Aluminum Design Manual
Frequently Asked Questions

1. Should I use nominal dimensions or nominal dimensions less the tolerances when I calculate section properties of members?

> Use nominal dimensions. Safety factors (or resistance factors if you use load and resistance factor design) account for the fact that parts might be smaller than the nominal dimension by the amount of the tolerance as long as tolerances are no greater than standard mill tolerances. Standard mill tolerances for aluminum products can be found in The Aluminum Association's publication *Aluminum Standards and Data*.

2. What is the allowable deflection for aluminum beams?

> The *Specification for Aluminum Structures* gives no general deflection limit for aluminum beams since the *Specification* is used in many different applications, each with its own performance requirements. In Section 8.4.4, a deflection limit of $L/60$ is given for roofing and siding, where L is the span length. Roofing deflections should be limited to avoid ponding, which is a function of roof slope. A deflection limit of $L/150$ where L is the short span is used in *Aluminum Design Manual* Part VII, Table 4-3 for allowable loads on aluminum checkered plate. Examples of deflection limits for aluminum applications are ASTM E1300 and AAMA TIR A10, which give deflection limits for glass supporting members.

3. To calculate the web crippling strength in accordance with *Specification for Aluminum Structures* Section 4.7.7, what inside radius R_i should I use for an extruded I beam?

> For extruded shapes, $R_i = 0$. See *ADM* Part VIII, Illustrative Example 4. Where the corner between the web and flange is a fillet (as is the case for extruded structural shapes) as opposed to a bent sheet, $R_i = 0$. Use the bend radius at the web-flange juncture as R_i for cold-formed sheet shapes.

4. Why don't the slenderness limits S_1 and S_2 given in the *ADM* Part VII Design Aid tables match those calculated by the formulas in the Part I *Specification for Aluminum Structures*?

> The slenderness limits in the Design Aid tables have been calculated using the rounded values for the allowable stresses above and below the limits. The difference in allowable stresses calculated by the Design Aid tables and those calculated by the formulas in the *Specification* are negligible. For example, in Part VII Table 2-2 for 1100-H14 Section 3.4.11, $S_1 = 24$, and the allowable stress for a slenderness $S = S_1$ is $8.8 – 0.034(24) = 8.0$ ksi. But using *Specification* Table 3.4-3, $S_1 = 1.2 (B_c – F_{cy})/D_c = 1.2 (14.5 – 13)/0.067 = 27$ and the allowable stress for a slenderness $S = S_1$ is $8.8 – 0.034(27) = 7.9$ ksi. The difference between 7.9 ksi and 8.0 ksi is not significant.

5. For Compressive Bending Stress in Round Tubes, in the Part I *Specification for Aluminum Structures* Tables 3.3-3 and 3.3-4, Buckling Constants, should I use F_{cy} or F_{ty} for F_y?

> Use the lesser of F_{cy} or F_{ty}.

6. What's the allowable tensile load on a partial penetration groove weld?

The allowable tensile load on a partial penetration groove weld is the allowable tensile stress times the effective area of the weld.

a. The allowable tensile stress is the tensile strength divided by a safety factor of 1.95. The tensile strength is the lesser of the tensile strength of the filler alloy and 90% of the weaker of the welded tensile ultimate strengths shown in Table 3.3-2 of *Specification for Aluminum Structures* for the two base metals joined by the weld (for example, if 6063-T6 (welded tensile ultimate strength = 17 ksi) is welded to 6061-T6 (welded tensile ultimate strength = 24 ksi), use 90% of 17 ksi = 15 ksi). Tensile strengths of filler alloys are given below:

Alloy	Minimum Tensile Ultimate Strength (ksi)
1100	11
2319	35
4043	24
5183	40
5356	35
5554	31
5556	42
5654	30

b. The effective area of the weld is the weld's effective length times the weld's effective size. The effective weld length of a groove weld is the length of the weld perpendicular to the direction of tensile or compressive stress, and shall not exceed the width of the part joined. For partial penetration welds that meet the conditions given in section 2.3.1.3 of AWS D1.2-97, *Structural Welding Code – Aluminum*, the effective size is the depth of preparation of the weld. For example, if the weld joins two ¾" thick plates and the preparation is a V-groove 5/8" deep, then the effective size of the weld is 5/8".

7. What are acceptable fabrication and construction tolerances for aluminum structures?

Aluminum beams and columns should not deviate from straight by more than $L/960$, where L is the length of the beam or column. Some fabrication tolerances on welded aluminum structural members are given in the American Welding Society's D1.2 *Structural Welding Code – Aluminum*. These include the $L/960$ straightness requirement for welded aluminum beams and columns, and tolerances on the depth of welded, built-up aluminum beams. You can order AWS D1.2 at the Aluminum Association's web site.

Tolerances for mill products such as sheet, plate, and extrusions are given in *Aluminum Standards and Data* published by the Aluminum Association.

There is no aluminum equivalent to the American Institute of Steel Construction's *Code* *of Standard Practice for Steel Buildings and Bridges*. For aluminum used in architectural applications, the provisions of the AISC *Code* for architecturally exposed structural steel (AESS) might be used. Aluminum is used in a great variety of structural applications; the construction tolerances for a given application should suit the needs of that application.

8. What are the tightening requirements for aluminum bolts?

Aluminum bolts may only be used in bearing connections, not friction connections, so like steel bolts in bearing connections, the only tightening requirement is that the bolts must be installed snug-tight. The snug-tight condition is defined as the tightness that exists when all plies in a joint are in firm but not necessarily continuous contact. In applications where vibrations or cyclic loads occur, a nut locking device should be used.

9. When I calculate S_1 for Section 3.4.7 using the LRFD Specification, I get a negative number. What should S_1 be for this case?

S_1 is zero for Section 3.4.7 in the LRFD Specification. This means that the compressive strength for columns is the inelastic buckling strength if the slenderness S is less than S_2. There is no slenderness for which the compressive strength is limited strictly by yielding.