac{1}{2}$	12	16	1 $\frac{1}{4}$	8	8 $\frac{1}{2}$
8	12	$\frac{3}{8}$	4 $\frac{1}{2}$	6	14	20	1 $\frac{1}{4}$	8 $\frac{1}{4}$	9
10	16	1	5 $\frac{1}{2}$	6 $\frac{1}{2}$	16	20	1 $\frac{1}{8}$	8 $\frac{1}{4}$	9 $\frac{1}{4}$
12	16	1 $\frac{1}{8}$	5 $\frac{1}{2}$	7	18	24	1 $\frac{1}{8}$	9 $\frac{1}{4}$	9 $\frac{1}{2}$
14	20	1 $\frac{1}{8}$	6	7	20	24	1 $\frac{1}{2}$	9 $\frac{1}{4}$	10 $\frac{1}{4}$
16	20	1 $\frac{1}{4}$	6 $\frac{1}{2}$	8	22	24	1 $\frac{3}{8}$	10 $\frac{1}{2}$	10 $\frac{3}{4}$
18	24	1 $\frac{1}{4}$	6 $\frac{1}{2}$	8	24	24	1 $\frac{3}{4}$	11	11 $\frac{1}{4}$
20	24	1 $\frac{3}{4}$	7	8					
22	24	1 $\frac{1}{2}$	7 $\frac{1}{2}$	9					
24	24	1 $\frac{1}{2}$	7 $\frac{1}{2}$	9					

NOTE: (1)

NOTE:

(1) For sizes 1" through 3" use 300 LB. orifice flanges.

BOLT CHART FOR 600 LB., 900 LB. & 1500 LB. ORIFICE FLANGES									
NOM PIPE SIZE	FLANGE BOLTS		600 LB. ORIFICE STUD LENGTH		NOM PIPE SIZE	FLANGE BOLTS		1500 LB. ORIFICE STUD LENGTH	
	QT'Y	SIZE	RF	RTJ		QT'Y	SIZE	RF	RTJ
4	8	$\frac{3}{8}$	5 $\frac{1}{4}$	6 $\frac{1}{4}$	1	4	$\frac{1}{8}$	5 $\frac{1}{2}$	5 $\frac{1}{4}$
5	8	1	6 $\frac{1}{2}$	7	1 $\frac{1}{4}$	4	$\frac{1}{8}$	5 $\frac{1}{2}$	5 $\frac{1}{4}$
6	12	1	6 $\frac{1}{4}$	7 $\frac{1}{4}$	1 $\frac{1}{2}$	4	1	5 $\frac{1}{4}$	6
8	12	1 $\frac{1}{8}$	7 $\frac{1}{8}$	8 $\frac{1}{4}$	2	8	$\frac{1}{8}$	5 $\frac{1}{4}$	6 $\frac{1}{4}$
10	16	1 $\frac{1}{8}$	8 $\frac{1}{2}$	9	2 $\frac{1}{2}$	8	1	6 $\frac{1}{4}$	6 $\frac{1}{2}$
12	20	1 $\frac{1}{4}$	9	9 $\frac{1}{2}$	3	8	1 $\frac{1}{8}$	7	7 $\frac{1}{8}$
14	20	1 $\frac{1}{4}$	9 $\frac{1}{4}$	9 $\frac{1}{2}$	4	8	1 $\frac{1}{4}$	7 $\frac{1}{4}$	8 $\frac{1}{4}$
16	20	1 $\frac{1}{2}$	10	10 $\frac{1}{2}$	5	8	1 $\frac{1}{2}$	9 $\frac{1}{4}$	10 $\frac{1}{4}$
18	20	1 $\frac{1}{2}$	11	11 $\frac{1}{4}$	6	12	1 $\frac{3}{8}$	10 $\frac{1}{4}$	11
20	24	1 $\frac{1}{2}$	11 $\frac{1}{4}$	12	8	12	1 $\frac{3}{8}$	11 $\frac{1}{4}$	12 $\frac{1}{2}$
22	24	1 $\frac{1}{2}$	12 $\frac{1}{4}$	13	10	12	1 $\frac{3}{4}$	13 $\frac{1}{4}$	14 $\frac{1}{4}$
24	24	1 $\frac{1}{2}$	13 $\frac{1}{4}$	13 $\frac{1}{2}$	12	16	2	14 $\frac{1}{4}$	16
3	8	$\frac{3}{8}$	5 $\frac{1}{4}$	6 $\frac{1}{4}$					
4	8	1	6 $\frac{1}{2}$	7					
5	8	1 $\frac{1}{8}$	7 $\frac{1}{8}$	8					
6	12	1 $\frac{1}{8}$	8 $\frac{1}{2}$	9					
8	12	1 $\frac{1}{4}$	9	9 $\frac{1}{2}$					
10	16	1 $\frac{1}{4}$	10	10 $\frac{1}{2}$					
12	20	1 $\frac{1}{2}$	11	11 $\frac{1}{4}$					

NOTE: (2)

NOTE: (3)

NOTES:

(1) For sizes 1" through 3" use 300 LB. orifice flanges.

(2) For sizes 1" through 2 $\frac{1}{2}$ " use 1500 LB. orifice flanges.

(3) 2500 LB. orifice flanges are also available.

OUTSIDE AND INSIDE DIAMETERS OF PIPE AND BORES FOR WELDING NECK AND SOCKET WELD FLANGES.

Nom. Pipe Size	Outside Diam.	Light Wall	Sched. 20	Sched. 30	Std. Wall	Sched. 40	Sched. 60	Extra Strong	Sched. 80	Sched. 100	Sched. 120	Sched. 140	Sched. 160	Double Extra Strong
1	0.840	0.74	...	...	0.622	0.622	...	0.540	0.540	...	...	...	0.414	0.414
1 1/2	1.050	0.84	...	...	0.824	0.824	...	0.727	0.727	...	...	...	0.613	0.613
2	1.315	1.097	...	...	1.040	1.040	...	0.957	0.957	...	...	...	0.808	0.808
2 1/2	1.660	1.442	...	...	1.380	1.380	...	1.278	1.278	...	...	...	1.100	1.100
3	1.900	1.682	...	...	1.610	1.610	...	1.500	1.500	...	...	...	1.318	1.318
4	2.375	2.157	...	...	2.067	2.067	...	1.949	1.949	...	...	...	1.667	1.667
5	2.875	2.635	...	...	2.469	2.469	...	2.344	2.344	...	...	...	2.000	2.000
6	3.500	3.260	...	...	3.065	3.065	...	2.903	2.903	...	...	...	2.500	2.500
8	4.500	4.260	...	...	4.026	4.026	...	3.824	3.824	...	...	...	3.244	3.244
10	5.563	5.295	...	...	5.017	5.017	...	4.776	4.776	...	...	...	4.144	4.144
12	6.625	6.357	...	...	6.065	6.065	...	5.783	5.783	...	...	...	5.000	5.000
14	8.625	8.359	8.125	8.071	7.875	7.875	7.653	7.400	7.400	7.144	6.875	6.600	6.000	5.750
16	10.750	10.420	10.250	10.150	10.013	10.013	9.750	9.450	9.450	9.144	8.875	8.600	8.000	7.750
18	12.750	12.390	12.250	12.093	11.938	11.938	11.625	11.275	11.275	10.944	10.625	10.300	9.600	9.375
20	14.600	14.300	14.125	13.938	13.750	13.750	13.375	12.975	12.975	12.625	12.275	11.900	11.200	10.938
24	18.000	17.500	17.375	17.125	16.875	16.875	16.400	15.900	15.900	15.500	15.125	14.750	14.000	13.750
30	20.000	19.500	19.250	19.000	18.750	18.750	18.125	17.575	17.575	17.125	16.750	16.375	15.600	15.375
36	24.000	23.500	23.250	22.938	22.625	22.625	21.875	21.200	21.200	20.625	20.125	19.625	18.800	18.500
42	30.000	29.375	29.000	28.750	28.500	28.500	27.625	26.875	26.875	26.250	25.750	25.250	24.400	24.125

NOTE: • Light wall diameters are the same as stainless steel Schedule 10S diameters thru 12" and to Schedule 10S diameters 14" and larger.

COMPARISON CHART FOR PACKING AND GASKET MATERIALS

COMPANY	GASKET MATERIAL				PACKING			
ANCHOR	424	425	430	434	105	106	000	
BELMONT	590	590	604	614	106	109	2504	2506
CHESTERTON	210	215	220	240	140		110	110
COLLINS	920		1004		124	164		174
DURABLE								
JOHN CRANE	114		091	111	000	004	026	1010
GARLOCK	2215	900	2220	2205	140	176	210	217
GREENE, TWEED	2000	2005	2010	2020	1206	1110		
MERCULES	544		544	520	101	122	121	110
JOHNS MANVILLE	60	61	76	84	166	211	2010	10
RAYBESTOS MANHATTAN	670	601	600	1002	121	176	100	
SOUTHEASTERN PRODUCE	300		240	400	151	00	045	120
INTERLING	418	412						

NOTE: Some of these gasket materials may be ordered ungraphited or with one or both sides graphited. Refer to suppliers catalog for more information.

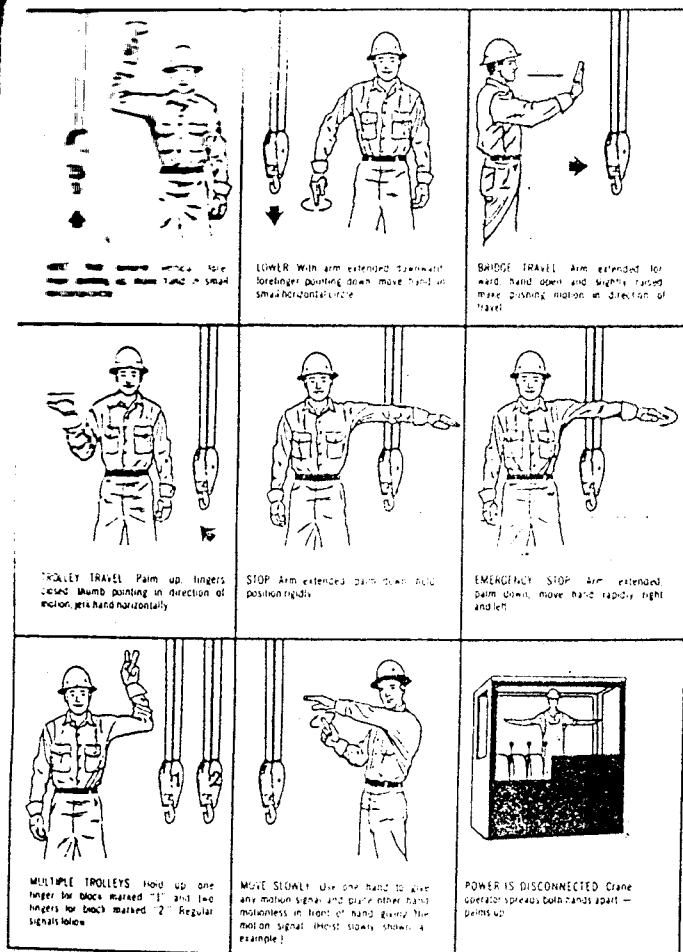


FIG. 3 STANDARD HAND SIGNALS FOR CONTROLLING OVERHEAD AND GANTRY CRANES

From B30.2-1967 Overhead and Gantry Cranes. With permission of The American Society of Mechanical Engineers, the Publisher, New York, N.Y. 10017.

USEFUL INFORMATION

TOTAL EXPANSION PER 100 FEET

1. Steel pipe equals (final temperature minus starting temperature) X .00804
2. Copper and brass pipe equals (final temperature minus starting temperature) X .0114
3. For lengths less than 100 feet move decimal point two places to the left. Examples: 72 feet equal .72, 172 feet equal 1.72 X above results for 100 feet

PIPE BENDS

1. The minimum radius is most often given as 6 X pipe size.
2. The amount of pipe required for a bend equals: The radius X the degrees X .01745

THE CIRCLE

1. Circumference equals diameter X 3.1416
2. Diameter equals circumference X .3183
3. Arc length equals 360 X degrees X .01745
4. Degrees arc equals length divided by radius X .01745
5. Radius arc equals length divided by degrees X .01745

HUNDREDS OF FEET

1. To change hundredths to feet multiply by 100
2. To change feet to hundredths divide by 100

SAFE LOADS FOR NEW ROPE

MANILA ROPE

3 Strands

Safety Factor 5:1

SIZE

1/2

3/4

1

1 1/4

1 1/2

1 3/4

2

250#

350#

450#

650#

920#

1280#

1600#

WIRE ROPE

3 Strands

6 X 19 Wire Rope Center

SIZE

1/2

3/4

1

1 1/4

1 1/2

1 3/4

2

2000#

2600#

3500#

4900#

6700#

9200#

12,700#

17,400#

CONVERSION CONSTANTS

TO CHANGE	TO	MULTIPLY BY
Inches	Feet	0.0833
Inches	Millimeters	25.4
Feet	Inches	12
Feet	Yards	0.3333
Yards	Feet	3
Square inches	Square feet	0.00694
Square feet	Square inches	144
Square feet	Square yards	0.1111
Square yards	Square feet	9
Cubic inches	Cubic feet	0.00058
Cubic feet	Cubic inches	1728
Cubic feet	Cubic yards	0.03703
Cubic yards	Cubic feet	27
Cubic inches	Gallons	0.00433
Gallons	Cubic inches	231
Gallons	Cubic feet	0.1337
Pounds	Pounds of water	8.33
Pounds of water	Gallons	0.12004
Gallons	Pounds	0.0625
Pounds	Gallons	16
Pounds of water	Pounds per square inch	0.0361
Pounds of water	Inches of mercury	0.0735
Pounds of water	Pounds per square inch	0.578
Pounds of water	Pounds per square foot	5.2
Pounds of mercury	Inches of water	13.6
Pounds of mercury	Feet of water	1.1333
Pounds of mercury	Pounds per square inch	0.4914
Pounds per square inch	Inches of mercury	0.127
Pounds per square inch	Inches of water	1.733
Pounds per square inch	Inches of water	27.72
Pounds per square inch	Feet of water	2.310
Pounds per square inch	Inches of mercury	2.04
Pounds per square inch	Atmospheres	0.0681
Feet of water	Pounds per square inch	0.434
Feet of water	Pounds per square foot	62.5
Feet of water	Inches of mercury	0.8824
Atmospheres	Pounds per square inch	14.696
Atmospheres	Inches of mercury	29.92
Atmospheres	Feet of water	34
Long tons	Pounds	2240
Short tons	Pounds	2000
Short tons	Long tons	0.89285

DECIMAL EQUIVALENTS

	$\frac{1}{64}$	.01563		$\frac{33}{64}$	.51563
	$\frac{1}{32}$	.03125		$\frac{17}{32}$	.53125
	$\frac{3}{64}$	.04688		$\frac{35}{64}$	.54688
$\frac{1}{16}$		.0625	$\frac{9}{16}$		.5625
	$\frac{5}{64}$	.07813		$\frac{37}{64}$	.57813
	$\frac{3}{32}$	.09375		$\frac{19}{32}$	.59375
	$\frac{7}{64}$	.10938		$\frac{39}{64}$	.60938
$\frac{1}{8}$		.125	$\frac{5}{8}$		.625
	$\frac{9}{64}$	.14063		$\frac{41}{64}$	.64063
	$\frac{5}{32}$	.15625		$\frac{21}{32}$	.65625
	$\frac{11}{64}$	.17188		$\frac{43}{64}$	.67188
$\frac{3}{16}$		.1875	$\frac{11}{16}$		.6875
	$\frac{13}{64}$	.20313		$\frac{45}{64}$	.70313
	$\frac{3}{32}$	.21875		$\frac{23}{32}$	.71875
	$\frac{15}{64}$	.23438		$\frac{47}{64}$	.73438
$\frac{1}{4}$		.250	$\frac{3}{4}$		.750
	$\frac{17}{64}$	.26563		$\frac{49}{64}$	.76563
	$\frac{7}{16}$	.28125		$\frac{25}{16}$	.78125
	$\frac{19}{64}$	.29688		$\frac{51}{64}$	.79688
$\frac{5}{16}$		.3125		$\frac{53}{64}$	.8125
	$\frac{21}{64}$	.32813		$\frac{55}{64}$	.82813
	$\frac{9}{32}$	.34375		$\frac{57}{64}$	.84375
	$\frac{23}{64}$	.35938		$\frac{59}{64}$	.85938
$\frac{3}{8}$		.375		$\frac{61}{64}$	.875
	$\frac{25}{64}$	.39063		$\frac{63}{64}$	.89063
	$\frac{13}{32}$	.40625		$\frac{29}{32}$	.90625
	$\frac{27}{64}$	.42188		$\frac{59}{64}$	.92188
$\frac{7}{16}$		.4375	$\frac{15}{16}$		.9375
	$\frac{29}{64}$	.45313		$\frac{61}{64}$	.95313
	$\frac{15}{32}$	.46875		$\frac{31}{32}$	.96875
	$\frac{31}{64}$	.48438		$\frac{63}{64}$	.98438
$\frac{1}{2}$		.500	1		1.00000

Φ 1" CATATAN:

AS ELBOW.

$$40^\circ = 15$$

$$80^\circ = 27$$

$$45^\circ = 15.9 = \frac{5}{8}$$

$$60^\circ = 22$$

$$90^\circ = 38.1 = 1.5$$

$$30^\circ = 11$$

$$70^\circ = 23.$$

$$20^\circ = 8$$

$$10^\circ = 4$$

$$15^\circ = 6.$$

MINUTES CONVERTED TO DECIMALS OF A DEGREE

MIN.	DEC.	MIN.	DEC.	MIN.	DEC.	MIN.	DEC.	MIN.	DEC.
1	0.0167	11	0.1833	21	0.3500	31	0.5167	41	0.6833
2	0.0333	12	0.2000	22	0.3667	32	0.5333	42	0.7000
3	0.0500	13	0.2167	23	0.3833	33	0.5500	43	0.7167
4	0.0667	14	0.2333	24	0.4000	34	0.5667	44	0.7333
5	0.0833	15	0.2500	25	0.4167	35	0.5833	45	0.7500
6	0.1000	16	0.2667	26	0.4333	36	0.6000	46	0.7667
7	0.1167	17	0.2833	27	0.4500	37	0.6167	47	0.7833
8	0.1333	18	0.3000	28	0.4667	38	0.6333	48	0.8000
9	0.1500	19	0.3167	29	0.4833	39	0.6500	49	0.8167
10	0.1667	20	0.3333	30	0.5000	40	0.6667	50	0.8333

FEET HEAD OF WATER TO PSI

FEET HEAD	POUNDS PER SQUARE INCH
1	2.31
2	4.62
3	6.93
4	9.24
5	11.55
6	13.86
7	16.17
8	18.48
9	20.79
10	23.10
11	25.41
12	27.72
13	30.03
14	32.34
15	34.65
16	36.96
17	39.27
18	41.58
19	43.89
20	46.20
21	48.51
22	50.82
23	53.13
24	55.44
25	57.75
26	60.06
27	62.37
28	64.68
29	66.99
30	69.30
31	71.61
32	73.92
33	76.23
34	78.54
35	80.85
36	83.16
37	85.47
38	87.78
39	90.09
40	92.40
41	94.71
42	97.02
43	99.33
44	101.64
45	103.95
46	106.26
47	108.57
48	110.88
49	113.19
50	115.50

NOTE: One foot of water at 62° Fahrenheit equals .433 pound pressure per square inch. To find the pressure per square inch for any feet head not given in the table above, multiply the feet head by .433

DECIMALS OF A FOOT

INCH	0"	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"
0	0	0.0433	0.0867	0.1300	0.1733	0.2167	0.2600	0.3033	0.3467	0.3900	0.4333	0.4767
1	0.0433	0.0867	0.1300	0.1733	0.2167	0.2600	0.3033	0.3467	0.3900	0.4333	0.4767	0.5200
2	0.0867	0.1300	0.1733	0.2167	0.2600	0.3033	0.3467	0.3900	0.4333	0.4767	0.5200	0.5633
3	0.1300	0.1733	0.2167	0.2600	0.3033	0.3467	0.3900	0.4333	0.4767	0.5200	0.5633	0.6067
4	0.1733	0.2167	0.2600	0.3033	0.3467	0.3900	0.4333	0.4767	0.5200	0.5633	0.6067	0.6500
5	0.2167	0.2600	0.3033	0.3467	0.3900	0.4333	0.4767	0.5200	0.5633	0.6067	0.6500	0.6933
6	0.2600	0.3033	0.3467	0.3900	0.4333	0.4767	0.5200	0.5633	0.6067	0.6500	0.6933	0.7367
7	0.3033	0.3467	0.3900	0.4333	0.4767	0.5200	0.5633	0.6067	0.6500	0.6933	0.7367	0.7800
8	0.3467	0.3900	0.4333	0.4767	0.5200	0.5633	0.6067	0.6500	0.6933	0.7367	0.7800	0.8233
9	0.3900	0.4333	0.4767	0.5200	0.5633	0.6067	0.6500	0.6933	0.7367	0.7800	0.8233	0.8667
10	0.4333	0.4767	0.5200	0.5633	0.6067	0.6500	0.6933	0.7367	0.7800	0.8233	0.8667	0.9100
11	0.4767	0.5200	0.5633	0.6067	0.6500	0.6933	0.7367	0.7800	0.8233	0.8667	0.9100	0.9533
12	0.5200	0.5633	0.6067	0.6500	0.6933	0.7367	0.7800	0.8233	0.8667	0.9100	0.9533	0.9967
13	0.5633	0.6067	0.6500	0.6933	0.7367	0.7800	0.8233	0.8667	0.9100	0.9533	0.9967	1.0400
14	0.6067	0.6500	0.6933	0.7367	0.7800	0.8233	0.8667	0.9100	0.9533	0.9967	1.0400	1.0833
15	0.6500	0.6933	0.7367	0.7800	0.8233	0.8667	0.9100	0.9533	0.9967	1.0400	1.0833	1.1267
16	0.6933	0.7367	0.7800	0.8233	0.8667	0.9100	0.9533	0.9967	1.0400	1.0833	1.1267	1.1700
17	0.7367	0.7800	0.8233	0.8667	0.9100	0.9533	0.9967	1.0400	1.0833	1.1267	1.1700	1.2133
18	0.7800	0.8233	0.8667	0.9100	0.9533	0.9967	1.0400	1.0833	1.1267	1.1700	1.2133	1.2567
19	0.8233	0.8667	0.9100	0.9533	0.9967	1.0400	1.0833	1.1267	1.1700	1.2133	1.2567	1.3000
20	0.8667	0.9100	0.9533	0.9967	1.0400	1.0833	1.1267	1.1700	1.2133	1.2567	1.3000	1.3433
21	0.9100	0.9533	0.9967	1.0400	1.0833	1.1267	1.1700	1.2133	1.2567	1.3000	1.3433	1.3867
22	0.9533	0.9967	1.0400	1.0833	1.1267	1.1700	1.2133	1.2567	1.3000	1.3433	1.3867	1.4300
23	0.9967	1.0400	1.0833	1.1267	1.1700	1.2133	1.2567	1.3000	1.3433	1.3867	1.4300	1.4733
24	1.0400	1.0833	1.1267	1.1700	1.2133	1.2567	1.3000	1.3433	1.3867	1.4300	1.4733	1.5167
25	1.0833	1.1267	1.1700	1.2133	1.2567	1.3000	1.3433	1.3867	1.4300	1.4733	1.5167	1.5600
26	1.1267	1.1700	1.2133	1.2567	1.3000	1.3433	1.3867	1.4300	1.4733	1.5167	1.5600	1.6033
27	1.1700	1.2133	1.2567	1.3000	1.3433	1.3867	1.4300	1.4733	1.5167	1.5600	1.6033	1.6467
28	1.2133	1.2567	1.3000	1.3433	1.3867	1.4300	1.4733	1.5167	1.5600	1.6033	1.6467	1.6900
29	1.2567	1.3000	1.3433	1.3867	1.4300	1.4733	1.5167	1.5600	1.6033	1.6467	1.6900	1.7333
30	1.3000	1.3433	1.3867	1.4300	1.4733	1.5167	1.5600	1.6033	1.6467	1.6900	1.7333	1.7767
31	1.3433	1.3867	1.4300	1.4733	1.5167	1.5600	1.6033	1.6467	1.6900	1.7333	1.7767	1.8200
32	1.3867	1.4300	1.4733	1.5167	1.5600	1.6033	1.6467	1.6900	1.7333	1.7767	1.8200	1.8633
33	1.4300	1.4733	1.5167	1.5600	1.6033	1.6467	1.6900	1.7333	1.7767	1.8200	1.8633	1.9067
34	1.4733	1.5167	1.5600	1.6033	1.6467	1.6900	1.7333	1.7767	1.8200	1.8633	1.9067	1.9500
35	1.5167	1.5600	1.6033	1.6467	1.6900	1.7333	1.7767	1.8200	1.8633	1.9067	1.9500	1.9933
36	1.5600	1.6033	1.6467	1.6900	1.7333	1.7767	1.8200	1.8633	1.9067	1.9500	1.9933	2.0367
37	1.6033	1.6467	1.6900	1.7333	1.7767	1.8200	1.8633	1.9067	1.9500	1.9933	2.0367	2.0800
38	1.6467	1.6900	1.7333	1.7767	1.8200	1.8633	1.9067	1.9500	1.9933	2.0367	2.0800	2.1233
39	1.6900	1.7333	1.7767	1.8200	1.8633	1.9067	1.9500	1.9933	2.0367	2.0800	2.1233	2.1667
40	1.7333	1.7767	1.8200	1.8633	1.9067	1.9500	1.9933	2.0367	2.0800	2.1233	2.1667	2.2100
41	1.7767	1.8200	1.8633	1.9067	1.9500	1.9933	2.0367	2.0800	2.1233	2.1667	2.2100	2.2533
42	1.8200	1.8633	1.9067	1.9500	1.9933	2.0367	2.0800	2.1233	2.1667	2.2100	2.2533	2.2967
43	1.8633	1.9067	1.9500	1.9933	2.0367	2.0800	2.1233	2.1667	2.2100	2.2533	2.2967	2.3400
44	1.9067	1.9500	1.9933	2.0367	2.0800	2.1233	2.1667	2.2100	2.2533	2.2967	2.3400	2.3833
45	1.9500	1.9933	2.0367	2.0800	2.1233	2.1667	2.2100	2.2533	2.2967	2.3400	2.3833	2.4267
46	1.9933	2.0367	2.0800	2.1233	2.1667	2.2100	2.2533	2.2967	2.3400	2.3833	2.4267	2.4700
47	2.0367	2.0800	2.1233	2.1667	2.2100	2.2533	2.2967	2.3400	2.3833	2.4267	2.4700	2.5133
48	2.0800	2.1233	2.1667	2.2100	2.2533	2.2967	2.3400	2.3833	2.4267	2.4700	2.5133	2.5567
49	2.1233	2.1667	2.2100	2.2533	2.2967	2.3400	2.3833	2.4267	2.4700	2.5133	2.5567	2.6000
50	2.1667	2.2100	2.2533	2.2967	2.3400	2.3833	2.4267	2.4700	2.5133	2.5567	2.6000	2.6433