



## The Bolt Doctor Guy Avellon

# ~Fastener Consulting~

### Q1. What is Fastener Consulting?

A fastener consultant is a person or company that offers advice or an opinion on a variety of issues involving fasteners; applications of products, metallurgy, manufacturing, heat treatment, quality control, testing, marketing, determining torque values and procedures, installation techniques, assembly methods, patent design or patent infringement advice, chemical coatings, training, failure analysis and providing expert witness testimony.

### Q2. Who Should Seek a Fastener Consultant?

#### New product design engineers:

Some design engineers like to reinvent the wheel. This is because they don't know all of the variety of fastener products that are available that would be more appropriate than what was specified.

For example; fasteners were specified with arbitrary lengths. Because they were not industry standard lengths, they cost more to make and the product cost more to produce. By designing and using standard fasteners and fasteners of standard lengths, production costs can be contained.

One example is that a customer had a 3/4" diameter bolt that the drawing called for a length of 9 1/4" in length. Is this necessary? They ordered several thousand pieces but also used bolts that were 9-1/2" for another assembly which used less volume. A recommendation was made to change the length to a

standard length of 9-1/2" to increase the part count and obtain better volume pricing.

The customer did not realize that standard inventory for lengths over 6 inches would be in 1/2" increments and his waiting lead time would be slashed drastically if it wasn't a special length that may not have even qualified for a production run.

There are also a variety of locking elements and locking nuts available that could make the design and functions of an assembly easier and more cost effective.

#### Fastener manufacturers and distributors:

A fastener manufacturer is good at making what products they produce; commodity or specialty fasteners. However, they do not know in many different applications their customers may use their products. Some may be of standard usage, others may be inappropriate for the size or grade of fastener used. The only time the manufacturer is aware of any problems is when the failed fastener is returned to the manufacturer with the presumption that it is faulty.

The fastener manufacturer can only retrieve test documents to prove the material was not defective and passed their standard testing methods. They can run further tests to prove that the product meets physical specifications and had no material defects, but that is all. The customer needs to know why it failed so future problems may be avoided.

An experienced fastener consultant can be an advocate for the manufacturer or distributor and outline the reasons why the part failed and provide guidance to the customer on how to prevent future fasteners from failing. Being able to help in this manner will solidify customer relations for the manufacturer or distributor.

#### End users (training):

Assemblers; people who are installing fasteners, especially with multiple fasteners in the joint, need instructions on torquing procedures, sequencing and the variables that exist which can compromise the joint connection.

Proper torque values must be observed between different fastener grades and surface finishes. This includes stainless steels, alloy steels and plain carbon steels, coated and non-coated as well as different types of lubricants.

For example; a manufacturer experienced returns due to the fasteners not being sufficiently tightened. A study of the assembly process revealed that at times, a sealing compound would accidentally get on the threads of the fastener. When torque was applied to assemble the parts, the fasteners with the sealing compound on the threads were not sufficiently tightened because the thread flanks were tightening against the lubricant and not stretching the fastener in tension.

Maintenance personnel need to be able to recognize the different grade markings on bolts and nuts. This is to avoid comingling different grades into the same storage bins. It can also become a problem when repairing equipment that has metric fasteners. It is imperative to know how fasteners are identified and how they are to be measured so the correct replacement part is used.

Sales personnel also need to know common terminology between 'industry' names and 'work' names so the correct part may be delivered to the customer; the different markings between SAE, ASTM structural fasteners and metric fasteners.

Testing labs: Many materials testing laboratories have now started to test threaded fasteners. The ASTM, ISO and SAE requirements for testing externally



and internally threaded fasteners are much different than for testing wire or bars.

One such laboratory was given a fracture to analyze. They identified the head failure as being caused by hydrogen embrittlement. However, the metallurgists could not understand why there was a fracture line extending outside the embrittlement zone. Had they been trained in the manufacturing processes for fasteners, they would have recognized the quench crack as the primary defect which allowed the hydrogen assisted failure to occur.

Law firms: accidents occur causing property damage or personal injury. Many times a fastener consultant can be of greater help than just a metallurgist.

For example; fasteners failed holding a ring gear on a crane. All of the metallurgists agreed that the cause of the fastener failures was due to metal fatigue and the litigators for the claimants accused the manufacturer of the fastener of inferior and defective products.

However, the fastener consultant, who also was a metallurgist, examined the recent maintenance procedures and noted that the fasteners originally specified by the manufacturer was made of special proprietary strength that was 10,000 psi stronger than standard and the metal lock nuts used were yellow in color. The maintenance personnel replaced the OE fasteners from a mill supply store with a standard fastener. The metal lock nuts were silver in color.

The crane was manufactured in the mid 1990's. The yellow lock nuts were cadmium plated and have been discontinued due to RoHS regulations in the early 2000's. The manufacturer's torque specifications were outdated. The silver colored lock nuts are zinc plated. The zinc plated lock nuts require a higher applied torque than the cadmium plated lock nuts to produce similar clamp loads.

However, when the lower cadmium torque value was applied to the zinc lock nut onto a fastener with 10 ksi less strength, it became apparent that these particular fasteners were severely under torqued and subject to metal fatigue. In this case, the manufacturer of the fasteners was exonerated and the blame went to the manufacturer of the equipment for improper maintenance procedures.

### **Q3. What Procedures do I Use to Find a Consultant?**

Consultants may be found by word of mouth, internet or even some organizations have consultants on file, such as ASTM or several sites recommending expert witnesses. Use key words like failure analysis, bolt failure, fastener consultants, fastener quality, etc.

### **Q4. What Criteria do I Use to Select a Consultant?**

As mentioned before, there are a variety of needs for a consultant and it depends upon your special situation; testing,

failure analysis, marketing, metallurgical testing, litigation, etc. There are not that many people who are fastener specialists and even fewer with multiple disciplines. Do you need someone to be able to communicate with your customer to alleviate tensions? Do you need training? Do you need litigation support? When one or more prospects are found, it is best to interview them to discuss your particular needs to find the correct match.

### **Q5. What Information do They Need?**

As much information as possible relating to the application, applied loads, installation procedures used and grade and type of fasteners. Photographs of the fasteners, especially of the fracture surface area are extremely useful.

### **Q6. What do I Expect from the Consultant?**

Sensitive and legal matters normally require an NDA (Non-Disclosure Agreement). This protects both parties. The consultant should be able to provide a detailed report, including photographs, with a detailed explanation of the failure. If required, they should be able to provide methods to prevent failures from reoccurring. ■

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