

Fillet Weld Strength - Allowable per Inch, ASD

Allowable fillet weld shear per inch, ASD. Leg size (w) · Effective throat (t_e) · Electrode strength (F_{EXX}) · Effective length (L) · Safety factor (Ω)

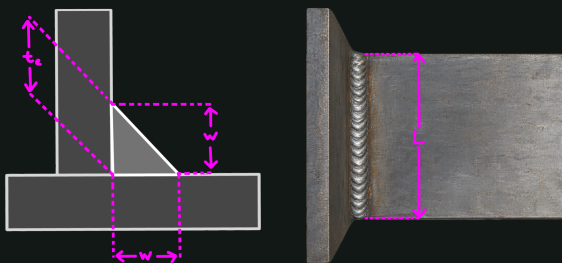
TECHNICAL NOTES

$$R_a = 0.60 \times F_{EXX} \times t_e \times L / \Omega$$

$$t_e = 0.707 \times w \quad R_n = 0.60 \times F_{EXX} \times t_e \times L \quad \Omega = 2.00$$

A fillet fails across its smallest section, the effective throat. For a standard 45° fillet that plane is 0.707 times the leg, so strength is referenced to the throat whatever leg size is called out. The limit state is shear on the throat at $0.60 \cdot F_{EXX}$. That is nominal; divide by $\Omega = 2.00$ for the ASD allowable and never size a weld off the nominal. F_{EXX} is the electrode classification strength in ksi; E70 is the structural default. Base-metal compatibility is set by the welding requirements, not by matching F_{EXX} to F_y or F_u .

LEG AND THROAT · PLAN VIEW



Left: equal-leg fillet in cross section, leg w and effective throat $t_e = 0.707w$, the shortest line from root to weld face. Right: the same T-joint in plan; L is the weld length. Unequal legs, deep-penetration fillets and groove welds are outside this sheet.

WORKED EXAMPLE: 1/4 IN E70 FILLET, 8 IN LONG

Given: $w = 0.25$ in · E70 ($F_{EXX} = 70$ ksi) · $L = 8$ in

1. $t_e = 0.707 \times 0.25 = 0.177$ in
2. $R_n = 0.60 \times 70 \times 0.177 = 7.42$ kip/in (nominal, per inch)
3. $R_a = 7.42 / 2.00 = 3.71$ kip/in (allowable, per inch)
4. $R_{a, \text{total}} = 3.71 \times 8 = 29.7$ kip

29.7 kip allowable on an 8 in run of 1/4 in E70. Two such welds give 59.4 kip only if they share the load as modelled, which is a connection assumption.

SIZE AND LENGTH LIMITS

Minimum size. The larger of what the force requires and the AISC minimum, which is set by the thinner connected part.

Maximum size. Under 1/4 in material, generally the thickness; 1/4 in and up, generally the thickness less 1/16 in, unless otherwise designated.

Effective length. Strength does not keep growing with length. Against weld size w :

- **$L < 4w$.** Full throat not developed; lengthen the weld or reduce the size assumed.
- **$L > 100w$.** End-loaded fillets peak at the ends; effective length is reduced.
- **$L > 300w$.** Effective length is held at a fixed value beyond this.

ALLOWABLE STRENGTH PER INCH, KIP/IN (ASD)

w (in)	t_e (in)	ELECTRODE F_{EXX} (KSI)						
		E60	E70	E80	E90	E100	E110	E120
1/8	0.088	1.59	1.86	2.12	2.39	2.65	2.92	3.18
3/16	0.133	2.39	2.78	3.18	3.58	3.98	4.37	4.77
1/4	0.177	3.18	3.71	4.24	4.77	5.30	5.83	6.36
5/16	0.221	3.98	4.64	5.30	5.97	6.63	7.29	7.95
3/8	0.265	4.77	5.57	6.36	7.16	7.95	8.75	9.54
7/16	0.309	5.57	6.50	7.42	8.35	9.28	10.21	11.14
1/2	0.353	6.36	7.42	8.48	9.54	10.60	11.67	12.73
5/8	0.442	7.95	9.28	10.60	11.93	13.26	14.58	15.91
3/4	0.530	9.54	11.14	12.73	14.32	15.91	17.50	19.09
7/8	0.619	11.14	12.99	14.85	16.70	18.56	20.41	22.27
1	0.707	12.73	14.85	16.97	19.09	21.21	23.33	25.45
1-1/8	0.795	14.32	16.70	19.09	21.48	23.86	26.25	28.63
1-1/4	0.884	15.91	18.56	21.21	23.86	26.51	29.16	31.81
1-3/8	0.972	17.50	20.41	23.33	26.25	29.16	32.08	35.00
1-1/2	1.060	19.09	22.27	25.45	28.63	31.82	35.00	38.18

R_a per inch = $0.60 \times F_{EXX} \times 0.707w / 2.00$, static, standard 45° fillet. AISC allows up to 50% more on transverse welds; not taken here. Multiply by effective length for total strength. Dashed box: E70, the structural default; 1/4 in row is the worked example. Connected material is checked separately and can govern.

FIELD NOTES

- **Balance the group.** Place welds symmetrically about the load line where possible. Where eccentricity, moment or torsion remain, force redistributes between welds and a uniform kip/in no longer applies; use a weld-group analysis.
- **Develop the part, not just the weld.** Size the weld for the force the connected element must transfer; a weld stronger than the part adds no capacity.
- **Minimum size is a code floor.** A weld can be adequate for the applied load and still be undersized for the connected material.
- **Access matters.** Overhead or restricted-access welding affects what can be practically and properly made.
- **A calculated weld is not necessarily a sound weld.** Confirm procedure, electrode, qualification, inspection and acceptance criteria against AISC 360 and AWS D1.1/D1.1M.
- **Visual inspection has limits.** A weld may appear acceptable visually while containing subsurface or otherwise hidden discontinuities. Where required by the design, specification, or governing code, NDT methods such as MPT or UT may be necessary to evaluate weld quality.
- **Moving loads need more.** Impact, vibration, cyclic loading, fatigue and overhead lifting require their own design provisions and factors beyond these static values.