Allowable Strength of Screws · Steel to Steel / Aluminum to Steel / Aluminum to Aluminum

$F_{ty} := 35 \cdot ksi$

- tensile yield strength of the thinner joined plate
- for aluminum read from Appendix C in Kissel and Ferry text
- for steel, enter the Fy of such part

35 ksi for **6061-T6 6061-T651 6061-T6510 6061-T6511** structural aluminum alloys

$$Ds := \begin{pmatrix} 0.138 \\ 0.151 \\ 0.19 \\ 0.216 \\ 0.25 \end{pmatrix} \cdot in \qquad V1 := \begin{pmatrix} 150 \\ 165 \\ 175 \\ 185 \\ 200 \end{pmatrix} \cdot lbf \qquad V2 := \begin{pmatrix} 220 \\ 240 \\ 260 \\ 280 \\ 300 \end{pmatrix} \cdot lbf \qquad V3 := \begin{pmatrix} 310 \\ 340 \\ 370 \\ 390 \\ 420 \end{pmatrix} \cdot lbf \qquad V4 := \begin{pmatrix} 395 \\ 470 \\ 520 \\ 555 \\ 600 \end{pmatrix} \cdot lbf \qquad V5 := \begin{pmatrix} 560 \\ 675 \\ 780 \\ 890 \\ 1000 \end{pmatrix} \cdot lbf$$

$$P1 := \begin{pmatrix} 60 \\ 70 \\ 80 \\ 95 \\ 110 \end{pmatrix} \cdot lbf \qquad P2 := \begin{pmatrix} 75 \\ 90 \\ 105 \\ 120 \\ 140 \end{pmatrix} \cdot lbf \qquad P3 := \begin{pmatrix} 95 \\ 115 \\ 135 \\ 155 \\ 180 \end{pmatrix} \cdot lbf \qquad P4 := \begin{pmatrix} 125 \\ 145 \\ 170 \\ 195 \\ 225 \end{pmatrix} \cdot lbf \qquad P5 := \begin{pmatrix} 175 \\ 210 \\ 245 \\ 280 \\ 320 \end{pmatrix} \cdot lbf$$

$v1(\phi) := interp(pspline(Ds, V1), Ds, V1, \phi)$ $\qquad$ $p1(\phi) := interp(pspline(Ds, P1), Ds, P1, \phi)$

$v2(\phi) := interp(pspline(Ds, V2), Ds, V2, \phi)$ $\qquad$ $p2(\phi) := interp(pspline(Ds, P2), Ds, P2, \phi)$

$v3(\phi) := interp(pspline(Ds, V3), Ds, V3, \phi)$ $\qquad$ $p3(\phi) := interp(pspline(Ds, P3), Ds, P3, \phi)$

$v4(\phi) := interp(pspline(Ds, V4), Ds, V4, \phi)$ $\qquad$ $p4(\phi) := interp(pspline(Ds, P4), Ds, P4, \phi)$

$v5(\phi) := interp(pspline(Ds, V5), Ds, V5, \phi)$ $\qquad$ $p5(\phi) := interp(pspline(Ds, P5), Ds, P5, \phi)$

$$ts := \begin{pmatrix} 0.0347 \\ 0.0451 \\ 0.0566 \\ 0.0713 \\ 0.1017 \end{pmatrix} \cdot in \qquad Shears(\phi) := \begin{pmatrix} v1(\phi) \\ v2(\phi) \\ v3(\phi) \\ v4(\phi) \\ v5(\phi) \end{pmatrix} \qquad Pullouts(\phi) := \begin{pmatrix} p1(\phi) \\ p2(\phi) \\ p3(\phi) \\ p4(\phi) \\ p5(\phi) \end{pmatrix}$$

$$V_{allowable}(t,\phi) := interp(pspline(ts, Shears(\phi)), ts, Shears(\phi), t)\cdot\frac{F_{ty}}{24\cdot\frac{kgf}{mm^2}}$$

$$P_{allowable}(t,\phi) := interp(pspline(ts, Pullouts(\phi)), ts, Pullouts(\phi), t)\cdot\frac{F_{ty}}{24\cdot\frac{kgf}{mm^2}}$$

$$tmaxs := \begin{pmatrix} 0.11 \\ 0.14 \\ 0.175 \\ 0.21 \\ 0.21 \end{pmatrix}\cdot in \qquad Limits := augment(Ds, tmaxs)$$

$t_{min} := 2\cdot mm$ thickness of the less thick joined plate (up to about 5 mm)

$\phi := 6\cdot mm$ nominal diameter of the screw

$P := 100\cdot kgf$ $V := 40\cdot kgf$ service level tensile and shearing forces

$$\left(\frac{P}{P_{allowable}(t_{min},\phi)}\right)^{1.5} + \left(\frac{V}{V_{allowable}(t_{min},\phi)}\right)^{1.5} = 0.92$$ the ratio needs be less than 1 for the check be OK

The table below lists in the second column the maximum thickness of the plate to which screws of the nominal diameter in the first column should be used

$Limits =$ (ϕ / t_{max}) mm

	1
1	3.51
2	3.84
3	4.83
4	5.49
5	...
6	

You can reduce the forces on each screw by using lesser separations between parts on which to screw

Comment

- The procedure should be reasonable accurate for steel screws for joined steel on steel plates of Fy=36 ksi, since taken from a table in **Residential Steel Framing Handbook**, *Robert Scharff*, Mc Graw Hill, New York 1996
- The rest is inferred using methods habitually employed in the science of construction.
- One needs to surmise the tensile strength of the screws does not control the design, so better use screws of over 36 ksi yield strength.