

Dr. Fastener

# Aerospace Fasteners



by Laurence Claus

## Q What are Aerospace Fasteners?

A: Aerospace Fasteners are fasteners that are used in aircraft and space vehicles. Normally the Aerospace Fastener market breaks into three segments; Commercial Aircraft, Business Jets, and Defense and Space. Many Aerospace Fasteners fall into similar categories as industrial and automotive fasteners, like bolts and screws, wrenchable nuts, and inserts but there are some fasteners that fall into categories only found in aerospace like pin and collars, anchor plates, and panel fasteners. Somewhere around 40%- 50% of all Aerospace Fasteners are made to National Aerospace Standards Committee (NAS) standards.

## Q How are Aerospace Fasteners Different than Fasteners in Other Fastener Markets?

A: The answer that everyone may think is the answer here would be that Aerospace Fasteners are much more highly engineered or complex than other market segment fasteners. The reality is that probably isn't quite true. There is no doubt that Aerospace Fasteners, generally speaking, are used in a higher percentage of critical applications than products in other market segments, but the manufacturing technology and sophistication in making the parts is not much different. I would say that the two most significant differentiators are; 1. Workmanship, and, 2. Quantities (lot Sizes). Lot size (the number of parts manufactured at one time) defines, for the most part, how a manufacturer is going to design their methods and processes to make parts. Making large quantities in a single run requires a very different approach than smaller quantity runs.

## Q What is "Workmanship"?

A: Workmanship is a term we apply to the "quality" of the part. Workmanship takes into account paying attention to small details. You might get a sense for good workmanship if you consider what bad workmanship is- parts that are "sloppy" and have lots of small defects would be examples of bad workmanship.

## Q How is Aerospace Workmanship Different?

A: A high percentage of aerospace parts are in critical fatigue environments. (Fatigue is a progressive failure mode when a part sees repeated on and off load cycles.) Parts most vulnerable to fatigue failure are ones that have stress concentrations or flaws that make it possible for a crack to initiate and grow. Many of the small surface imperfections can become cracks. Therefore, many aerospace parts have exceptional workmanship requirements. Parts must be free of cracks, both large and very small, thread laps, folds, dings, nicks, and scratches. Additionally geometric form is often much better than non-aerospace parts, sporting heads that have been shaved almost perfectly round and ends that have been machined flat and square.

## Q Why do Aerospace Fasteners Often Have the Fillet Radius and Threads Rolled After Heat Treating?

A: Again, because of the fatigue concern, often times Aerospace Fasteners have measures taken to make them less vulnerable to fatigue. Normally, the two most highly stressed areas on an external fastener are the fillet area (the junction from the head to the shank) and the first and second threads engaged in the internally threaded feature. To strengthen these areas, manufacturers of Aerospace Fasteners often put the parts through a unique process of rolling the fillet radius and threads after heat treating. What this accomplishes is placing a compressive stress in the parts at those locations which make it much harder for a fatigue crack to start.

## Q What is Aerospace Quality Material?

A: Once again, in an effort to reduce the chances of fatigue, Aerospace Fasteners often use specially produced raw material. Aerospace Quality material basically addresses two things; internal quality and external surface quality. All wrought metals have a small amount of contaminants inside. If these contaminants are too great in number or too big, it has the effect of dragging down the performance of that particular lot of material. While most normal material is melted at the mill in atmospheric furnaces, most aerospace material is melted or remelted in a vacuum furnace. In some instances material may be remelted up to three times in a vacuum. The vacuum has the effect of drawing impurities out to the surface which can then be removed once the material cools off. Repeating this process multiple times has the effect of pulling more and more contaminants out. In addition to the inside, processing techniques at the Mill often leave flaws in the outer surface of the raw material. Aerospace Quality raw material removes that outer layer by cutting or grinding it away.

## Q Do you Need AS9100 or AS9120 to be an Aerospace Fastener Supplier?

A: I can't say for sure, as every customer gets to make up their own requirements. AS9100 and AS9120 are both aerospace versions of Quality Management Systems. AS9100 is for manufacturers and AS9120 for distributors. These systems are derived from ISO 9001



and actually “add” requirements to the 135 requirements already found in this standard. Aerospace customers, like many automotive customers, have established prerequisites of doing business with them. Often one of these requirements is that you have a registered Quality Management System to AS9100 or AS9120. If you already have a registered Quality Management System like ISO9001 or IATF 16949 (if you are an automotive supplier), it may not be that difficult to add AS9100 or AS9120. However, if you possess no formal, documented Quality Management System, preparing for and becoming certified is a big task.

## **Q** How Can a Company Become an Aerospace Fastener Supplier?

**A:** Possessing the expertise to make Aerospace Fasteners is generally not as big a hurdle as one might think. Although workmanship requirements foster different manufacturing approaches and processes, the actual methods, equipment, and engineering are not that different. The challenge is the approach. Understanding the quality, workmanship, and customer service requirements of aerospace customers can be very confusing and challenging to the uninitiated. Additionally, as already discussed in one of the earlier questions, Aerospace Fasteners are purchased in smaller quantities so that manufacturing lots are much smaller than other fastener market segments. Companies must structure themselves to work in this sort of environment. In many instances an existing operation must try to infuse a small lot production model within a large lot production model. In fact, it just doesn't work, which is why you don't see manufacturers that provide product across a wide spectrum of market segments (i.e. aerospace, automotive, industrial and construction) supplying them from the same facility. In addition to the manufacturing systems required, aerospace fastener manufacturers usually must receive approvals from their aerospace customers to make parts. This is known as Source Approval. Aerospace Fastener customers often require source approvals, either of the product or of vendors conducting contracted processes such as heat treating or plating. Failure to follow these Source Approval guidelines will quickly get a company “blacklisted”. Although I believe it is possible, my personal experience teaches me otherwise, fastener manufacturers that are not today aerospace fastener manufacturers will not be successful simply trying to break into the business. If a non-aerospace manufacturer is really interested in becoming an aerospace Fastener manufacturer they will need to be very deliberate and intentional in making it happen and should probably approach it like starting a Greenfield business from scratch. ■



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