"Doing It Right the First Time"

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Designing the right joint or fastening system up-front with some value and application engineering techniques in the early design stages is extremely important.

In the 1998 movie, "Armageddon", as he is being strapped into a space capsule atop a rocket, Rock Hound, the character played by **Steve Buscemi** utters this line to Harry, the character played by **Bruce Willis**, "Hey Harry? You know we're sitting on four million pounds of fuel, one nuclear weapon and a thing that has two hundred and seventy thousand moving parts built by the lowest bidder. Makes you feel good, doesn't it?"

In my opinion, this ranks as one of the most humorous lines from Hollywood in recent years. But unfortunately, one that expresses, at its core, an attitude that all too often seems to prevail among even the best and most enlightened users of fasteners.

How often have you heard that, "it's only a screw, nut or bolt" or found yourself in a tense situation trying to make or locate a fastener because your customer failed to appreciate the engineering complexity, time or dollar constraints associated with making or procuring the right one?

Naturally, most of the readers of *Fastener Technology International* probably have a healthy respect for how much engineering goes into specifying, designing and manufacturing the right fastener for a specific application. You realize how critical a fastener can be to the overall success or failure of a customer's project.

You can probably cite multiple instances of customers that have failed to adequately consider the design of the fastened joint or waited to the last minute to choose the proper fastener, and then had the audacity to wonder why your company cannot support them. How often have these delays or oversights ultimately cost the customer precious resources and you "reputation points"?

Fortunately, no one needs to find themselves in this predicament. With proper education, communication and the latest in application and value-engineering tools, many of these pitfalls can be avoided. Generally, it doesn't take a significant investment of time or resources to work with a manufacturer, authorized distributor or knowledgeable party to conduct value and application engineering services early in the design cycle and eliminate much of this frustration on the backend. In most cases, it is clearly evident this early investment can pay significant dividends later in the design cycle.

What Should Be Considered?

At the early stages, what should the Engineer or Designer be considering? As with any technical problem solving, it all begins with a clear and concise understanding of the problem definition. What needs to be accomplished? Restated in more technical terms, this line of questioning leads to a clear idea of what the technical, appearance and performance needs are, which results in the development of a print or Statement of Requirements. Either of these items should clearly communicate what the customer believes is needed.

However, in cases where the customer may not be the clear expert, it is important to come alongside and educate the customer about how your product will help the customer meet its important requirements.

The list of considerations can be extensive and will be unique to every specific case. Several high-level considerations might include the following points.

• *Criticality of the Joint*

There are really two cases, those that are critical and those that are not. One might argue that all joints that hold something together are critical, but for the sake of discussion here, I am referring to the extent that the consequences of failure affect function, usability, safety or perception.

In this case, a critical joint is one where the integrity of the unit or assembly resides with a fastened joint or combination of fastened joints. An example might be the studs and lug nuts that hold your car's tire on. If these joints failed you would have the disastrous consequence of your wheel coming off. This might not be so bad if the car is parked in your driveway, but it is obviously a catastrophe if you are driving 70 miles per hour down the expressway at the time. Conversely, a noncritical joint is one whose failure may still leave a lasting negative impression on a user of the product, but it either fails to completely degrade the function or integrity of the product.

For many years, I had a large, plastic, hard-cover suitcase that I used for overseas trips. On several occasions upon returning home and unpacking I would find a loose screw in the bottom of the suitcase. Although this jaded my perception as to the ultimate quality of this suitcase, it never resulted in a failure to function as a suitcase.

• *Applications Engineering*

Application engineering can be an involved process. However, there should be an understanding of how the product will be used and the resulting requirements and needs of the joint to accomplish this function.

This is the place where one is asking questions about each component of the fastened joint such as what materials are involved, whether the components are compatible with one another, whether the joint is hard or soft, whether thread forming is a possibility and many other questions. In the end, an understanding of the product and how it is intended to function is very important to getting the components all working well together.

• ***Fastening***

This fits along with and is perhaps a subcategory of Applications Engineering. Here one is looking at all the aspects of assembly of the joint and asks questions such as what kind of drive system is required, will it be automatically or manually assembled, what torque is required for installation, is a lubricant required and many other questions. Getting installation parameters optimized is critical for long-term stability and performance.

• ***Fasteners***

These are the considerations nearest to the hearts of most of those reading this article, but as described above, only a small piece of the success of the entire fastened joint. This is where one asks questions and makes decisions specifically about the design or manufacture of the fastener. Typical questions would be what thread size and type are to be used, what material and strength properties are required, is a prevailing torque feature necessary, is the fastener easily cold-formed and many other questions. In the end, the result should be a fastener that works with the others to maximize joint performance and integrity.

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The Need for Optimum Engineering Research During the Design Phase

The considerations listed above can in fact be quite overwhelming. This is why it is important to conduct as much up-front engineering as possible prior to going into production and before significant amounts of time and money are invested in bolstering the weaknesses of a less than optimum design direction. For this reason, enlightened Engineers or Designers will employ a variety of helpful tools or practices early in the design stage. The following list is not exhaustive, but provides a look at three commonly used tools that can be employed.

FMEAs. A Failure Mode and Effects Analysis (FMEA), when used properly, is a powerful tool available to an Engineer to review potential failures and assess the associated risks that go along with each. This tool is designed for different stages of the design process so that there are DFMEAs for design purposes and PFMEAs for process or manufacturing purposes. If done thoroughly and completely, this is a tool that can be used to predict and prevent the likelihood of failures before they happen.

Simulation. Simulation programs and software are available today for most manufacturing processes. Properly understood and administered, they are powerful tools at predicting and in many cases modeling the behavior of how a tool will function, a material will flow or metal will deform. In the fastener industry, there are several excellent simulation programs that provide information with respect to forming of the fastener and design and longevity of the tooling. These programs can be an invaluable tool to the manufacturer as they can significantly reduce failed manufacturing trials, eliminate costly iterations of heading tool changes and troubleshoot solutions to existing problems.

It is equally important, however, that the Fastener Engineer or Applications Engineer be able to evaluate the entire joint.

To this end, simulation programs that look at the fastened joint (perhaps one integrated with a CAD program), the integrity of the fastener site (such as a mold flow program for injection molded or die cast parts) or simulate thread forming performance (such as plastic thread forming behavior) are very useful in providing assurances that not only are fastener components well designed, but that the entire joint is well integrated with all components working together for a single purpose.

Design Guides. Design guidelines are available for many fasteners either in the form of performance and design guidelines for proprietary fasteners or industrial standards for nonproprietary fasteners. Typically these documents have many hours of testing and field experience embodied in them. These documents can be crucial to getting designs right and optimized, especially early in the process when utilizing such guidelines is easiest to incorporate in the overall design or built into tooling.

Therefore, designing the right joint or fastening system up-front, with some value and application engineering techniques in the early design stages, is extremely important. And although doing some of these up-front techniques might seem like a significant investment, doing it right and having the rationale of why it is right will always pay you dividends in the long run.

In addition to potentially avoiding the consequences that go along with a failure, getting it right the first time will help cement the respect and loyalty you desire to gain with your customers.

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