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WHY FASTENER STANDARDS ARE SO IMPORTANT

I just returned from a meeting that included many of the leaders of the North American fastener industry. Amidst the discussions of the impacts of COVID-19 and 2020 Presidential Elections, I found myself in several discussions about fastener standards. Although I understand that among this important and influential audience other topics reach higher priority, I was surprised to find a complete absence of understanding and interest into why fastener standards are important and perhaps even critical to their organizations.

Based on their individual perspective, many organizations may wrestle with this assertion. In fact, there would have been a time in my career where I would have been leading the pack in asserting little or no relevancy between the industrial standards our company intersected with and the success of our business. However, I now believe this argument to be very relevant and would like to take the rest of this article to explore why I believe standards represent a critical and often times overlooked key to the success of our businesses.

To begin the discussion we must first review the fundamentals. What is a standard, what is it seeking to do, and how does the normal fastener supplier interact with them?

To define what a standard is, let me share an example. Imagine you are rolling up to a stoplight as it turns red. You clearly know what to do, stop! In fact, anywhere in the world if you encounter a stoplight you know that red means to stop, green means to go, and amber means caution. You also might not be surprised to find this same convention expressed in other formats, such as signage and instruction manuals. Whatever the presentation of these color conventions may be, you always know what to do. These color conventions represent a simple, but very important, standard.

Imagine what would happen if the color conventions were reversed in, say, Europe. If you rented a car there you might find it exceedingly difficult to drive because you would want to stop when it was time to go and vice versa. Amongst other things, standards help to provide guidance and understanding so that we have consistency rather than chaos.

Even though industrial standards are more complicated than the simple example I have cited above, the principles and the purposes are pretty much the same. Industrial standards exist to provide a uniformity and consistency in product or practice that allows users and buyers to have confidence in knowing what they are getting.

One need only understand a little of the history and evolution of fastener standardization to know that standards serve this purpose. Mechanical fasteners have been around for a long time, with examples appearing in much studied early civilizations such as the Assyrians and Egyptians. Examples of “modern” threaded fasteners begin to appear in the Middle Ages. However, items using such fasteners were hand crafted by a local craftsman. This created a significant problem should a fastened item require a replacement and the original craftsman was not readily available.

As society began to urbanize and industrialize this problem became increasingly more acute. In the early 1840's, Joseph Whitworth, a pioneering British industrial engineer, began investigating fastener problems associated with railroad steam engines. He studied the leading London suppliers of threaded fasteners and discovered that although their product was generally uniform within their own product lines, there was little or no correlation with the neighboring competition. This led Mr. Whitworth to publish, "A Uniform System of Screw Threads", defining the Whitworth thread form and making history as the first industrial standard. Within several years this 55° angle profile thread would become the British national thread form, accepted throughout Great Britain and the British colonies.

About twenty years later, William Sellers, a United States engineer would propose the Seller's Thread Form. This was different than the Whitworth thread form, primarily in the 60° angle profile of its thread. The Seller's thread would quickly become the American Standard, adopted in 1868 as the US national standard and as the national standard throughout much of mainland Europe in 1898.

Although multiple, competing standards are rarely an ideal situation, this was fine until world war broke out and the United States and British war machines were comingled. Since the British were using the British National (Whitworth) thread and the US were using the American National (Sellers) thread, and the two were not interchangeable, maintenance problems arose immediately. Fortunately for the Allies World War I would resolve itself relatively quickly after first experiencing these problems but rise again to greater heights during World War II. After World War II ended, leaders were committed to not let this problem occur ever again, and so a council was convened and a harmonized screw thread was established, the Unified Thread Series.

As more countries adopted the Metric System, a standard for metric threads would need to be developed. The version used today, ISO 68, was developed in the early 1970s. Fastener standards fall into one of five categories;

[1] Product (or Dimensional) Standards - these inform the user how to make the part

[2] Material Standards - these inform the user on a material or process used to make a part or an operation such as heat treating or plating that may be conducted on a part

[3] Testing Standards - often test requirements are included in the Product or Material Standard but occasionally are developed into a stand-alone document informing how the part should be tested

[4] Procurement Standards - provide information about requirements the purchaser may have relative to a part

[5] System Standards - these are often Quality Management System standards such as ISO 9001 and provide guidance on all aspects of structuring and running one's business or some sub-system of a business

In addition to these five different categories, fastener standards have two types, Consensus Standards and Non-Consensus Standards. Simply defined, a Consensus Standard is derived by a consensus standard organization, or one which employs the principle of open access by industry participants and experts who work together using a structured process that insures consensus of the end product. Organizations like ASTM, ASME, SAE and ISO are all consensus standards organizations. By contrast, a Non-Consensus standard is generated by a non-consensus organization, which means that the input is either not open or there is no process to make sure that the users of the standard agree to the contents. Non-Consensus Standards exist for the sole and exclusive benefit of the entity that creates them. Common examples of Non-Consensus Standards include all automotive OEM standards, MIL Standards, and OEM aircraft manufacturer standards.

An important item to clarify at this point is the relationship between Consensus and Non-Consensus standards. One might like to think that there would be no relationship between the two, and occasionally this is true. More often, however, Non-Consensus Standards rely heavily on the Consensus Standards.

Take for example all of the individual automotive OEM standards related to fastener material strength. Without exception, these draw heavily on the ISO Consensus Standard ISO 898. Therefore, any changes to the ISO standard can have a dramatic impact on the Non-Consensus Standard, and whether aware or not, downstream users of those OEM Non-consensus standards are closely coupled with the work on the Consensus Standard.

Let me share two examples to illustrate this point.

ISO 4042 and ASTM F1941/F1941M are both fastener specific standards for zinc electroplating. I say they are "fastener specific" because both ISO and ASTM have other general industry standards for electroplating. These fastener specific standards include topics such as post plating thread gaging and hydrogen embrittlement relief requirements. Both standards have been recently updated and revised and provide excellent, up-to-date guidance of hydrogen embrittlement relief. In fact, the work on ISO 4042 led to the publication of ISO technical report ISO TR 20491, "Fundamentals of Hydrogen Embrittlement in Steel Fasteners".

There are many documents out there which include guidance on hydrogen embrittlement relief. If we collected them all and lined them up, we would quickly discover that they don't agree with one another. In fact, it would not surprise me if some OEM organizations have multiple standards that actually send conflicting messages on this topic. This serves only to cause confusion and hardship in the industry. Fortunately, Consensus Standard documents such as ISO 4042 and ASTM F1941/F1941M lead the way in assisting non-Consensus standards writers to revise their documents with the most technically up-to-date information. Therefore, the first important lesson we learn is that Consensus Standards are the first ones updated with current and state-of-the-art information, and, thus, lead the way for the industry.

In another example, ISO 898 Part 1 is the metric standard defining strength classes of screw, bolts, and studs. This is an extensive standard of many pages detailing hundreds of requirements. When one digs deep into these requirements, one would find a small footnote instructing the user that high strength Property Class 12.9 fasteners require dephosphitizing prior to heat treatment. This is essentially a cleaning process requirement where any phosphate residues remaining from the coating on the raw material are removed in an effort to eliminate the risk of phosphate by-products that are believed by some to potentially embrittle high strength fasteners. If we collected all of the equivalent Non-Consensus US standards on this topic, we would find a similar requirement or footnote in all of them.

A number of years ago, the ISO committee debated whether this requirement should be applied to lower strength fasteners as well. A number of ISO delegations, including the United States, provided data showing that such a move was unnecessary at lower property classes. However, had it been allowed to be added, likely all of the OEM Non-Consensus standards would also have adopted it. Such a move would have mandated an expensive, and, per the data, unnecessary operation prior to the heat treating process. Without the active oversight and participation of interested parties, an expensive and likely unnecessary mandate would have been enacted. Thus we learn our second lesson that vigilance and participation in Consensus Standard activities is critical to the well-being of our industry.

The two examples above illustrate how changes to Consensus Standards can affect Non-Consensus Standards and trickle down to users with dramatic consequences. Investing in standards development and maintenance has another impact on participating entities. It allows them to be educated, knowledgeable, and to help provide unambiguous guidance to other users. Having definitive guidance that represents sound technical state-of-the-art and does not conflict with other standards is important.

In perhaps one of the most egregious examples in recent years was the confusion caused by the hydrogen embrittlement relief practice conflict between ASTM B633 and ASTM F1941/F1941M. As introduced above, ASTM F1941/F941M is a fastener specific standard for zinc electroplating. ASTM B633 is also a standard for zinc electroplating but for "general industry" purposes. In other words it was created to be employed over a variety of industries and products.

About 15 years ago the ASTM committee that maintains this document revised the standard including lowering the threshold where baking to relieve hydrogen embrittlement risk was mandated. This put the two standards in conflict with one another. This would not be a problem except many in the fastener industry utilize B633 as their electroplating standard and the B633 committee failed to definitively guide fastener interests to F1941/F1941M. Unfortunately this conflict has led to some confusion including being raised as legal arguments in several lawsuits impacting our industry. Needless to say, it was a happy day in early 2019 when the ASTM committee that "owns" this document finally changed it to agree with the F1941/F1941M document. This change, a critical development in the fastener industry, would never have happened without dedicated individuals and companies investing their time and resources into getting it resolved.

This close marriage between Non-Consensus and Consensus Standards makes it important for all fastener organizations to be aware of and stay on top of what is happening in the fastener standards world. To this end, here are a couple of actions that fastener suppliers (distributors and manufacturers) can take to assist the industry and their organization:

[1] Invest resources to get your experts involved in Consensus Standards activities. I know of one distributor who has involved their entire engineering team on all the US and ISO fastener standards committees and encourages them to be active and involved. Their team members are some of the most respected and productive individuals on these committees because of the leadership roles they take. Surely their investment is repaid with the knowledge and influence they receive by participating on the committees. Regretfully they are an exception. Too few companies are involved, leaving the heavy lifting to a select few.

[2] Stay up-to-date on fastener standards. It continues to surprise me when someone comes up to me at a trade show and proudly tells me how much they appreciate and use their 7th edition of the IFI Fastener Standards. I am pleased that the IFI Standards remain relevant and helpful, but the 7th edition was published 17 years ago in 2003. Almost every standard in that book is no longer up-to-date. Having up-to-date standards is very important, especially if your company maintains a QMS certification such as ISO 9001. Even better than the most recent printed version, the IFI and many others now offer their Fastener Standards in an on-line subscription that is always kept up-to-date.

[3] Educate your organization and be aware of fastener standards that impact your company. Again, this may run deeper than what a surface investigation exposes. For example, if you serve the automotive industry you might be accustomed to only directly referencing OEM standards, but many of these may be derived from ISO or other Consensus Standards such as ISO 898.

[4] Educate and train individuals in your organization on how to read and understand standards. Understanding standards is not always intuitive. Gaining a comfort level with them takes time, practice, and often a helping hand from a more experienced, knowledgeable individual. Two excellent training opportunities for improving awareness of standards are Fastener Training Institute's Fastener Training Week and IFI's Standards 101 training.

Engineering standards are a very important part of our industry. Whether they are aware or not, all fastener suppliers, both distributors and manufacturers, are impacted by fastener standards. It is good business to know about and have internal experts on this subject. It is even better to be involved and making a first hand impact on the industry.