A Design Aid for Connection Angle Welds Subjected to Combined Shear and Axial Loads

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The Eighth Edition AISC *Manual of Steel Construction*[1] contains tables to assist in the analysis and design of various weld groups under eccentric loads. These are Tables XIX through XXVI and specialized Tables III and IV for connection angle welds. In all of these tables, although the load is eccentric to the weld group, it is aligned with one of the principal axes of the weld group. It is common in actual connections for the load to have an arbitrary alignment with the weld group principal axes in addition to being eccentric. There are no tables in the Eighth Edition AISC Manual covering these cases. The designer or detailer, therefore, has two options to treat these cases: the elastic method (AISC Manual pp. 4-71, 4-72) or the inelastic method (Manual pp. 4-72, 4-73). Both these options involve extensive calculations for the analysis and design of each connection. In the case of the inelastic method, a computer program is almost a necessity. Such a program is available.[2] The elastic method calculations, while extremely tedious, can be done manually, or with a programmable calculator. The use of this method, however, will produce a connection with a higher degree of conservatism (and therefore, more expensive) than the same connection designed by the inelastic method.

The purpose of this paper is to provide a design aid, in the form of a set of charts, that permits the routine use of the inelastic method in the design of commonly used weld groups subjected to loads of arbitrary orientation. The specific weld groups considered are shown in Fig. 1. These are C-shaped, L-shaped and line welds which occur in shop-welded, framed-beam connections, such as shown in Fig. 2, and in similar clip angle to gusset plate welds.

DESIGN CHARTS

The design charts are given in Tables 1 through 6. Two alternate, but equivalent methods for presenting the design data are given. Tables 1, 2 and 3 present the data in a resultant-angular position format, while Tables 4, 5 and 6 use a shear/axial format. The following comments on these tables should be noted.

1. Capacities in the design charts were calculated using the Fortran computer program developed by Brandt.[2]
2. Tables for capacities of C-shaped, L-shaped and line welds are based on the weld geometries in Fig. 1.
3. Capacities in the design charts are based on double clips, fillet welds near side and far side, bolts in outstanding legs of clips and a ½-in. setback from the faying surface of the clip angle outstanding legs (see Fig. 2).
4. Capacities in the design charts are based on E70XX electrodes, per 1/16-in. of weld size.
5. It is assumed the axial load T acts at the half-depth of the connection, and that the shear V acts at the face of the outstanding legs of the clip angles.
6. The axial load T may be tension or compression. For the L-shaped welds different capacities are obtained for ϕ and $-\phi$, where ϕ is the angle the resultant load makes with the vertical (see Fig. 1). The minimum capacity for ϕ and $-\phi$ is included in the charts.

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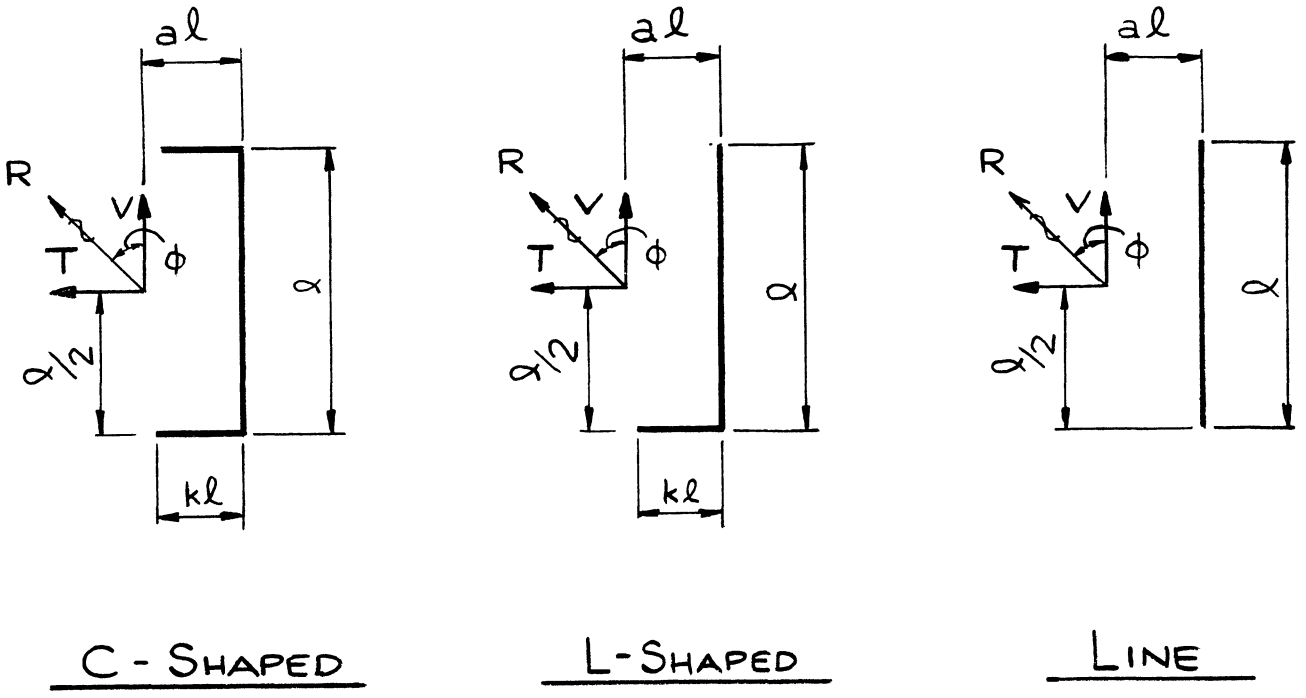

Fig. 1. Weld geometries (V and T are applied shear and axial loads, respectively).

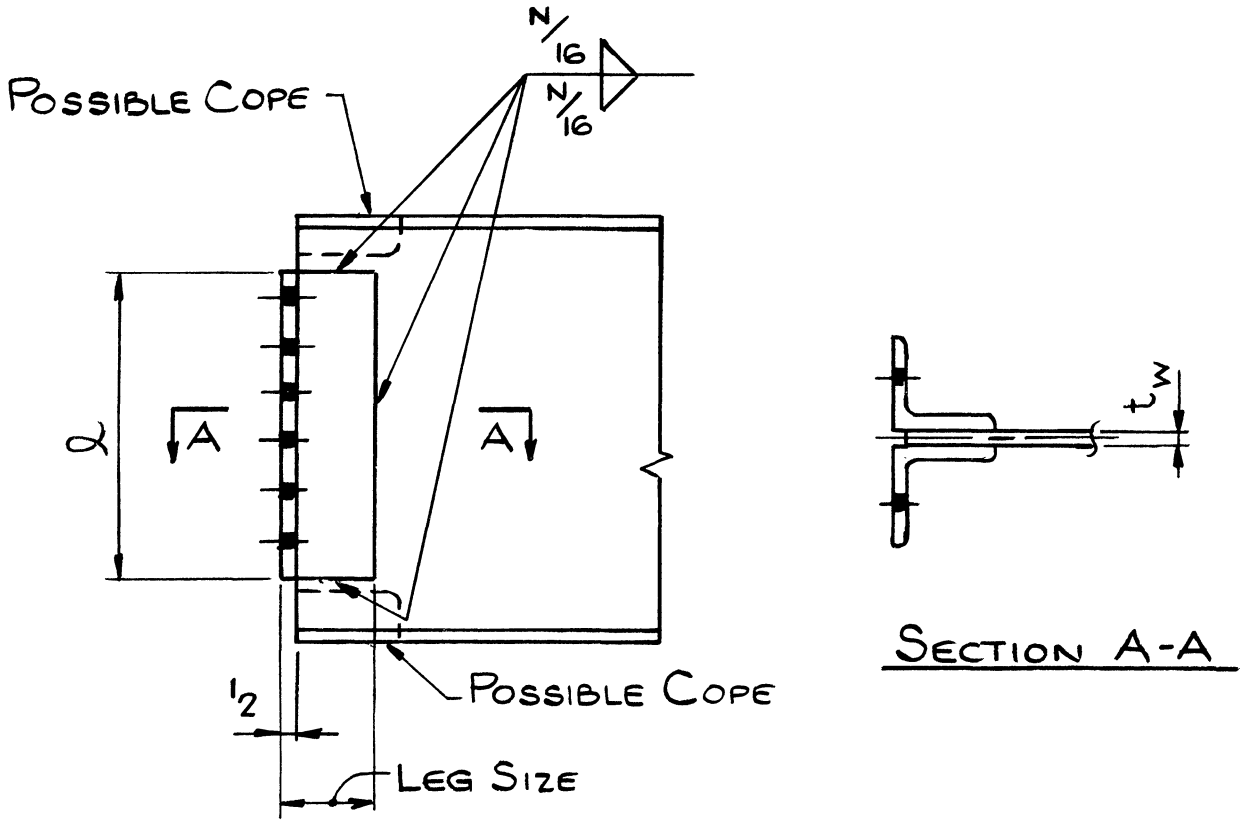

Fig. 2. Typical framed beam connection.

DESIGN PROCEDURES

Design procedures for both the resultant method and the shear/tension method are given in general form in this section of the paper.

Method 1

Resultant Method (Tables 1–3)

1.1 Determine the resultant of the applied shear and axial loads and the angle at which it acts with respect to vertical.

1.2 Divide the resultant by the number of sixteenths in the weld size to be used.

1.3 Calculate the proration factor ρ, Appendix A.*

1.4 Divide the value calculated in Step 1.2 by the proration factor ρ, Step 1.3, when $\rho<1$.

1.5 Using the calculated angle (Step 1.1) and the value from Step 1.4, determine the depth of connection required to support the applied loads.

a. Enter the table that corresponds to the weld geometry and clip leg size used in the connection.

b. Find the depth of connection which has an allowable resultant load acting at the calculated angle (Step 1.1) which exceeds the value calculated in Step 1.4.

Method 2

Shear and Tension Method (Tables 4–6)

2.1 Divide applied shear and axial loads by the number of sixteenths in the weld size to be used.

2.2 Calculate the proration factor ρ, Appendix A.*

2.3 Divide shear and axial values calculated in Step 2.1 by the proration factor ρ, when $\rho<1$.

2.4 Enter the table that corresponds to the weld geometry and clip leg size used in the connection, and find the depth of connection which has an allowable shear and allowable axial force greater than the values calculated in Step 2.3.

EXAMPLES

Example 1 (Method 1)

Given:

Beam: W24×76 ASTM A36 (F_y = 36 ksi)

Reactions: 100 kips shear
30 kips axial

Weld: E70XX C-shaped weld

Clips: 3½-in. leg attached to beam web

Design the clip angle to beam web weld to support the given reactions.

1. The resultant $= \sqrt{100^2 + 30^2} = 104.4$ kips

   The angle with respect to vertical is

   $$\phi = \tan^{-1}\left(\frac{30}{100}\right) = 16.7°$$

2. Since the beam web is .44 in. thick, try ¼-in. fillet welds. Then the load per 16th of fillet weld is

   $$\frac{104.4}{4} = 26.1 \text{ kips/16th}$$

3. The proration factor (Appendix A) is

   $$\rho = \frac{.44}{.51} = .863$$

4. Then $\dfrac{26.1}{.863} = 30.3$ kips/16th

5. Enter table for C-shaped welds on 3½-in. clip leg with required capacity 30.3 kips/16th and $\phi = 16.7°$

   Find in Table 1B:

	10°	20°
17½	34.5	34.9

   Capacity @ 10° = 34.5 kips/16th > 30.3 kips/16th
   ∴ **o.k.**

   Capacity @ 20° = 34.9 kips/16th > 30.3 kips/16th
   ∴ **o.k.**

   Use clip length = 17½-in. with ¼-in. C-shaped fillet welds.

Example 2 (Method 2)

Given:

Beam: W21×44 ASTM A36 (F_y = 36 ksi)

Reactions: 21 kips shear
74 kips axial

Weld: E70XX

Clips: 4-in. leg attached to beam web

The beam top flange is coped, such that only an L-shaped weld can be applied.

Design the clip angle to beam web weld to support the given reactions.

1. Since the beam web is .35-in. thick, try 3/16-in. fillets. Then

   $$\frac{21}{3} = 7 \text{ kips/16th}$$

   $$\frac{74}{3} = 24.7 \text{ kips/16th}$$

**The proration factor is the ratio of actual web or plate thickness to thickness required to develop the strength of the welds.*

2. The proration factor ρ = .35/.38 = .92
3. Then 7/.92 = 7.61 and 24.7/.92 = 26.9
4. Enter Table 5C with 7.61 kips/16th required shear capacity and 26.9 kips/16th required tension capacity. For a 17½-in. deep clip, find

17½		9.48/26.0	5.06/28.7	

By interpolation, when the shear is 7.61, the allowable tension is 27.1. Since 27.1 > 26.9, the 17½-in. clips and 3/16-in. L-shaped fillet welds are **o.k.**

REFERENCES

1. *American Institute of Steel Construction, Inc.* Manual of Steel Construction *8th Ed., 1980, Chicago, Ill., pp. 4-28 through 4-37, 4-71 through 4-83.*
2. *Brandt, G. Donald* A General Solution for Eccentric Loads on Weld Groups *AISC Engineering Journal, Vol. 19, No. 3, 3rd Qtr. 1982, pp. 150–159.*
3. *Thornton, William A.* Bracing Connections for Heavy Construction *AISC Engineering Journal, Vol. 21, No. 3, 3rd Qtr. 1984, pp. 139–148.*

APPENDIX A
Capacity of Beam Web or Gusset Plate To Support Fillet Welds

The maximum effective weld size for fillets on both sides of a web or plate can be related to the web or plate thickness and the traditional method for doing so equates the maximum unit stress on the throat of the fillet to the maximum permitted shear stress in the web or plate. For E70XX electrodes,

$$\frac{1}{\sqrt{2}} \times 21 \times \frac{N}{16} \times 2 = .4 \times F_y \times t_r$$

and the required web or plate thickness t_r can be determined as

$$t_r = \frac{1.856N}{.4F_y}$$

where N is the number of 16ths of fillet weld on each side of the web or plate. It is customary to base t_r for A36 steel on a shear stress of 14.5 ksi rather than .4 × 36 = 14.4 ksi.

To fully use the capacity of a weld of N 16ths, the web or plate thickness t_w must equal or exceed t_r. Defining a proration factor $\rho = t_w/t_r$, $\rho \leq 1$, it is customary to reduce weld capacity (multiply by ρ) or to increase applied loads (divide by ρ), whenever $\rho < 1$. This will insure that the web or plate stress under the weld will nowhere exceed $.4F_y$. An alternate, less conservative, method to assess web or plate strength under fillet welds is given in Ref. 3.

Table 1A. C-shaped Weld, 3-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	11.9	11.8	12.0	12.2	12.4	12.9	13.5	14.5	15.8	16.3
8½	17.8	17.8	18.0	18.1	18.2	18.5	19.0	19.8	21.1	21.9
11½	23.4	23.3	23.6	23.9	24.0	24.2	24.5	25.3	26.6	27.4
14½	28.6	28.5	28.8	29.3	29.8	29.9	30.1	30.8	33.9	33.0
17½	33.6	33.5	33.8	34.6	35.6	35.7	35.8	36.4	39.5	38.6
20½	38.3	38.3	38.8	39.9	41.4	41.4	41.5	42.1	45.1	44.1
23½	43.0	43.0	43.6	45.5	47.2	47.1	47.2	47.8	50.6	49.7
26½	47.5	47.5	48.4	51.1	53.0	52.9	53.0	56.0	56.2	55.3
29½	51.9	52.0	53.2	56.6	58.8	58.7	58.8	61.6	61.8	60.8

Table 1B. C-shaped Weld, 3½-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	12.3	12.2	12.4	12.7	13.1	13.7	14.5	15.7	17.2	17.5
8½	18.3	18.3	18.5	18.6	18.9	19.3	19.9	20.9	22.9	23.1
11½	24.2	24.1	24.3	24.5	24.7	25.0	25.4	26.3	27.8	28.6
14½	29.5	29.4	29.7	30.2	30.4	30.7	31.0	31.7	35.3	34.2
17½	34.6	34.5	34.9	35.5	36.3	36.4	36.6	37.3	40.9	39.8
20½	39.6	39.5	39.9	40.9	42.0	42.0	42.3	42.9	46.5	45.3
23½	44.4	44.3	44.9	46.2	47.8	47.8	47.9	48.6	52.0	50.9
26½	49.0	49.0	49.7	51.8	53.6	53.6	53.6	54.3	57.6	56.5
29½	53.6	53.6	54.5	57.4	59.5	59.4	59.4	60.1	63.2	62.0

Table 1C. C-shaped Weld, 4-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	12.7	12.7	12.9	13.2	13.8	14.5	15.5	16.9	18.6	18.7
8½	18.8	18.8	19.0	19.2	19.5	20.0	20.8	22.0	23.7	24.3
11½	24.8	24.7	24.9	25.1	25.3	25.7	26.3	27.3	29.0	29.8
14½	30.3	30.3	30.5	30.9	31.1	31.4	31.9	32.7	34.5	35.4
17½	35.6	35.5	35.8	36.4	36.9	37.1	37.4	38.3	42.3	41.0
20½	40.7	40.6	40.9	41.8	42.8	42.8	43.0	43.8	47.9	46.6
23½	45.6	45.5	46.0	47.1	48.5	48.5	48.6	49.5	53.4	52.1
26½	50.4	50.3	50.9	52.4	54.3	54.2	54.3	55.1	59.0	57.7
29½	55.0	55.0	55.8	58.0	60.1	60.0	60.1	60.8	64.6	63.3

Table 1D. C-shaped Weld, 5-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	13.5	13.5	13.8	14.4	15.1	16.2	17.6	19.4	21.5	21.1
8½	19.6	19.6	19.9	20.3	20.8	21.6	22.7	24.3	26.5	26.7
11½	25.8	25.8	26.0	26.3	26.6	27.2	28.1	29.6	31.6	32.3
14½	31.6	31.6	31.8	32.2	32.4	32.9	33.6	34.9	36.9	37.8
17½	37.3	37.2	37.5	38.0	38.2	38.6	39.1	40.2	42.5	43.4
20½	42.5	42.5	42.8	43.5	44.0	44.3	44.7	45.8	50.6	49.0
23½	47.7	47.6	48.0	48.9	49.8	49.9	50.3	51.3	56.2	54.6
26½	52.7	52.6	53.1	54.3	55.6	55.6	55.9	56.8	61.8	60.1
29½	57.6	57.5	58.1	59.6	61.4	61.4	61.6	62.5	67.4	65.7

Table 1E. C-shaped Weld, 6-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	14.4	14.5	14.8	15.5	16.5	17.9	19.7	22.0	24.5	23.6
8½	20.4	20.4	20.8	21.3	22.2	23.2	24.8	26.8	29.3	29.1
11½	26.7	26.6	26.9	27.4	27.9	28.8	30.0	31.8	34.3	34.7
14½	32.7	32.7	32.9	33.4	33.7	34.4	35.4	37.1	39.6	40.3
17½	38.6	38.5	38.8	39.3	39.5	40.0	40.9	42.4	44.8	45.8
20½	44.1	44.1	44.4	45.0	45.3	45.7	46.4	47.9	50.3	51.4
23½	49.5	49.4	49.8	50.6	51.1	51.4	51.9	53.3	59.0	57.0
26½	54.7	54.6	55.1	56.0	57.0	57.2	57.6	58.8	64.6	62.5
29½	59.8	59.7	60.2	61.4	62.8	62.8	63.2	64.4	70.2	68.1

Table 2A. L-shaped Weld, 3-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	7.39	7.04	6.84	6.79	6.89	7.13	7.54	8.21	9.15	10.5
8½	12.9	12.4	12.0	11.8	11.7	11.9	12.2	12.9	13.9	15.4
11½	18.8	18.1	17.6	17.2	17.0	17.1	17.3	17.9	19.0	20.6
14½	24.0	23.7	23.2	22.7	22.5	22.4	22.6	23.1	24.2	25.9
17½	29.1	29.0	28.8	28.4	28.1	27.9	28.0	28.4	29.5	31.5
20½	34.0	33.9	33.9	34.0	33.7	33.5	33.4	33.8	34.9	36.9
23½	38.7	38.7	38.9	39.5	39.4	39.2	39.0	39.3	40.3	42.6
26½	43.3	43.4	43.9	44.7	45.2	44.8	44.5	44.8	45.7	48.4
29½	47.7	48.0	48.8	50.0	51.0	50.5	50.1	50.3	51.4	56.5

Table 2B. L-shaped Weld, 3½-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	7.24	6.91	6.74	6.72	6.85	7.15	7.64	8.40	9.45	11.0
8½	12.6	12.0	11.6	11.4	11.4	11.6	12.1	12.8	14.0	15.7
11½	18.4	17.6	17.0	16.7	16.5	16.6	17.0	17.7	18.9	20.7
14½	24.0	23.4	22.7	22.2	21.9	21.9	22.2	22.8	24.0	25.9
17½	29.1	28.9	28.3	27.8	27.5	27.3	27.5	28.0	29.3	31.3
20½	34.2	34.1	33.8	33.4	33.0	32.8	32.9	33.4	34.6	36.9
23½	39.1	39.0	39.0	39.0	38.7	38.4	38.3	38.7	40.0	42.3
26½	43.8	43.8	44.0	44.6	44.3	44.0	43.8	44.2	45.4	47.9
29½	48.5	48.5	49.0	49.8	50.1	49.7	49.4	49.7	50.8	53.6

Table 2C. L-shaped Weld, 4-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	7.16	6.87	6.73	6.75	6.92	7.27	7.84	8.68	9.88	11.6
8½	12.3	11.7	11.3	11.1	11.2	11.5	12.0	12.9	14.1	16.0
11½	18.0	17.2	16.6	16.2	16.1	16.3	16.8	17.6	18.9	20.9
14½	23.8	22.9	22.1	21.7	21.4	21.5	21.8	22.6	24.0	26.1
17½	29.1	28.6	27.8	27.2	26.9	26.8	27.0	27.7	29.1	31.4
20½	34.3	34.0	33.4	32.8	32.4	32.2	32.4	33.0	34.4	36.7
23½	39.3	39.2	38.9	38.4	38.0	37.7	37.7	38.3	39.7	42.2
26½	44.2	44.1	44.0	44.1	43.6	43.4	43.2	43.7	45.0	47.7
29½	49.0	49.0	49.1	49.7	49.3	48.9	48.7	49.1	50.4	53.3

Table 2D. L-shaped Weld, 5-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	7.16	6.95	6.92	6.99	7.25	7.72	8.41	9.45	10.9	13.0
8½	11.8	11.2	10.9	10.9	11.0	11.4	12.1	13.2	14.7	17.0
11½	17.2	16.4	15.8	15.5	15.6	15.9	16.5	17.6	19.2	21.5
14½	23.0	21.9	21.1	20.7	20.6	20.7	21.3	22.4	24.0	26.4
17½	28.8	27.6	26.7	26.1	25.8	25.9	26.3	27.3	28.9	31.5
20½	34.2	33.4	32.4	31.7	31.2	31.2	31.5	32.4	34.1	36.7
23½	39.4	38.9	38.0	37.2	36.7	36.5	36.8	37.6	39.3	42.1
26½	44.5	44.2	43.7	42.9	42.2	42.0	42.1	42.8	44.6	47.5
29½	49.6	49.3	49.0	48.5	47.9	47.5	47.5	48.1	49.9	53.0

Table 2E. L-shaped Weld, 6-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	7.35	7.18	7.19	7.37	7.76	8.34	9.18	10.4	12.2	14.6
8½	11.5	11.1	10.9	10.8	11.1	11.6	12.5	13.7	15.5	18.1
11½	16.6	15.8	15.3	15.1	15.3	15.7	16.5	17.8	19.7	22.3
14½	22.2	21.1	20.4	20.0	19.9	20.3	21.0	22.3	24.2	27.0
17½	28.0	26.7	25.7	25.2	25.0	25.2	25.8	27.1	29.0	31.9
20½	33.7	32.4	31.3	30.6	30.2	30.3	30.8	32.0	34.0	37.0
23½	39.2	38.2	37.0	36.1	35.6	35.6	36.0	37.0	39.1	42.3
26½	44.5	43.8	42.6	41.6	41.1	40.9	41.2	42.3	44.3	47.4
29½	49.7	49.2	48.3	47.3	46.6	46.3	46.6	47.5	49.5	52.8

Table 3A. Line Weld, 3-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	3.97	3.96	4.03	4.21	4.50	4.93	5.56	6.49	7.84	10.2
8½	8.63	8.60	8.61	8.84	9.18	9.75	10.5	11.6	13.3	15.8
11½	14.1	13.9	13.8	14.0	14.4	15.0	15.8	17.0	18.8	21.3
14½	19.7	19.4	19.3	19.4	19.8	20.4	21.2	22.4	24.4	26.9
17½	25.4	25.0	24.8	24.9	25.3	25.9	26.8	28.0	31.8	32.5
20½	30.9	30.4	30.2	30.4	30.8	31.6	32.5	33.7	37.4	38.1
23½	36.5	35.8	35.6	35.9	36.5	37.4	38.1	39.4	43.0	43.6
26½	41.8	41.1	40.9	41.5	42.5	43.2	43.9	45.1	48.6	49.2
29½	47.2	46.3	46.2	47.2	48.4	49.0	49.6	51.0	54.2	54.8

Table 3B. Line Weld, 3½-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	3.47	3.47	3.55	3.72	4.02	4.46	5.10	6.07	7.54	10.2
8½	7.72	7.71	7.78	8.01	8.41	9.02	9.90	11.1	12.9	15.8
11½	12.9	12.8	12.8	13.0	13.4	14.1	15.0	16.4	18.4	21.3
14½	18.5	18.2	18.1	18.3	18.7	19.4	20.4	21.8	23.9	26.9
17½	24.2	23.7	23.6	23.7	24.1	24.9	25.9	27.2	29.7	32.5
20½	29.8	29.3	29.1	29.2	29.6	30.4	31.5	32.9	37.2	38.1
23½	35.4	34.7	34.5	34.7	35.2	36.1	37.1	38.6	42.9	43.6
26½	40.8	40.1	39.9	40.2	40.9	41.8	42.7	44.2	48.5	49.2
29½	46.3	45.4	45.2	45.7	46.8	47.6	48.6	49.9	54.1	54.8

Table 3C. Line Weld, 4-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	3.07	3.08	3.16	3.32	3.62	4.06	4.71	5.70	7.27	10.2
8½	6.95	6.95	7.05	7.29	7.74	8.36	9.31	10.6	12.6	15.8
11½	11.9	11.7	11.8	12.1	12.5	13.3	14.4	15.8	18.0	21.3
14½	17.2	17.0	17.0	17.2	17.7	18.5	19.6	21.2	23.6	26.9
17½	22.9	22.5	22.4	22.6	23.1	23.8	25.0	26.6	29.1	32.5
20½	28.5	28.1	27.9	28.0	28.5	29.3	30.5	32.1	34.8	38.1
23½	34.2	33.6	33.3	33.5	34.0	34.9	36.1	37.7	42.7	43.6
26½	39.7	39.1	38.8	39.0	39.6	40.6	41.8	43.4	48.3	49.2
29½	45.3	44.5	44.2	44.4	45.3	46.3	47.4	49.1	54.0	54.8

Table 3D. Line Weld, 5-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	2.49	2.50	2.58	2.74	3.01	3.42	4.06	5.06	6.80	10.2
8½	5.75	5.77	5.90	6.16	6.62	7.30	8.29	9.75	11.9	15.8
11½	10.1	9.99	10.1	10.4	11.0	11.9	13.1	14.8	17.3	21.3
14½	15.0	14.9	15.0	15.3	15.9	16.8	18.2	20.0	22.7	26.9
17½	20.5	20.2	20.2	20.4	21.0	22.0	23.4	25.4	28.3	32.5
20½	26.0	25.7	25.5	25.8	26.4	27.3	28.8	30.8	33.9	38.1
23½	31.7	31.2	31.0	31.2	31.8	32.8	34.3	36.3	39.5	43.6
26½	37.3	36.7	36.5	36.6	37.2	38.3	39.8	41.8	45.2	49.2
29½	43.0	42.3	41.9	42.1	42.8	43.8	45.4	47.4	53.6	54.8

Table 3E. Line Weld, 6-in. Angle Leg

ℓ \ ϕ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5½	2.09	2.10	2.18	2.32	2.57	2.95	3.55	4.55	6.33	10.2
8½	4.89	4.91	5.05	5.32	5.76	6.44	7.44	8.99	11.4	15.8
11½	8.69	8.64	8.82	9.17	9.77	10.7	12.0	13.9	16.6	21.3
14½	13.2	13.1	13.3	13.6	14.3	15.4	16.9	19.0	22.0	26.9
17½	18.3	18.1	18.2	18.5	19.3	20.4	22.0	24.2	27.4	32.5
20½	23.6	23.3	23.3	23.7	24.4	25.6	27.2	29.5	33.0	38.1
23½	29.2	28.8	28.7	29.0	29.7	30.9	32.5	35.0	38.6	43.6
26½	34.8	34.3	34.1	34.3	35.0	36.2	38.0	40.5	44.2	49.2
29½	40.5	39.8	39.6	39.8	40.5	41.7	43.5	45.8	49.9	54.8

Table 4A. C-shaped Weld, 3-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	11.9 / 0.0	11.6 / 2.05	11.2 / 4.09	10.5 / 6.08	9.53 / 8.00	8.28 / 9.86	6.77 / 11.7	4.95 / 13.6	2.75 / 15.6	0.0 / 16.3
8½	17.8 / 0.0	17.5 / 3.09	16.9 / 6.14	15.6 / 9.03	13.9 / 11.7	11.9 / 14.2	9.51 / 16.5	6.78 / 18.6	3.66 / 20.8	0.0 / 21.9
11½	23.4 / 0.0	23.0 / 4.05	22.1 / 8.06	20.7 / 11.9	18.4 / 15.4	15.6 / 18.6	12.3 / 21.2	8.65 / 23.8	4.62 / 26.2	0.0 / 27.4
14½	28.6 / 0.0	28.1 / 4.95	27.0 / 9.84	25.4 / 14.6	22.8 / 19.1	19.2 / 22.9	15.1 / 26.1	10.5 / 29.0	5.88 / 33.4	0.0 / 33.0
17½	33.6 / 0.0	33.0 / 5.82	31.8 / 11.6	30.0 / 17.3	27.3 / 22.9	22.9 / 27.3	17.9 / 31.0	12.5 / 34.2	6.85 / 38.9	0.0 / 38.6
20½	38.3 / 0.0	37.7 / 6.65	36.4 / 13.3	34.6 / 20.0	31.7 / 26.6	26.6 / 31.7	20.7 / 35.9	14.4 / 39.6	7.83 / 44.4	0.0 / 44.1
23½	43.0 / 0.0	42.3 / 7.46	41.0 / 14.9	39.4 / 22.8	36.1 / 30.3	30.3 / 36.1	23.6 / 40.9	16.4 / 44.9	8.80 / 49.9	0.0 / 49.7
26½	47.5 / 0.0	46.8 / 8.25	45.5 / 16.6	44.3 / 25.6	40.6 / 34.1	34.0 / 40.5	26.5 / 45.9	19.2 / 52.6	9.76 / 55.4	0.0 / 55.3
29½	51.9 / 0.0	51.2 / 9.03	50.0 / 18.2	49.0 / 28.3	45.1 / 37.8	37.7 / 45.0	29.4 / 50.9	21.1 / 57.9	10.7 / 60.9	0.0 / 60.8

Table 4B. C-shaped Weld, 3½-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	12.3 / 0.0	12.1 / 2.13	11.7 / 4.25	11.0 / 6.34	10.0 / 8.43	8.79 / 10.5	7.27 / 12.6	5.35 / 14.7	2.99 / 16.9	0.0 / 17.5
8½	18.3 / 0.0	18.0 / 3.18	17.4 / 6.33	16.1 / 9.32	14.4 / 12.1	12.4 / 14.8	9.97 / 17.3	7.16 / 19.7	3.98 / 22.6	0.0 / 23.1
11½	24.2 / 0.0	23.7 / 4.18	22.8 / 8.30	21.2 / 12.3	18.9 / 15.9	16.0 / 19.1	12.7 / 22.0	8.98 / 24.7	4.82 / 27.3	0.0 / 28.6
14½	29.5 / 0.0	29.0 / 5.11	27.9 / 10.2	26.1 / 15.1	23.3 / 19.6	19.7 / 23.5	15.5 / 26.8	10.8 / 29.8	6.13 / 34.7	0.0 / 34.2
17½	34.6 / 0.0	34.0 / 6.00	32.8 / 11.9	30.8 / 17.8	27.8 / 23.3	23.4 / 27.9	18.3 / 31.7	12.8 / 35.1	7.10 / 40.2	0.0 / 39.8
20½	39.6 / 0.0	38.9 / 6.86	37.5 / 13.6	35.4 / 20.4	32.2 / 27.0	27.0 / 32.2	21.1 / 36.6	14.7 / 40.3	8.07 / 45.8	0.0 / 45.3
23½	44.4 / 0.0	43.6 / 7.69	42.1 / 15.3	40.0 / 23.1	36.6 / 30.7	30.7 / 36.6	24.0 / 41.5	16.6 / 45.7	9.04 / 51.3	0.0 / 50.9
26½	49.0 / 0.0	48.2 / 8.51	46.7 / 17.0	44.8 / 25.9	41.1 / 34.5	34.4 / 41.0	26.8 / 46.4	18.6 / 51.0	10.0 / 56.8	0.0 / 56.5
29½	53.6 / 0.0	52.7 / 9.30	51.2 / 18.6	49.7 / 28.7	45.5 / 38.2	38.2 / 45.5	29.7 / 51.4	20.6 / 56.5	11.0 / 62.3	0.0 / 62.0

Table 4C. C-shaped Weld, 4-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	12.7 / 0.0	12.5 / 2.20	12.1 / 4.41	11.5 / 6.62	10.6 / 8.88	9.32 / 11.1	7.77 / 13.5	5.78 / 15.9	3.23 / 18.3	0.0 / 18.7
8½	18.8 / 0.0	18.5 / 3.27	17.8 / 6.50	16.6 / 9.61	14.9 / 12.5	12.9 / 15.4	10.4 / 18.0	7.54 / 20.7	4.12 / 23.3	0.0 / 24.3
11½	24.8 / 0.0	24.3 / 4.29	23.4 / 8.51	21.8 / 12.6	19.4 / 16.3	16.5 / 19.7	13.1 / 22.8	9.35 / 25.7	5.04 / 28.6	0.0 / 29.8
14½	30.3 / 0.0	29.8 / 5.25	28.7 / 10.4	26.8 / 15.5	23.8 / 20.0	20.2 / 24.0	15.9 / 27.6	11.2 / 30.8	5.99 / 34.0	0.0 / 35.4
17½	35.6 / 0.0	35.0 / 6.17	33.7 / 12.3	31.5 / 18.2	28.3 / 23.7	23.8 / 28.4	18.7 / 32.4	13.1 / 36.0	7.34 / 41.6	0.0 / 41.0
20½	40.7 / 0.0	40.0 / 7.05	38.5 / 14.0	36.2 / 20.9	32.8 / 27.5	27.5 / 32.8	21.5 / 37.2	15.0 / 41.2	8.31 / 47.1	0.0 / 46.6
23½	45.6 / 0.0	44.8 / 7.90	43.2 / 15.7	40.8 / 23.5	37.1 / 31.2	31.2 / 37.1	24.3 / 42.1	16.9 / 46.5	9.28 / 52.6	0.0 / 52.1
26½	50.4 / 0.0	49.5 / 8.73	47.8 / 17.4	45.4 / 26.2	41.6 / 34.9	34.9 / 41.5	27.2 / 47.1	18.8 / 51.8	10.2 / 58.1	0.0 / 57.7
29½	55.0 / 0.0	54.2 / 9.55	52.4 / 19.1	50.2 / 29.0	46.0 / 38.6	38.6 / 45.9	30.0 / 52.0	20.8 / 57.1	11.2 / 63.6	0.0 / 63.3

Table 4D. C-shaped Weld, 5-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	13.5 / 0.0	13.3 / 2.35	13.0 / 4.73	12.4 / 7.18	11.6 / 9.73	10.4 / 12.4	8.78 / 15.2	6.63 / 18.2	3.73 / 21.2	0.0 / 21.1
8½	19.6 / 0.0	19.3 / 3.41	18.7 / 6.81	17.6 / 10.1	16.0 / 13.4	13.9 / 16.6	11.4 / 19.7	8.32 / 22.9	4.60 / 26.1	0.0 / 26.7
11½	25.8 / 0.0	25.4 / 4.47	24.4 / 8.88	22.8 / 13.1	20.4 / 17.1	17.5 / 20.8	14.1 / 24.4	10.1 / 27.8	5.50 / 31.2	0.0 / 32.3
14½	31.6 / 0.0	31.1 / 5.49	29.9 / 10.9	27.9 / 16.1	24.8 / 20.8	21.2 / 25.2	16.8 / 29.1	11.9 / 32.8	6.41 / 36.4	0.0 / 37.8
17½	37.3 / 0.0	36.6 / 6.45	35.2 / 12.8	32.9 / 19.0	29.3 / 24.6	24.8 / 29.5	19.6 / 33.9	13.8 / 37.8	7.37 / 41.8	0.0 / 43.4
20½	42.5 / 0.0	41.8 / 7.38	40.3 / 14.7	37.7 / 21.8	33.7 / 28.3	28.5 / 33.9	22.3 / 38.7	15.7 / 43.0	8.80 / 49.9	0.0 / 49.0
23½	47.7 / 0.0	46.9 / 8.27	45.1 / 16.4	42.4 / 24.4	38.2 / 32.0	32.1 / 38.3	25.2 / 43.6	17.5 / 48.2	9.77 / 55.4	0.0 / 54.6
26½	52.7 / 0.0	51.8 / 9.14	49.9 / 18.2	47.0 / 27.1	42.6 / 35.8	35.8 / 42.6	27.9 / 48.4	19.4 / 53.4	10.7 / 60.9	0.0 / 60.1
29½	57.6 / 0.0	56.6 / 9.99	54.6 / 19.9	51.6 / 29.8	47.1 / 39.5	39.5 / 47.0	30.8 / 53.3	21.4 / 58.7	11.7 / 66.4	0.0 / 65.7

Table 4E. C-shaped Weld, 6-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	14.4 / 0.0	14.2 / 2.51	13.9 / 5.07	13.4 / 7.74	12.6 / 10.6	11.5 / 13.7	9.88 / 17.1	7.51 / 20.6	4.25 / 24.1	0.0 / 23.6
8½	20.4 / 0.0	20.1 / 3.55	19.5 / 7.10	18.5 / 10.7	17.0 / 14.3	14.9 / 17.8	12.4 / 21.4	9.15 / 25.1	5.08 / 28.8	0.0 / 29.1
11½	26.7 / 0.0	26.2 / 4.62	25.3 / 9.20	23.7 / 13.7	21.4 / 17.9	18.5 / 22.0	15.0 / 26.0	10.9 / 29.9	5.97 / 33.8	0.0 / 34.7
14½	32.7 / 0.0	32.2 / 5.68	30.9 / 11.3	28.9 / 16.7	25.8 / 21.7	22.1 / 26.4	17.7 / 30.7	12.7 / 34.8	6.88 / 39.0	0.0 / 40.3
17½	38.6 / 0.0	37.9 / 6.68	36.4 / 13.3	34.0 / 19.6	30.3 / 25.4	25.7 / 30.7	20.5 / 35.4	14.5 / 39.8	7.79 / 44.2	0.0 / 45.8
20½	44.1 / 0.0	43.4 / 7.65	41.7 / 15.2	39.0 / 22.5	34.7 / 29.1	29.4 / 35.0	23.2 / 40.2	16.4 / 45.0	8.73 / 49.5	0.0 / 51.4
23½	49.5 / 0.0	48.7 / 8.58	46.8 / 17.0	43.8 / 25.3	39.2 / 32.9	33.1 / 39.4	26.0 / 45.0	18.2 / 50.1	10.2 / 58.1	0.0 / 57.0
26½	54.7 / 0.0	53.8 / 9.48	51.8 / 18.8	48.5 / 28.0	43.7 / 36.6	36.7 / 43.8	28.8 / 49.9	20.1 / 55.3	11.2 / 63.7	0.0 / 62.5
29½	59.8 / 0.0	58.8 / 10.4	56.6 / 20.6	53.2 / 30.7	48.1 / 40.4	40.4 / 48.1	31.6 / 54.8	22.0 / 60.6	12.2 / 69.2	0.0 / 68.1

Table 5A. L-shaped Weld, 3-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	7.39 / 0.0	6.94 / 1.22	6.43 / 2.34	5.88 / 3.40	5.27 / 4.43	4.58 / 5.46	3.77 / 6.53	2.81 / 7.72	1.59 / 9.01	0.0 / 10.5
8½	12.9 / 0.0	12.2 / 2.15	11.3 / 4.10	10.2 / 5.89	8.98 / 7.53	7.63 / 9.10	6.12 / 10.6	4.40 / 12.1	2.41 / 13.7	0.0 / 15.4
11½	18.8 / 0.0	17.8 / 3.15	16.5 / 6.01	14.9 / 8.60	13.0 / 10.9	11.0 / 13.1	8.67 / 15.0	6.16 / 16.8	3.30 / 18.7	0.0 / 20.6
14½	24.0 / 0.0	23.4 / 4.12	21.8 / 7.94	19.7 / 11.4	17.2 / 14.5	14.4 / 17.2	11.3 / 19.6	7.92 / 21.7	4.20 / 23.8	0.0 / 25.9
17½	29.1 / 0.0	28.5 / 5.03	27.1 / 9.85	24.6 / 14.2	21.5 / 18.1	18.0 / 21.4	14.0 / 24.2	9.73 / 26.7	5.13 / 29.1	0.0 / 31.5
20½	34.0 / 0.0	33.4 / 5.89	31.9 / 11.6	29.4 / 17.0	25.8 / 21.7	21.5 / 25.7	16.7 / 28.9	11.6 / 31.8	6.06 / 34.4	0.0 / 36.9
23½	38.7 / 0.0	38.1 / 6.72	36.6 / 13.3	34.2 / 19.8	30.2 / 25.3	25.2 / 30.0	19.5 / 33.8	13.4 / 36.9	7.01 / 39.7	0.0 / 42.6
26½	43.3 / 0.0	42.7 / 7.53	41.2 / 15.0	38.7 / 22.3	34.6 / 29.1	28.8 / 34.3	22.3 / 38.6	15.3 / 42.1	7.94 / 45.0	0.0 / 48.4
29½	47.7 / 0.0	47.2 / 8.33	45.9 / 16.7	43.3 / 25.0	39.0 / 32.8	32.5 / 38.7	25.1 / 43.4	17.2 / 47.2	8.92 / 50.6	0.0 / 56.5

Table 5B. L-shaped Weld, 3½-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	7.24 / 0.0	6.80 / 1.20	6.33 / 2.30	5.82 / 3.36	5.25 / 4.41	4.59 / 5.47	3.82 / 6.62	2.87 / 7.89	1.64 / 9.31	0.0 / 11.0
8½	12.6 / 0.0	11.8 / 2.08	10.9 / 3.97	9.88 / 5.70	8.74 / 7.33	7.47 / 8.91	6.04 / 10.5	4.39 / 12.1	2.43 / 13.8	0.0 / 15.7
11½	18.4 / 0.0	17.4 / 3.06	16.0 / 5.83	14.4 / 8.34	12.7 / 10.6	10.7 / 12.7	8.50 / 14.7	6.07 / 16.7	3.29 / 18.6	0.0 / 20.7
14½	24.0 / 0.0	23.0 / 4.06	21.3 / 7.76	19.2 / 11.1	16.8 / 14.1	14.1 / 16.8	11.1 / 19.2	7.81 / 21.5	4.17 / 23.7	0.0 / 25.9
17½	29.1 / 0.0	28.4 / 5.01	26.6 / 9.69	24.1 / 13.9	21.0 / 17.7	17.6 / 20.9	13.7 / 23.8	9.59 / 26.3	5.08 / 28.8	0.0 / 31.3
20½	34.2 / 0.0	33.5 / 5.92	31.8 / 11.6	28.9 / 16.7	25.3 / 21.2	21.1 / 25.2	16.4 / 28.5	11.4 / 31.4	6.01 / 34.1	0.0 / 36.9
23½	39.1 / 0.0	38.4 / 6.78	36.6 / 13.3	33.8 / 19.5	29.6 / 24.9	24.7 / 29.4	19.2 / 33.2	13.2 / 36.4	6.95 / 39.4	0.0 / 42.3
26½	43.8 / 0.0	43.2 / 7.61	41.4 / 15.1	38.7 / 22.3	34.0 / 28.5	28.3 / 33.7	21.9 / 37.9	15.1 / 41.5	7.88 / 44.7	0.0 / 47.9
29½	48.5 / 0.0	47.8 / 8.43	46.1 / 16.8	43.1 / 24.9	38.4 / 32.2	31.9 / 38.1	24.7 / 42.8	17.0 / 46.7	8.82 / 50.0	0.0 / 53.6

Table 5C. L-shaped Weld, 4-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	7.16 / 0.0	6.77 / 1.19	6.33 / 2.30	5.85 / 3.38	5.30 / 4.45	4.67 / 5.57	3.92 / 6.79	2.97 / 8.16	1.72 / 9.73	0.0 / 11.6
8½	12.3 / 0.0	11.5 / 2.03	10.6 / 3.86	9.66 / 5.58	8.58 / 7.20	7.38 / 8.80	6.01 / 10.4	4.41 / 12.1	2.46 / 13.9	0.0 / 16.0
11½	18.0 / 0.0	16.9 / 2.98	15.6 / 5.67	14.1 / 8.12	12.4 / 10.4	10.5 / 12.5	8.39 / 14.5	6.02 / 16.5	3.29 / 18.6	0.0 / 20.9
14½	23.8 / 0.0	22.5 / 3.97	20.8 / 7.57	18.7 / 10.8	16.4 / 13.8	13.8 / 16.4	10.9 / 18.9	7.72 / 21.2	4.16 / 23.6	0.0 / 26.1
17½	29.1 / 0.0	28.2 / 4.97	26.1 / 9.51	23.5 / 13.6	20.6 / 17.3	17.2 / 20.5	13.5 / 23.4	9.48 / 26.0	5.06 / 28.7	0.0 / 31.4
20½	34.3 / 0.0	33.5 / 5.90	31.4 / 11.4	28.4 / 16.4	24.8 / 20.8	20.7 / 24.7	16.2 / 28.0	11.3 / 31.0	5.97 / 33.8	0.0 / 36.7
23½	39.3 / 0.0	38.6 / 6.80	36.6 / 13.3	33.3 / 19.2	29.1 / 24.4	24.3 / 28.9	18.9 / 32.7	13.1 / 36.0	6.90 / 39.1	0.0 / 42.2
26½	44.2 / 0.0	43.4 / 7.66	41.4 / 15.1	38.2 / 22.0	33.4 / 28.0	27.9 / 33.2	21.6 / 37.4	14.9 / 41.1	7.82 / 44.3	0.0 / 47.7
29½	49.0 / 0.0	48.2 / 8.50	46.2 / 16.8	43.0 / 24.8	37.7 / 31.7	31.4 / 37.4	24.3 / 42.2	16.8 / 46.1	8.76 / 49.7	0.0 / 53.3

Table 5D. L-shaped Weld, 5-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	7.16 / 0.0	6.85 / 1.21	6.51 / 2.37	6.06 / 3.50	5.55 / 4.66	4.96 / 5.91	4.21 / 7.29	3.23 / 8.88	1.90 / 10.8	0.0 / 13.0
8½	11.8 / 0.0	11.1 / 1.95	10.3 / 3.74	9.40 / 5.43	8.44 / 7.08	7.35 / 8.76	6.06 / 10.5	4.52 / 12.4	2.56 / 14.5	0.0 / 17.0
11½	17.2 / 0.0	16.1 / 2.84	14.9 / 5.41	13.5 / 7.77	11.9 / 10.0	10.2 / 12.2	8.26 / 14.3	6.02 / 16.5	3.33 / 18.9	0.0 / 21.5
14½	23.0 / 0.0	21.6 / 3.81	19.9 / 7.24	17.9 / 10.4	15.8 / 13.2	13.3 / 15.9	10.7 / 18.5	7.65 / 21.0	4.16 / 23.6	0.0 / 26.4
17½	28.8 / 0.0	27.2 / 4.80	25.1 / 9.14	22.6 / 13.0	19.8 / 16.6	16.6 / 19.8	13.2 / 22.8	9.35 / 25.7	5.03 / 28.5	0.0 / 31.5
20½	34.2 / 0.0	32.9 / 5.80	30.4 / 11.1	27.4 / 15.8	23.9 / 20.1	20.0 / 23.9	15.8 / 27.3	11.1 / 30.4	5.91 / 33.5	0.0 / 36.7
23½	39.4 / 0.0	38.3 / 6.76	35.7 / 13.0	32.2 / 18.6	28.1 / 23.6	23.5 / 28.0	18.4 / 31.9	12.8 / 35.3	6.82 / 38.7	0.0 / 42.1
26½	44.5 / 0.0	43.5 / 7.68	41.0 / 14.9	37.1 / 21.4	32.4 / 27.2	27.0 / 32.2	21.1 / 36.5	14.6 / 40.2	7.74 / 43.9	0.0 / 47.5
29½	49.6 / 0.0	48.6 / 8.57	46.1 / 16.8	42.0 / 24.2	36.7 / 30.8	30.5 / 36.4	23.7 / 41.1	16.5 / 45.2	8.67 / 49.2	0.0 / 53.0

Table 5E. L-shaped Weld, 6-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	7.35 / 0.0	7.07 / 1.25	6.75 / 2.46	6.39 / 3.69	5.94 / 4.99	5.36 / 6.39	4.59 / 7.95	3.56 / 9.78	2.12 / 12.0	0.0 / 14.6
8½	11.5 / 0.0	10.9 / 1.93	10.2 / 3.71	9.39 / 5.42	8.50 / 7.14	7.47 / 8.90	6.23 / 10.8	4.70 / 12.9	2.70 / 15.3	0.0 / 18.1
11½	16.6 / 0.0	15.6 / 2.75	14.4 / 5.25	13.1 / 7.57	11.7 / 9.81	10.1 / 12.0	8.26 / 14.3	6.09 / 16.7	3.41 / 19.4	0.0 / 22.3
14½	22.2 / 0.0	20.8 / 3.66	19.1 / 6.97	17.3 / 10.0	15.3 / 12.8	13.0 / 15.5	10.5 / 18.2	7.64 / 21.0	4.20 / 23.8	0.0 / 27.0
17½	28.0 / 0.0	26.3 / 4.63	24.2 / 8.80	21.8 / 12.6	19.1 / 16.1	16.2 / 19.3	12.9 / 22.4	9.26 / 25.4	5.04 / 28.6	0.0 / 31.9
20½	33.7 / 0.0	31.9 / 5.63	29.4 / 10.7	26.5 / 15.3	23.1 / 19.4	19.5 / 23.2	15.4 / 26.7	11.0 / 30.1	5.91 / 33.5	0.0 / 37.0
23½	39.2 / 0.0	37.6 / 6.63	34.7 / 12.6	31.3 / 18.0	27.3 / 22.9	22.9 / 27.2	18.0 / 31.2	12.7 / 34.8	6.79 / 38.5	0.0 / 42.3
26½	44.5 / 0.0	43.1 / 7.61	40.0 / 14.6	36.1 / 20.8	31.5 / 26.4	26.3 / 31.3	20.6 / 35.7	14.4 / 39.7	7.68 / 43.6	0.0 / 47.4
29½	49.7 / 0.0	48.4 / 8.54	45.4 / 16.5	40.9 / 23.6	35.7 / 30.0	29.8 / 35.5	23.4 / 40.3	16.2 / 44.6	8.59 / 48.7	0.0 / 52.8

Table 6A. Line Weld, 3-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	3.97 / 0.0	3.90 / 0.69	3.79 / 1.38	3.65 / 2.11	3.45 / 2.89	3.17 / 3.78	2.78 / 4.81	2.22 / 6.10	1.36 / 7.72	0.0 / 10.2
8½	8.63 / 0.0	8.47 / 1.49	8.10 / 2.95	7.65 / 4.42	7.03 / 5.90	6.27 / 7.47	5.27 / 9.12	3.98 / 10.9	2.31 / 13.1	0.0 / 15.8
11½	14.1 / 0.0	13.7 / 2.42	13.0 / 4.74	12.1 / 7.01	11.0 / 9.25	9.63 / 11.5	7.92 / 13.7	5.81 / 16.0	3.27 / 18.5	0.0 / 21.3
14½	19.7 / 0.0	19.2 / 3.38	18.2 / 6.62	16.8 / 9.72	15.1 / 12.7	13.1 / 15.6	10.6 / 18.4	7.68 / 21.1	4.25 / 24.1	0.0 / 26.9
17½	25.4 / 0.0	24.6 / 4.34	23.3 / 8.48	21.6 / 12.5	19.3 / 16.2	16.7 / 19.9	13.4 / 23.2	9.59 / 26.4	5.52 / 31.3	0.0 / 32.5
20½	30.9 / 0.0	30.0 / 5.28	28.4 / 10.3	26.3 / 15.2	23.6 / 19.8	20.3 / 24.2	16.2 / 28.1	11.5 / 31.6	6.50 / 36.9	0.0 / 38.1
23½	36.5 / 0.0	35.3 / 6.22	33.4 / 12.2	31.1 / 17.9	28.0 / 23.5	24.0 / 28.6	19.1 / 33.0	13.5 / 37.0	7.47 / 42.4	0.0 / 43.6
26½	41.8 / 0.0	40.4 / 7.13	38.4 / 14.0	35.9 / 20.7	32.5 / 27.3	27.7 / 33.1	22.0 / 38.0	15.4 / 42.4	8.45 / 47.9	0.0 / 49.2
29½	47.2 / 0.0	45.6 / 8.04	43.4 / 15.8	40.9 / 23.6	37.0 / 31.1	31.5 / 37.5	24.8 / 43.0	17.4 / 47.9	9.42 / 53.4	0.0 / 54.8

Table 6B. Line Weld, 3½-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	3.47 / 0.0	3.41 / 0.60	3.33 / 1.21	3.22 / 1.86	3.08 / 2.58	2.87 / 3.42	2.55 / 4.42	2.08 / 5.71	1.31 / 7.43	0.0 / 10.2
8½	7.72 / 0.0	7.59 / 1.34	7.31 / 2.66	6.93 / 4.00	6.44 / 5.41	5.80 / 6.91	4.95 / 8.58	3.81 / 10.5	2.25 / 12.7	0.0 / 15.8
11½	12.9 / 0.0	12.6 / 2.22	12.0 / 4.37	11.3 / 6.50	10.3 / 8.63	9.05 / 10.8	7.52 / 13.0	5.60 / 15.4	3.20 / 18.1	0.0 / 21.3
14½	18.5 / 0.0	17.9 / 3.16	17.0 / 6.20	15.8 / 9.15	14.3 / 12.0	12.5 / 14.9	10.2 / 17.7	7.47 / 20.5	4.16 / 23.6	0.0 / 26.9
17½	24.2 / 0.0	23.4 / 4.12	22.2 / 8.08	20.5 / 11.9	18.5 / 15.5	16.0 / 19.0	12.9 / 22.4	9.32 / 25.6	5.15 / 29.2	0.0 / 32.5
20½	29.8 / 0.0	28.8 / 5.08	27.3 / 9.94	25.3 / 14.6	22.7 / 19.1	19.5 / 23.3	15.7 / 27.2	11.2 / 30.9	6.47 / 36.7	0.0 / 38.1
23½	35.4 / 0.0	34.2 / 6.03	32.4 / 11.8	30.0 / 17.3	27.0 / 22.6	23.2 / 27.6	18.5 / 32.1	13.2 / 36.2	7.45 / 42.2	0.0 / 43.6
26½	40.8 / 0.0	39.5 / 6.97	37.5 / 13.6	34.8 / 20.1	31.3 / 26.3	26.9 / 32.0	21.4 / 37.0	15.1 / 41.5	8.42 / 47.8	0.0 / 49.2
29½	46.3 / 0.0	44.7 / 7.89	42.5 / 15.5	39.6 / 22.9	35.9 / 30.1	30.6 / 36.5	24.2 / 42.0	17.1 / 46.9	9.40 / 53.3	0.0 / 54.8

Table 6C. Line Weld, 4-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	3.07 / 0.0	3.03 / 0.53	2.97 / 1.08	2.88 / 1.66	2.77 / 2.33	2.61 / 3.11	2.35 / 4.08	1.95 / 5.36	1.26 / 7.16	0.0 / 10.2
8½	6.95 / 0.0	6.84 / 1.21	6.63 / 2.41	6.32 / 3.65	5.93 / 4.97	5.37 / 6.40	4.66 / 8.06	3.64 / 9.99	2.19 / 12.4	0.0 / 15.8
11½	11.9 / 0.0	11.6 / 2.04	11.1 / 4.04	10.4 / 6.04	9.59 / 8.05	8.54 / 10.2	7.18 / 12.4	5.42 / 14.9	3.12 / 17.7	0.0 / 21.3
14½	17.2 / 0.0	16.8 / 2.96	16.0 / 5.82	14.9 / 8.62	13.6 / 11.4	11.9 / 14.2	9.80 / 17.0	7.24 / 19.9	4.09 / 23.2	0.0 / 26.9
17½	22.9 / 0.0	22.2 / 3.92	21.1 / 7.67	19.6 / 11.3	17.7 / 14.8	15.3 / 18.3	12.5 / 21.6	9.11 / 25.0	5.06 / 28.7	0.0 / 32.5
20½	28.5 / 0.0	27.7 / 4.88	26.2 / 9.55	24.3 / 14.0	21.8 / 18.3	18.8 / 22.4	15.2 / 26.4	11.0 / 30.2	6.05 / 34.3	0.0 / 38.1
23½	34.2 / 0.0	33.1 / 5.84	31.3 / 11.4	29.0 / 16.7	26.1 / 21.9	22.4 / 26.7	18.0 / 31.3	12.9 / 35.5	7.42 / 42.1	0.0 / 43.6
26½	39.7 / 0.0	38.5 / 6.78	36.5 / 13.3	33.8 / 19.5	30.3 / 25.4	26.1 / 31.1	20.9 / 36.2	14.8 / 40.8	8.39 / 47.6	0.0 / 49.2
29½	45.3 / 0.0	43.8 / 7.72	41.5 / 15.1	38.5 / 22.2	34.7 / 29.1	29.8 / 35.5	23.7 / 41.0	16.8 / 46.1	9.37 / 53.1	0.0 / 54.8

Table 6D. Line Weld, 5-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	2.49 / 0.0	2.46 / 0.43	2.43 / 0.88	2.38 / 1.37	2.31 / 1.94	2.20 / 2.62	2.03 / 3.51	1.73 / 4.76	1.18 / 6.69	0.0 / 10.2
8½	5.75 / 0.0	5.68 / 1.00	5.54 / 2.02	5.34 / 3.08	5.07 / 4.25	4.69 / 5.59	4.15 / 7.18	3.34 / 9.16	2.07 / 11.8	0.0 / 15.8
11½	10.1 / 0.0	9.83 / 1.73	9.53 / 3.47	9.05 / 5.23	8.45 / 7.09	7.63 / 9.09	6.54 / 11.3	5.07 / 13.9	3.01 / 17.0	0.0 / 21.3
14½	15.0 / 0.0	14.7 / 2.59	14.1 / 5.13	13.3 / 7.65	12.2 / 10.2	10.8 / 12.9	9.09 / 15.7	6.86 / 18.8	3.95 / 22.4	0.0 / 26.9
17½	20.5 / 0.0	19.9 / 3.51	19.0 / 6.91	17.7 / 10.2	16.1 / 13.5	14.2 / 16.9	11.7 / 20.3	8.69 / 23.9	4.92 / 27.9	0.0 / 32.5
20½	26.0 / 0.0	25.3 / 4.46	24.0 / 8.74	22.3 / 12.9	20.2 / 16.9	17.6 / 20.9	14.4 / 24.9	10.5 / 28.9	5.88 / 33.4	0.0 / 38.1
23½	31.7 / 0.0	30.7 / 5.42	29.1 / 10.6	27.0 / 15.6	24.3 / 20.4	21.1 / 25.1	17.1 / 29.7	12.4 / 34.1	6.86 / 38.9	0.0 / 43.6
26½	37.3 / 0.0	36.2 / 6.38	34.3 / 12.5	31.7 / 18.3	28.5 / 23.9	24.6 / 29.3	19.9 / 34.5	14.3 / 39.3	7.84 / 44.5	0.0 / 49.2
29½	43.0 / 0.0	41.6 / 7.34	39.4 / 14.3	36.5 / 21.0	32.7 / 27.5	28.2 / 33.6	22.7 / 39.3	16.2 / 44.6	9.31 / 52.8	0.0 / 54.8

Table 6E. Line Weld, 6-in. Angle Leg

ℓ	SHEAR / AXIAL									
5½	2.09 / 0.0	2.07 / 0.37	2.05 / 0.74	2.01 / 1.16	1.97 / 1.65	1.90 / 2.26	1.78 / 3.08	1.55 / 4.27	1.10 / 6.24	0.0 / 10.2
8½	4.89 / 0.0	4.84 / 0.85	4.74 / 1.73	4.60 / 2.66	4.41 / 3.70	4.14 / 4.93	3.72 / 6.44	3.08 / 8.45	1.98 / 11.2	0.0 / 15.8
11½	8.69 / 0.0	8.51 / 1.50	8.30 / 3.02	7.94 / 4.58	7.49 / 6.28	6.85 / 8.17	5.99 / 10.4	4.75 / 13.0	2.89 / 16.4	0.0 / 21.3
14½	13.2 / 0.0	12.9 / 2.28	12.5 / 4.53	11.8 / 6.81	11.0 / 9.21	9.89 / 11.8	8.45 / 14.6	6.49 / 17.8	3.83 / 21.7	0.0 / 26.9
17½	18.3 / 0.0	17.8 / 3.14	17.1 / 6.21	16.0 / 9.27	14.7 / 12.4	13.1 / 15.6	11.0 / 19.1	8.29 / 22.8	4.76 / 27.0	0.0 / 32.5
20½	23.6 / 0.0	23.0 / 4.05	21.9 / 7.99	20.5 / 11.8	18.7 / 15.7	16.4 / 19.6	13.6 / 23.6	10.1 / 27.8	5.73 / 32.5	0.0 / 38.1
23½	29.2 / 0.0	28.3 / 5.00	27.0 / 9.81	25.1 / 14.5	22.7 / 19.1	19.8 / 23.6	16.3 / 28.2	12.0 / 32.9	6.70 / 38.0	0.0 / 43.6
26½	34.8 / 0.0	33.8 / 5.95	32.0 / 11.7	29.7 / 17.2	26.8 / 22.5	23.3 / 27.8	19.0 / 32.9	13.8 / 38.0	7.68 / 43.5	0.0 / 49.2
29½	40.5 / 0.0	39.2 / 6.92	37.2 / 13.5	34.5 / 19.9	31.0 / 26.0	26.8 / 31.9	21.7 / 37.6	15.6 / 43.0	8.66 / 49.1	0.0 / 54.8

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