September 19, 2013

September 2013 Fastener Industry Technology Update

This document contains information about activities in fastener standard and other technical issues relevant to the fastener industry over the past month.

1. ***Standards Organizations Activities***
   a. ***Standards published during June***
      i. ***SAE J2596-2013***, Fastener Part Standard - Tapping Screws and Metallic Drive Screws (Inch Dimensioned) for ***Ship Systems***
      ii. ***IFI 135***, Testing of Blind Rivets – 2013

   b. ***Standards in the publishing stage***
      i. ***B18.6.3 –*** Inch machine and tapping screws

   c. ***Standards in the revision process***
      i. ***ASME B18.24 –*** Fastener part identification numbering system
      ii. ***ASME B18.31.2 –*** Inch studs
      iii. ***ASME B18.16.6 –*** Inch Lock Nuts
      iv. ***ASTM F16 –*** A new standard is in the works which is a compilation of inch and metric bolt standards including A325, A490, F1852, F 2280, A449, A354, A325M, and A490M. This is an effort to make the requirements of these related bolt standards consistent.
      v. ***ASME B18.31.3,*** Threaded rod (inch)
      vi. ***ASTM F1941,*** Electroplating Standard for Fasteners.
      vii. **ISO/CD 13469 –** Riveted Joint Testing
      viii. ***ISO 10683 –*** Zinc flake coatings for fasteners, is being prepared for final ballot sometime by mid-2013.
      ix. ***ISO 4042 –*** Electroplating finishes for fasteners was discussed for two days in an ad hoc meeting in Paris during June. The majority of the work was on Appendix B which addressed Hydrogen failures and how to manage process variables to decrease its potential effects. No ballot is expected until 2014.
      x. ***ISO 3269 –*** Fastener acceptance, first draft proposal to convert this standard from an AQL plan to a C=0 plan has been submitted to the ISO TC 2 by the US. The Committee agreed to continue work to rationalize the proposed samples verses the current sample sizes. Formal committee work will begin on this in October, 2013 in Paris.
      xi. ***ISO 6157 –*** Fastener surface discontinuities was discussed in Sydney. Work will continue in working group in 2013.
      xii. ***ISO 2320 –*** Locking nut performance – agreements were reached in Sydney. A ballot should be issued in early 2013.
      xiii. ***ISO 1891-4 –*** Terms and terminology related to quality assurance. This was worked on at an ad hoc meeting in Paris in June, 2013. This should be balloted before the end of 2013.

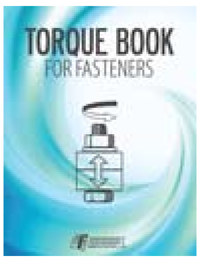
2. ***IFI Technical Working Group activities in progress:***
   a. ***Division I – Blind Rivet Standards-***
      i. ***IFI* 116 – Multi-grip Blind Rivet Standard**. This is a new IFI standard covering blind rivets that can cover a wider range of application thicknesses than the rivets covered by IFI 114. Completion is expected before the end of 2013.

   b. ***IFI Division III – A Guide for Ultra-high Strength Metric Fasteners-***
   The work is on-going. More testing is in process. Parts made from the same material

some with a martensitic microstructure and others of the same hardness with a bainitic microstructure are being fatigue tested to determine the relative fatigue performance of the different microstructures.

GM, Chrysler, and the IFI have committed to jointly sponsor a research project on evaluating the hydrogen susceptibility of ultra-high strength bolts at the same hardness with a martensitic verses a bainitic micro-structure. The research will be conducted at McGill University directed by Salim Brahimi. The research funds will be matched by a Canadian government group that supports research conducted in Canada.

3. ***Other Technical Information:***
   - ***a.*** See attached article on ***ASTM F1941 Electroplating Standard is Being Revised.***
   - ***b.*** The next fastener training opportunity is the Fastener Training Institute Fastener Training Week held at the IFI headquarters in Independence, Ohio on November 18 – 22. For more information see, http://www.fastenertraining.org/fastener-training-week/.



   - ***c.*** New publications:
     - **i.** The TORQUE Book of Fasteners is now available from the IFI. For more information on the "MUST HAVE" fastener resource visit http://www.indfast.org/shop/display_products.asp?cat=2 .
     - **ii.** Mechanical Fastening and Joining by Bengt Blendulf is now available from the IFI. This book contains a wealth of fastener industry technology that all fastener supliers should have as a training resource for their personnel, http://www.indfast.org/shop/product_detail.asp?cat=2&m=0&id=524 .

IFI Update

ASTM F1941 Electroplating Standard is Being Revised

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A lot has been happening with fastener finishes for the past five years that affect *ASTM F1941*, Electrodeposited Coatings on Threaded Fasteners. Two changes have been very significant and it has taken a while for those changes to become stable enough for the standards to be updated to address them effectively. Those two changes are the expanded use of trivalent chromates replacing hexavalent chromates on electroplated finishes and greater understanding about the causes and prevention of hydrogen embrittlement in hardened fasteners.

Trivalent Versus Hexavalent Chromium Conversion Coatings on Electroplating

Many years ago, the serious health problems associated with the use of hexavalent chromium came to light. The most dramatic evidence of the seriousness of the problem was the story of **Erin Brochovich**, where she discovered that the hexavalent chromium had gotten into the drinking water of Hinckley, Ca, USA, causing an extraordinary number of incidences of cancer in the local community. That and other incidences and research lead to the European regulations called *RoHS* and *REACH*. *RoHS* first impacted the global auto industry where a lot of hexavalent chromium was used as a corrosion inhibitor. Prior to *RoHS* most fastener finishes contained hexavalent chromium.

Since the auto industry is the largest consumer of mechanical fasteners worldwide, when the auto industry banned use of hexavalent chromium, a major transformation took place in fastener finishes and in electroplating in particular. Electroplated finishes without a chromate have close to zero corrosion resistance. Many chemical suppliers for finishes worked very hard to develop alternatives to hexavalent chromium. The largest shift was to the substitution of trivalent chromium.

That sounded easy enough, but like most things that look simple at first, it turned out not to be so simple. The transition was painful and expensive for plating companies. It was discovered very early that you cannot just take the hexavalent tank out of the plating line and put in the trivalent tank in and carry on. The demand for hexavalent chromium did not go away overnight and the demand for trivalent was gradual. Platers had to install completely separate plating lines to do the electroplating finishes using trivalent chromium.

Quickly after the conversion to trivalent chromium started, a number of discouraging things were discovered:

- Trivalent chromium has only about one-half the corrosion resistance of hexavalent chromium.
- The yellow colored trivalent chromium added no additional corrosion resistance as users were used to when they switched from clear hexavalent chromium to yellow hexavalent chromium where the corrosion resistance at least doubled.
- School is still out on whether the K factor of trivalent chromium is the same or higher than for hexavalent chromium, but there are many that contend the K factor is higher on the trivalent chromium. If this is correct, changing from zinc plating with a hexavalent chromium to a trivalent chromium can result in a joint with less tension, thus the possibility to more joint loosening.

In the 2007 revision of *ASTM F1941*, there was a provision for trivalent chromium to be specified by simply adding a "T" to the end of the finish designation number to indicate that the electroplated finish must use trivalent chromium instead of hexavalent chromium. Unfortunately, the three issues above had not fully come to light at that time.

Much has been learned about the use of trivalent chromium since 2007, thus the need for the current revision to *ASTM F1941*. The **F16 Committee** hopes to publish this new revision before the end of 2013. Following are some of the proposed changes:

- The recognition that topcoats and sealers are needed in addition to trivalent chromium conversion finishes to achieve the corrosion resistant values indicated in the standard.
- Friction modifiers are available and may be desirable to enable the finish to perform as desired from a tightening perspective. Friction modifiers can be PTFE (Teflon) incorporated into the topcoat or can be a wax applied as the last operation in applying the finish.
- A system for designating these multi-layer finishes is being introduced in this revision.

Hydrogen Embrittlement Prevention & Detection

Much research has been completed since 2007 on the subject of hydrogen induced failures in fasteners. Some of the conclusions coming from the research is resulting in some proposed changes in *ASTM F1941*. The research has confirmed the previous threshold for the concern for hydrogen embrittlement baking starting at Rockwell C40. It has been further validated that the susceptibility for hydrogen embrittlement failures increases rapidly as the fastener hardness increases. This means that *ASTM F1941* does NOT mandate post plating baking for any *SAE J429* Grades 5 or 8, *ASTM A354*, *ASTM A449* or *ISO 898-1*, 10.9 bolts or screws.

The standard recommends that finishes other than electroplating should be considered for fasteners that are Rockwell C40 and above, but if they are electroplated, the fasteners should be baked for a minimum of 14 hours instead of the long-published recommended four-hour bake. It is suggested that when baking is performed, it should be done as quickly as practical after plating, but the exact period is not specified as critical. Testing after baking through-hardened bolts and screws must be conducted according to *ASTM F606* as specified in the current revision of *F1941*, but the requirement for the use of the method specified in *ASME B18.6.3* is proposed to be used after electroplating all types of tapping screws.

Inch & Metric Requirements Are Now Combined

Last year, the F16 Committee decided that all new or revised finish standards should cover both inch and metric fasteners. The reasoning on that is that the finishes have no different requirements whether the finish is on an inch or a metric bolt. Only the expressions of the units must be stated throughout. This decision makes it much easier for the F16 Committee to keep the inch and metric requirements coordinated at all times.

Conclusion

ASTM F1941, Electrodeposited Coatings on Threaded Fasteners, is in the revision process at this time. Here are significant changes:

1. Topcoats and sealers are identified and it is acknowledged that trivalent chromium finishes must incorporate the topcoats and sealers to meet the published corrosion resistance requirements.

2. Torque modifiers are identified that can be added to finishes so the K factors can be controlled much more precisely than in the past.

3. A new finish identification system is being introduced so that the addition of topcoats, sealants and friction modifiers can be clearly designated when specifying finishes in the future.

4. When electroplating fasteners that have a hardness of HRC 40 or above, the recommended baking time is being raised from four hours to fourteen hours at temperature. The temperatures will not change.

5. Inch/metric requirements will be incorporated into one standard.

It is hoped that the revision of *ASTM F1941* is published before the end of 2013. Contact the author at ***jgreenslade@indfast.org***. **FTI**

Founded in 1931, the **Industrial Fasteners Institute (IFI)**, Independence, OH, USA, is an association of the leading North American manufacturers of bolts, nuts, screws, rivets and all types of special formed parts. Associate members include suppliers of equipment

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