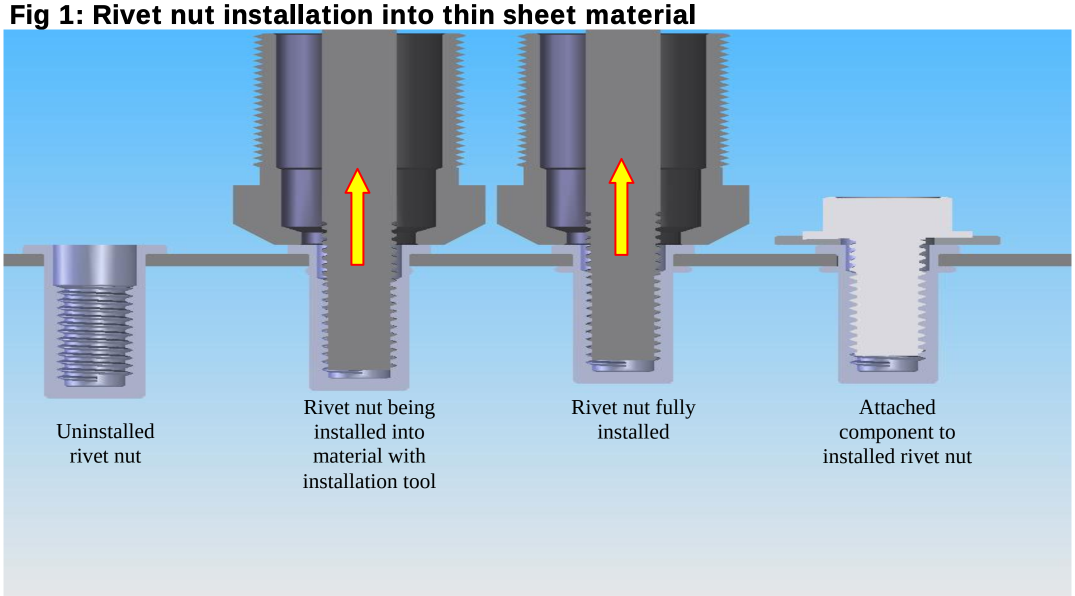
WHITE PAPER

Environment Rules Joint Design, by Adam Pratt

Over seven decades ago rivet nuts were invented for airplane wing attachment points. Since then, the need for reliable threads in thin materials has dramatically increased. Rivet nuts allow designers to use thin sheet metal or composites to reduce weight and cost from an assembly. Rivet nuts can be easily installed into base material with a hand tool. They do not require heat, accessibility to both sides of the work piece, or expensive presses for installation. The ease of assembly and disassembly makes rivet nuts an ideal fastening method when compared to other permanent fastening methods such as riveting.

Fig 1: Rivet nut installation into thin sheet material



As applications for rivet nuts have expanded, so have the variety of environments where they are utilized. Today, rivet nuts may be used to attach a roof rack to a vehicle, a blower to the base pan in an HVAC system, or grab handles and gauges in a boat. The features and benefits of using rivet nuts in applications in automotive, marine, food equipment, and military make it a fastener of choice when captive threaded fasteners are required.

The environment of the specific application is critical when determining what rivet nut style, material and surface finish to select. Corrosive environments can deteriorate a joint to the point where serviceability is compromised due to binding threads. Material loss due to corrosion can also reduce the clamp load of the joint causing the increased likelihood of loosening and joint failure. Therefore, matching the rivet nut with the environmental expectations of the application is critical for proper joint design.

There are four standard options for addressing corrosive environments with rivet nut fasteners; stainless steel, aluminum, Monel™ and sacrificial finishes on steel.

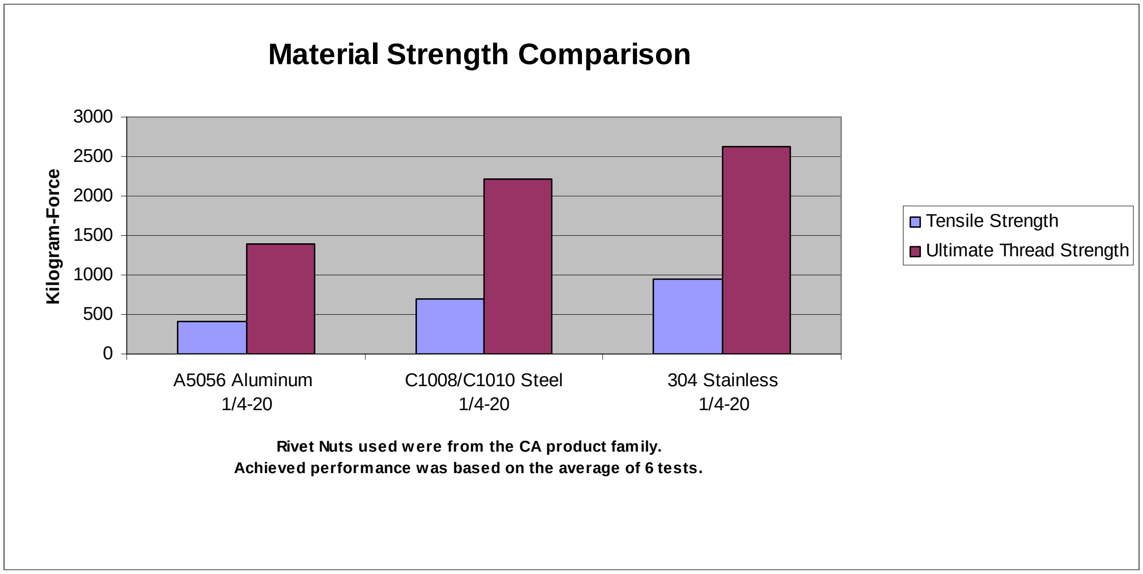
Stainless steel rivet nuts are typically manufactured in 430, 304 or 316 alloys. Rivet nuts manufactured from 430 stainless steel wire are typically made in small runs for military and aerospace applications to comply with the NAS 12730 specification. Most industrial applications today migrate towards the 302/304 and 316 alloys for the increased corrosion resistance and their availability in the market place.

304 stainless steel is a common choice due to its balance between corrosion resistance and affordability in many applications. Designers will chose 304 rivet nuts for applications in the appliance, transportation, and fresh water marine industries. Alloying Chromium and nickel with other materials yield the corrosion resistant properties of 304 stainless steel, however, at about half the cost point of 316 stainless steel.

316 stainless steel takes the basic components of 304 and adds Molybdenum to provide the highest corrosion resistance of the stainless steel rivet nut product line. 316 offers superior corrosion resistance in chemical environments where 304 is not recommend. In particular, 316 performs well when in contact with chloride based cleaning solutions. 316 stainless rivet nuts will typically be used in the chemical, food handling equipment, medical, and salt water marine equipment industries to name a few.

Aluminum is another common material for corrosion resistant rivet nuts. Aluminum rivet nuts will typically be made from either 5056 or 6061 aluminum grades and can be provided with an anodized finish for added corrosion protection. However, the lower strength characteristics of aluminum typically prevent it from being used in load bearing applications. Also, it is not recommended to use aluminum rivet nuts in stainless steel panels due to the affect of galvanic corrosion attacking the aluminum. Figure 2 provides a comparison of the strength characteristics of the three most common types of materials used in producing rivet nuts.

Fig. 2: Strength comparison of 3 rivet nuts of differing materials

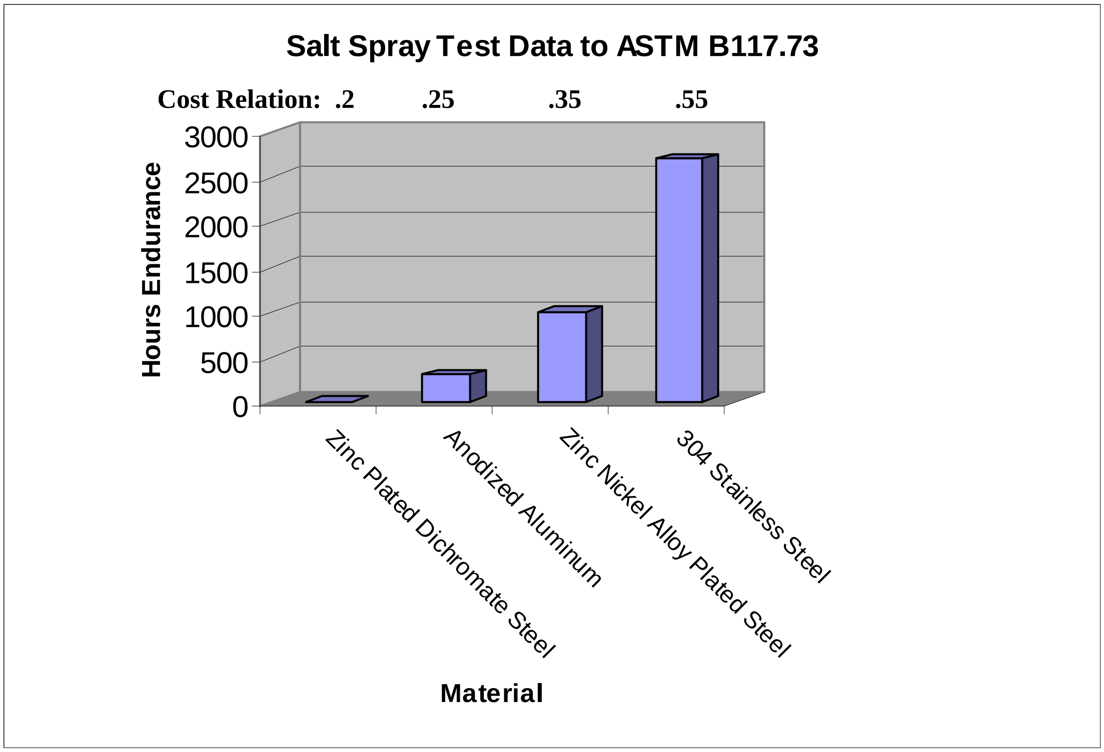


*****Ultimate Thread Strength is the force required to strip out the threads of the rivet nut after upset and when an axial force is induced on the thread.**
*****Tensile Strength in this case is the force required to tensile fracture the deformed section of the rivet nut.**

Monel™ is another material that is occasionally used in rivet nut manufacturing. It is used to prevent galling when in contact with stainless steel and offers exceptional corrosion, chemical, and thermal resistance. Its high cost, typically 30% above 316, prevents it from being viable for many applications.

In recent years, the technological improvement in electroplating alloys has offered base steel with an electroplated surface finish as an option for high corrosion applications. Typically, zinc will be electrodeposited onto the surface of steel with a subsequent layer of tin or nickel to increase corrosion resistance. Plating thicknesses vary between 8 µm and 15 µm. This is what is referred to as a sacrificial coating in that the surface finish will corrode before the steel, but at a much slower rate. When the surface finish corrodes it is commonly referred to as alloy corrosion (white rust), once the surface finish has been exhausted, the base material begins the oxidation process yielding red corrosion (red rust). Testing on zinc nickel alloy electroplated rivet nuts has yielded over 1,000 hours of resistance to red corrosion in an accelerated corrosive environment when tested to ASTM B117 and SAE J2334 60 cycle specifications. Rivet nuts with zinc nickel alloy electroplating also provide a cost advantage of approximately 50-60% when compared to stainless steel. See figure three for a comparison of cost and corrosion protection for various rivet nut options

Fig. 3: Comparison of hours of corrosion resistance of four materials (cost analysis: 316SS = 1)



Cost relation is a comparison of finished goods, NOT raw material

There are many other finishes available in the market today offering superior corrosion resistance. However, many are not applicable to rivet nut fasteners. One such finish family is the dip spin finishes. These finishes are typically applied in thicknesses of 18-24 µm which causes interference with thread fit on rivet nuts and also poor adhesion when the rivet nut is installed.

While there are many factors that go into choosing the proper rivet nut for an application, the corrosion resistant properties of the rivet nut are critical for ensuring proper joint performance. Zinc nickel electroplated steel provides a good corrosion resistant product with a cost point that is considerably lower than stainless steel. 304 is a good choice for applications requiring a higher level of corrosion resistance, but not requiring a resistance to breakdown when in contact with food and chemicals. 316 stainless steel is the ultimate material option for rivet nut applications requiring resistance to chemicals and food matter. While there are many other considerations to take into account when matching the proper rivet nut and material to your application, this should be a good start for helping you determine which rivet nut fastener will meet the specific requirements of your application.

Sherex is a leading manufacturer of Blind Rivet Nut Inserts and specialty fasteners. Sherex is certified to ISO 9001-2000 and TS 16949.

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This article was intended to provide a brief overview of commercially available rivet nuts in the market place and the common characteristics of each. While other materials may yield higher results in certain corrosive situations, they are not typically used in the manufacture of blind rivet nuts.