



# Stainless Steel

Chemical Properties  
Galling

## STAINLESS STEEL CHEMICAL PROPERTIES

|    | Suitable Alloys          | Carbon   | Silicon | Manganese | Phosphorus | Sulphur  | Chromium  | Molybdenum | Nickel    |
|----|--------------------------|----------|---------|-----------|------------|----------|-----------|------------|-----------|
| A2 | 302, 304, 304L, 321, 347 | 0.08 max | 1.0 max | 2.0 max   | 0.05 max   | 0.03 max | 17.0-20.0 | -          | 8.0-13.0  |
| A4 | 316,316L                 | 0.08 max | 1.0 max | 2.0 max   | 0.05 max   | 0.03 max | 16.0-18.5 | 2.0-3.0    | 10.0-14.0 |

### How to stop Galling on Stainless Fasteners

Galling is described by John Bicford in his book "An introduction to the design and behaviour of bolted joints", as a cold welding process which occurs when male and female threads come in such close contact that an atomic bond can form between them".

Thread galling is portrayed by the Industrial Fastener Institute as being most prevalent with fasteners made of stainless steel, aluminum, titanium, and other alloys which self generate an oxide surface film for corrosion protection. During fastener tightening, as pressure builds between the contacting and sliding thread surfaces, protective oxides are broken, possibly wiped off, and interface metal high points shear or lock together. This cumulative clogging–shearing–locking action causes increasing adhesion. In the extreme, galling leads to seizing - the actual freezing together of the threads. If tightening is continued, the fastener can be twisted off or its threads ripped out.

Suggestions for dealing with galling in stainless fasteners:

- Slowing down the installation rpm.
- Lubricating the internal and or external threads. The lubricants should contain substantial amounts of molybdenum disulfide. Use silicon grease where stainless bolts are used in aluminum. Fastener coatings such as Molykote or Xylan also provide a solution for galling.
- Using different stainless alloy grades for the bolt and the nut reduces galling. The key here is mating of materials having different harnesses, this is because different alloys work harden at different rates. 400 series stainless steel nuts work well on 316 stainless bolts, and a cheaper alternative combination of 304 & 316 has also shown useful results.
- Thread roughness affects galling, the rougher the thread flanks, the greater the likelihood galling will occur. Generally it is the internal thread that has the rougher thread (threads are cut) and hence contributes most to galling. Most stainless bolts have rolled threads.