The Importance of Consensus Standards

Protecting All Participants in the Fastener Supply Chain

by Laurence Claus

Imagine a world without standards or one characterized by many competing standards. It probably does not take too long for a picture to emerge in your mind. Think back, for example, to cell phones ten years ago. If your cell phone communicated using a standard that was not available within the local network, you did not get service. This frustrated many an international traveler who expected their phone to work in the country they were visiting only to find that their phone communicated with a different standard than the local one and therefore did not work. Or for those old enough to recall, take for example, the battle between VHS and Betamax video formats. Although today both video replication formats are pretty much retired, how frustrating it was then for the owner of a player of one format to be unable to play a cassette in the other format. These are not isolated examples. Every day we touch and depend on a wide variety of items and technologies to perform in uniform and predictable ways. When things and people fail to perform in the ways we have come to expect, a great deal of frustration, inconvenience, and chaos normally ensues.

If we could transport ourselves back one hundred and seventy five years in time to look at the fastener industry, we would find an industry completely foreign to our modern day perspective. Although we would see a rapidly growing market for threaded fasteners driven by the onset of Industrial Revolution machinery, upon closer inspection we would find that every nut and bolt pair was uniquely matched with one another and not easily interchangeable. In fact, although the idea of interchangeable parts had certainly caught on, parts manufactured by different companies could not be expected to fit one another. This created a particularly frustrating challenge in certain industries, such as the railroad and military, where maintenance tasks might need to be performed many miles away from where the item or machine was first assembled.

In 1841 Sir Joseph Whitworth of Britain quietly canvassed many of the English bolt manufacturing shops and obtained samples of their products. He confirmed what any mechanic already knew, that they were interchangeable with other bolts and nuts from the same shop but not from other shops. So later that year he proposed the first fastener standard, "A Uniform System of Screw-Threads" and the Whitworth screw-thread system was born. Although it would take about twenty years, once the concept gained momentum it was readily accepted throughout Britain.

In 1864 the first screw-thread standard was developed in the United States by William Sellers. As commonly occurs, the version proposed by Sellers directly addressed some of the objections people had to the Whitworth Standard. In particular, the Seller version adopted a 60° thread profile and flat root and crest which made it easier to produce and gage. By 1868 both the US Navy and the US railroad industry had adopted this standard. In 1898 this standard was adopted for Europe.

Unfortunately, in much the same way that VHS and Betamax coexisted together, so did the Sellers and Whitworth Standards. This uneasy coexistence though would create significant challenges during World Wars I and II where US and British war equipment would share many of the same or interchangeable parts, except for the fasteners. Fortunately they were able to work around these challenges, but the experience illustrated an important lesson about the problems of competing standards. In 1948 the "Unified Thread" standards were created, which combined the best of the Sellers and Whitworth standards and comprise what is the UNC and UNF Inch series today. In the 1970s a new series of metric threads would be proposed and eventually adopted by ISO to make up the metric "M" threads. Today this is the prevalent metric thread standard.

Although this is a very abridged history of only one family of fastener standards, it provides some insight into the world of all fastener standards. Today hundreds of different fastener standards exist worldwide, which help define the many different product and ancillary fastener information such as gaging, testing, and materials. In general, fastener standards can be categorized into the following: Product Standards (which include finished product types, thread types, and gaging), Material and Performance Standards, Testing Standards, Procurement Standards, and Quality and System Standards.

Standards Organization	Country of Residence	Primary Fastener Committee	Secondary Fastener or Related Committee(s)	Example Standard Call-out
Aerospace Industries Association (AIA)	United States	NASC (National Aerospace Standards Committee)	N/A	NAS(XXX), NASM(XXX), NA(XXX), NAM(XXX)
American Society of Mechanical Engineers (ASME)	United States	B18	B1	B18.(XXX).(XXX)
American Society for Testing and Materials (ASTM)	United States	F16	A01, B02, B08, E04, E08, F07	ASTM F(XXX)
Deutsches Institut fur Normen (DIN)	Germany	NA067	N/A	DIN(XXX) or DIN EN ISO (XXX)
International Organization for Standardization (ISO)	Global (HQ: Geneva, Switzerland)	TC2	N/A	ISO (XXX)
Japanese Industrial Standards (JIS)	Japan	Division B	N/A	JIS B (XXX)
Society of Automotive Engineers (SAE)	United States	Fastener Committee	N/A	SAE J(XXX), AMS(XXX)

Table 1- Primary Fastener Consensus Standards

Product Standards:

These standards are likely the most abundant and describe a specific product or feature of a product in detail. They generally provide all the information needed to manufacture a part or to fully describe a feature of a part. Several examples of this type of standard include ASME B18.2.1 (Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)) , ASME B18.6.3 (Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)), and ISO 15480 (Hexagon Washer Head Drilling Screws with Tapping Screw Thread).

Material and Performance Standards:

These standards provide guidance related to specific materials or performance requirements. They may be very focused and provide only information on a very specific topic or be more general and provide information spanning a wide range of conditions. One well recognized example of this type of standard is ASTM A325 (Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength). An example of a very focused specification is AMS 5732 (Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing and Rings 15Cr 25.5Ni 1.2Mo 2.1Ti 0.006B 0.30V, Consumable Electrode Melted 1800°F (982°C) Solution and Precipitation Heat Treated) which only addresses one case of parts made from nickel based A286 material while ISO 898-1 (Mechanical Properties of Fasteners made of Carbon and Alloy Steel, Part 1, Bolts, Screws, and Studs with Specified Property Classes-Coarse Thread and Fine Pitch Thread) is an example of a specification that addresses a broad range of materials and strength classifications.

Testing Standards:

These are pretty self-explanatory and refer to standards written specifically to address testing or test equipment protocol. A couple of well-known examples would include the entire family of NASM1312 (Fastener Test Methods) standards, ASTM F606 (Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets), or ASTM B117 (Standard Practice for Operating Salt Spray (Fog) Apparatus).

Procurement Standards:

These are a specialized type of standard, used predominantly in aerospace and military fastener procurement that provide all the ground rules required by the purchasing entity. They might include anything from additional testing or technical requirements to how the parts should be packaged. An example would be NA0009 (Procurement Specification for Nut, Self-Locking, 235°C, Metric).

Quality and System Standards:

These tend to describe how a system should be put together and run. Naturally one of the most recognizable standards of this type is ISO 9000. However, there are fastener-specific ones such as ISO 16426 (Fasteners-Quality Assurance System), as well.

In addition to different categories of standards, there are two distinctly different types of standards, Consensus and Customer Specific. Consensus standards are those that are published and maintained by a Consensus Standard Organization and developed in such a fashion that industry experts are brought together and pursue a process aimed at getting industry consensus around the topic. Consensus Standard organizations include ASTM, ASME, SAE, ISO, DIN, JIS, and NASC (AIA), to name a few. (See **Table 1**) Customer Specific standards are, as the name implies, standards that have been developed by a company or organization to address their own needs and requirements. Unlike consensus standards, they normally do not go through a process of seeking to find consensus among many different parties. The fact that they are customer specific, however, does not mean that they do not have broad recognition in the industry. Take for example Ford, GM, or MIL specifications. All of these are widely used outside their organizations.

One might wonder exactly how these standards come to be. In the case of Consensus Standards it is truly a unique process. The sponsoring organizations (ASTM, ASME, ISO...) form a committee that is tasked with developing and maintaining pertinent standards. These committees are made up of expert volunteers in the field that normally include participants categorized as manufacturers, resellers, users, and "general interest" (which are usually consultants, university professors, and other interested individuals that don't fall into any of the other categories). Often times these committees have strict rules about the composition of the voting participants of the committee to assure that no one block of participants can skew the proceedings. Additionally, initiatives and changes are controlled by ballots, and these committees take special care to work through concerns or challenges that individuals may express so that the final standard is truly achieved by consensus.

When a committee receives a new task, often it gets directed to a subcommittee or task group, which is a smaller group of focused experts. These groups do most of the "heavy lifting" and develop a draft document for the larger Committee or Subcommittee to review and vote on. This draft document will then be sent out by ballot to all the members of the Committee or Subcommittee who will vote to approve, disapprove, or abstain. Often these votes include comments. At the end of the voting period, all the votes and comments are tallied and the task group starts the process of working through all of the identified issues. The goal is to address each comment accordingly and to try to find consensus in the final draft. This process is iterative and several rounds of review, balloting, and revising may occur before a final document is approved and published.

Consensus Standards have many advantages and offer value that cannot be obtained from non-consensus standards. Five of these primary advantages are:

The standards have been reviewed and vetted by a broad range of industry experts. Unlike a customer specific standard that depends on a few in-house experts to develop it, the consensus standard process has access to the best and brightest in the industry.

The consensus standard process takes advantage of a diversity of perspective. Since the committees and working groups are made up of a balanced mix of manufacturers, users, resellers, and other experts, a broad and diverse perspective and expertise are brought into play. This is ratcheted up even further at ISO where the perspective of many different countries comes into play. It is not at all uncommon to have a specific user, manufacturer, or country experience something that gets included in a standard and benefits everybody that will utilize that standard in the future.

Consensus standards are kept up-to-date. All Consensus Standards Organizations have a policy regarding keeping the standards up-to-date. The time period may differ from one organization to another, but all require that a document be reviewed and re-affirmed on a regular basis. If technology has

advanced or changed, it gets flagged at the time of review and the document gets updated. In this way, these standards are able to "keep up with the times".

Consensus Standards are a wealth of information. In addition to providing some of the best guidance available on the specific subject of the standard, quite often these standards include annexes (appendixes) which provide additional guidance and perspective not readily found elsewhere.

Consensus Standards are readily available and easily researched. Most, if not all, of these standards are copy-written documents and sold for a price to help offset the costs of these activities. There are multiple sources where they can be purchased. Additionally, when trying to determine which standard may be relevant, these same sources usually have a reference or index table that allow for quick and easy identification of the desired standard.

Consensus Standards are designed to be easy to use. Although they differ slightly in format from one organization to another, they all are similar in structure. Perhaps the most important part of the standard is the Scope or Introduction. This is a concise statement of what is contained in the standard as well as what it is and is not applicable to. Following that is the body of the standard, which contains all the details. This is the working part of the document and will provide all the specifics relevant to the type of standard that it is. Finally, many of these standards contain Annexes (appendixes) at the end of the document which help to further educate or explain something specific about the topic of the standard.

Although standards are probably taken for granted most of the time, they are truly a very important part of our society and particularly the fastener industry. Consensus Standards are especially important because they bring together the perspective of many different individuals or in some cases different countries. This serves to provide one unified approach which, as introduced in this article, is critical to providing society with order, simplicity, and value. Individuals within the fastener industry should have a basic understanding of what these documents do and how to locate and use them when needed.

Accreditations:

Industrial Fasteners Institute, The Heritage of Mechanical Fastening, IFI, Cleveland, OH, 1974.
Consensus Standards Organizations:
AIA: 100 Wilson Blvd, Suite 1700, Arlington VA,22209 www.aia-aerospace.org
ASME: Two Park Avenue, New York NY, 10016-5990 www.asme.org
ASTM: 100 Barr Harbor Drive, West Conshohocken PA 19428-2959 www.astm.org
DIN: Am DIN-Platz, Burggratenstrasse 6, 10787 Berlin Germany www.din.de
ISO Central Secretariat: 1, ch. De la Voie-Creuse, CP56-CH-1211, Geneva 20 Switzerland www.iso.org
JIS: 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901 Japan www.jsc.go.jp
SAE: 400 Commonwaelth Drive, Warrendale PA 15096 www.SAE.org