



## ASTM F16 FASTENER COMMITTEE INFO

### 2015 BSEE DOMESTIC AND INTERNATIONAL STANDARDS WORKSHOP

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By

**Joe Greenslade**

**Director of Engineering Technology**

**Industrial Fasteners Institute**



## ASTM F16 Representative Today



**Joe Greenslade**  
IFI Director of Engineering

- 45 years of fastener experience
- ASME B18 Chairman
- ASTM F16 Member
- SAE Fastener Committee
- SAE Ship Systems Committee
- Research Council on Structural Connections (RCSC)
- US Delegate to ISO TC2

## ASTM F16 Hydrogen Embrittlement Expertise

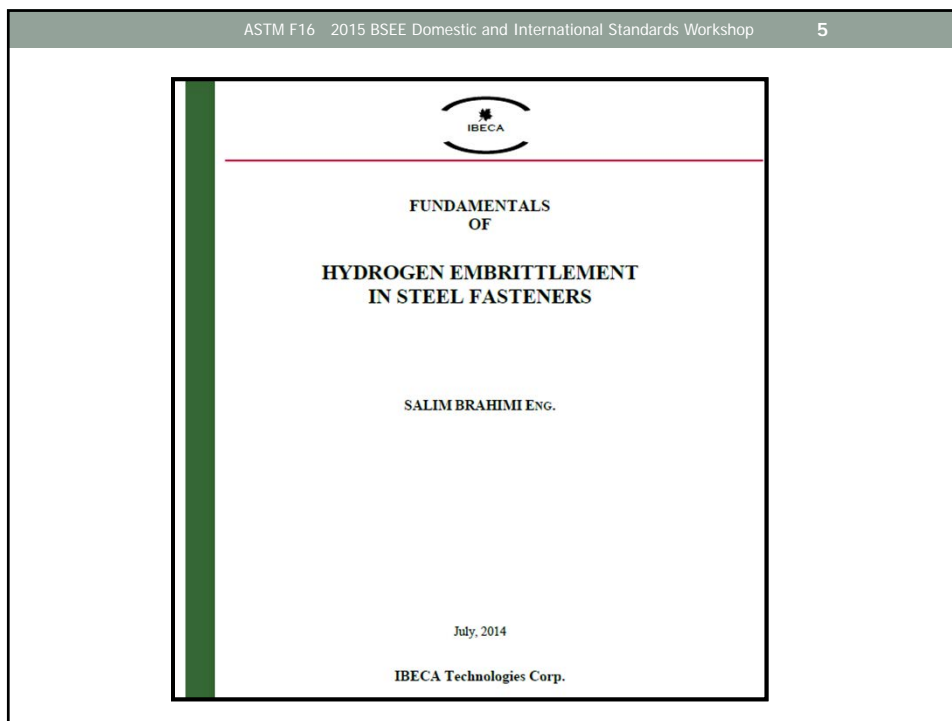


Salim Brahimi  
ASTM F16 Chairman

- Conducting Fastener HE research at McGill University since 2005
- Author of ASTM F1941, electroplating finishes for fasteners
- Contributor to ISO TC2 fastener finishes
- Recipient of recognition awards related to HE from ASTM F16 and the Industrial Fasteners Institute (IFI)

## ASTM F16 Positions Stated Today

- Extensive fastener experience.
- HE research specific to fastener related materials and their interactions with finishes.
- **Research Facts about Fastener HE Failures**
  - HE failures do NOT occur in fasteners with hardness less than **HRC 40** when the microstructure is uniform.
  - Fasteners must be under stress
  - Failures are delayed
    - IHE occurs within 48 hours of applied stress
    - EHE can occur any time after 48 hours – usually weeks to years after installation.



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## BOP bolt failure issue

- On **December 18, 2012**, while the Transocean Discoverer India was performing drilling operations at the Keathley Canyon (KC) KC-736 lease block in the Gulf of Mexico, the rig's lower marine riser package (LMRP) separated from the blowout preventer (BOP) stack resulting in the release of approximately 432 barrels of synthetic-based drilling fluids into the Gulf of Mexico. **Chevron, the designated operator, reported to the Bureau of Safety and Environmental Enforcement (BSEE**

## Information from BSEE report

- The failure of the GE H4 connector bolts was primarily caused by hydrogen induced stress corrosion cracking **(SCC) due to hydrogen embrittlement**, which led to the fracturing of the installed bolts. This finding is consistent with the conclusions of the Transocean/Chevron/GE root cause analysis.
- **ASTM F16 experts agree this was an environmental hydrogen embrittlement (EHE) failure.**

**ASTM F16 experts disagree that this was internal hydrogen embrittlement (IHE) failure resulting from baking processing.**

## Information from BSEE report

- A GE subcontractor relied on an older 1998 version of the American Society for Testing and Materials (ASTM) B633 standard and therefore, the bolts **did not receive the required post electroplating treatment**. This finding is consistent with the Transocean/Chevron/GE submitted root cause analysis report.
- **ASTM F16 experts disagree that the failure had anything to do with baking. If these bolts would have baked a week or more they still would have failed!**
- **The inappropriate application of zinc plating and the improper cathodic protection were two key factors!**

## Information from BSEE report

- Existing industry standards do not adequately address bolting/connector performance in subsea marine applications. For example, although API Specification 16A provides requirements for BOP connectors, it does not contain material property requirements for the connection bolting used for subsea applications. Furthermore, other industry standards that apply to subsea equipment have different maximum hardness limit requirements for bolts.

**ASTM F16 feels that subsea applications should be limited to the use of ASTM F1137, phosphate and oil finish and that all bolts should be thoroughly painted for added protection.**

## Information from BSEE report

### 1. *Improve industry standards.*

- BSEE should encourage industry to develop a consistent set of standards for connections and connection fasteners used in all offshore subsea systems, including a requirement that allows tracking connection components during their service life. **This should include clear and consistent guidance on material hardness, yield strength and ultimate tensile strength requirements.** (The release of API Spec 20E; First Edition, August 2012 "Alloy and Carbon Steel Bolting for use in the Petroleum and Natural Gas Industries" should address some of the concerns regarding manufacture of bolts, studs, etc.)
- BSEE should request that ASTM** further revise its relevant standards to provide additional clarity related to the design and use of coatings for marine service.

**ASTM F16 is willing to provide input into API bolting specifications.**

## Information from BSEE report

- **GE did not sign off on the final 2013 Combined RCA Report** because it believed that the true root cause for the bolts fracture and cause for synthetic-based mud spillage was not determined.

GE's representatives also stated that they are confident in the performance reliability of the replaced H4 connector bolts by **reverting to the previously used zinc phosphate coating** (with a post-bake period specified) for the following reasons:

- They report no previous issues or failures with the zinc phosphate coating,
  - The bolts located on the lower H4 connector on the same BOP stack that were coated with the same previous zinc phosphate coating were completely intact without any identified fractures or cracks, and
  - A third party reviewed and approved use of the replacement bolts.
- **ASTM F16 agrees with GE that the most logical action is simply to revert to phosphate and oil finish per ATMS F1137 (baking not required)!**

## Information from BSEE report

- **GE's technical staff disagrees with the QC-FIT interpretation of ASTM B633** and believes that the charts relied upon by QC-FIT are only "examples of appropriate service conditions" and "non-mandatory." In addition, GE states that proper application of relevant API standards does not permit use of coatings with thickness greater than SC 2 since the relevant assembly could not be accomplished to meet API requirements. Furthermore, GE believes that a review of all relevant industry standards supports its position that the bolts met the required specifications.
- The fact that two groups differ on a provision within a key **ASTM document suggests that the document needs to be clarified or a request for interpretation be submitted to ASTM.** The QC-FIT recommends further examination of appropriate ASTM fastener standards for material coating selection for subsea applications. In particular, are the current standards suitable for the current marine environments where companies are now operating?
- **ASTM F16 feels B633 or any other zinc plating is inappropriate for subsea and phos & oil or a barrier coating like Xylan should be used.**

## Understanding issue based on report

- **F. ABSENCE OF PAINT OR COATING**
- The 2013 Combined RCA Report discussed the impact of the absence of paint or coating on hydrogen generation on cathodically protected structures. The purpose of paint on subsea structures is to reduce the current required for cathodic protection by sealing and elimination of the available interface for cathodic reaction. **Although it is impossible for a paint coating to form a complete hermetic seal, unpainted areas will result in increased current drawn from the CP anode system current, resulting in some amount of hydrogen generation.** The more negative the CP value, the higher the potential for hydrogen charging (2013 Combined RCA Report pages 328-330). **Therefore, hydrogen ion generation can possibly contribute to hydrogen embrittlement corrosion** (GE states that their inspection program has been revised to include 100% visual and documentation for the H4 assembly prior to shipment). It is not known to what extent this contributed to the bolt incident in question here.
- **ASTM F16 experts feel proper painting is critical in preventing HE.**

## ASTM F16 suggestions for subsea fasteners

1. ***Never use zinc electroplating on any subsea bolts.***
  1. *The failures were EHE and NOT IHE.*
  2. *Baking played no role in the bolt failures!*
2. ***For subsea fasteners use ASTM F1137, phosphate and oil finish (no baking required) or barrier finishes like Xylan.***
3. ***ASTM F16 is willing to provide research, input, and other assistance to API on all issues related to bolting standards and specifications.***

## F16 Fasteners

**Title:** Workshop on Hydrogen Embrittlement Avoidance in Mechanical Fasteners Focus on the Oil and Gas Industry

**Dates:** Sunday May 17 2015

**Location:** Marriott Anaheim; Anaheim, CA

**Event Name:** May 2015 Committee Week

[About The Event](#)

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### About the Event

A Workshop on Hydrogen Embrittlement Avoidance in Mechanical Fasteners – Focus on the Oil & Gas Industry will be held Sunday, May 17, 2015 from 1:00pm - 5:00pm. Sponsored by ASTM Committee F16 on Fasteners, the workshop will be held at the Marriott Anaheim in Anaheim, CA, in conjunction with the May standards development meetings of the committee.

#### Objectives

Following the December, 2012 failure of H4 connector bolts on a Chevron oil rig in the Gulf of Mexico and the ensuing report by the Bureau of Safety and Environmental Enforcement (BSEE), to address the general issues of fastener and bolting standards in the oil and gas industry, with a particular focus on Hydrogen Embrittlement Avoidance. This workshop will be undertaken as a collaborative effort between all stakeholders.

#### The main objectives of the workshop are:

1. To engage and inform stakeholders in the oil and gas industry about the science and state of the art relative to preventing fastener hydrogen embrittlement.
2. To promote adoption of effective preventive measures in oil and gas industry standards and practices.
3. To advise the oil and gas industry regarding the appropriate ASTM standards for fastener hydrogen embrittlement avoidance (e.g., ASTM F1941).

#### Who Should Attend?


- Oil companies, offshore platform operators, oil platform manufacturers and their fastener supply chain
- Consensus Standards Organizations: API, ASME
- ASTM Committees: F16, A01, B08, G01, F07
- Industrial Fasteners Institute (IFI)

#### Preliminary list of topics of interest

1. Review of Chevron case and BSEE report
2. Fundamentals of fastener hydrogen embrittlement
3. Latest research findings
4. Other failure case studies
5. Baking requirements and ASTM standards
6. Recommendations for oil and gas standards and practices



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# IFI Mission:

To represent the North American fastener manufacturers to its suppliers, customers, the government, and the public at large to advance the competitiveness, products, and innovative technology of the IFI Member Companies in a global marketplace.


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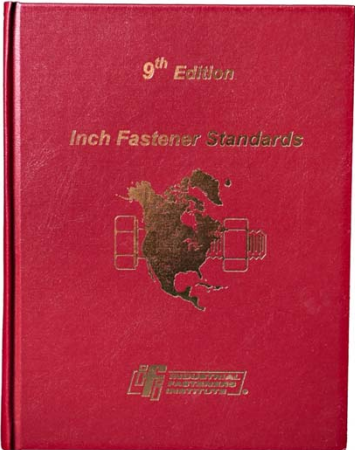
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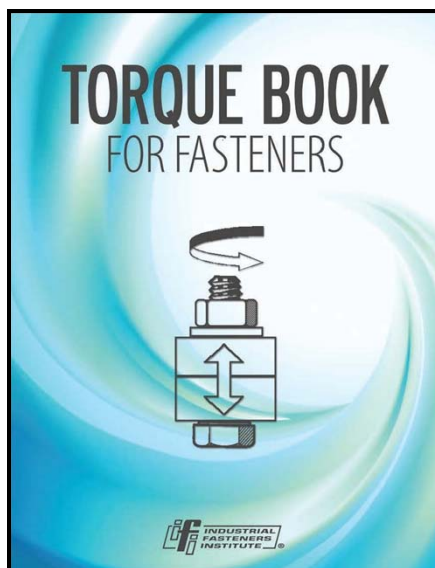
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## **IFI Standards Books**





## ***Fastener Brain for Only \$125***

***Mechanical Fastening and Joining*** by Bengt Blendulf



Bengt Blendulf is acknowledged as one of the leading fastener authorities in the world today. In 2013 he was honored with the *IFI Soaring Eagle Award* for his 50 years of technological contributions to the North American fastener industry.

The IFI worked with Mr. Blendulf for over two years to capture the fastener knowledge that resides in his fantastic fastener brain for the on-going benefit of the fastener industry. The result was the book entitled *Mechanical Fastening and Joining* which is a compilation of over 60 articles written by Mr. Blendulf on a wide variety of crucial and timeless fastener topics.

Every sales and technical person working in the fastener industry should read this book. How can you pass up a whole brain's worth of fastener knowledge for just **\$125**?



<http://www.indfast.org/shop/>

## IFI Fastener Technology Handbook

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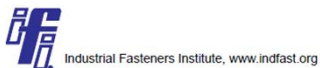
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### *The 90 Critical Fastener Facts Every Fastener Supplier and User Should Know*




*Is your staff well versed in fastener technology?*



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### Bolt and Cap Screw Technology



21. What is the standard covering inch bolt and screw Grades 2, 5, and 8?  
*SAE J429 is the standard that covers inch bolt and screws Grades 2, 5, and 8.*

22. What is the ISO standard covering metric bolt and screw Property Classes 4.8 ...12.9?  
*ISO 898-1 is the standard that covers metric bolt and screws Property Classes 4.8, 8.8, 10.9, and 12.9.*

23. What is the inch standard covering stainless steel hex head cap screws and what are the two most commonly supplied grades?  
*ASTM A593 is the inch standard covering stainless steel hex head cap screws with the most commonly supplied grades being Group 1 CW (304) and Group 2 CW (316).*

24. What is the ISO bolt standard covering Property Classes A2 and A4?  
*ISO 3506-1 is the ISO bolt standard that covers Property Classes A2 and A4.*

a. What types of stainless materials are designated A2 and A4?  
*The types of stainless materials that are designated A2 and A4 are 304 SS and 316 SS respectively.*

b. What does the "-70" represent in the designation A2-70?  
*The "-70" in the designation A2-70 represents the minimum tensile strength of 70 MPa.*

25. What is the most commonly used inch standard covering bolts and various cap screws?  
*ASME B18.2.1 is the most commonly used inch standard covering bolts and various cap screws.*

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The Fastener Training Institute® provides beginning and advanced training on fastener products, standards and specifications.

Our core purpose is to enhance fastener use, reliability and safety. By providing fastener product and technical training at all levels, the Fastener Training Institute® can achieve its goal of strengthening the industry and its personnel in all segments.

**Last chance to attend Fastener Training Week in 2014!**

FTI continues its partnership with the Industrial Fasteners Institute to offer this acclaimed training program. In 2014 Fastener Training Week has been presented three times with one final week available to attend in Cleveland, Ohio. Click here to see an overview of the course content.

The Certified Fastener Specialist program has over 400 graduates. You can be one too!

Click here to get more information about the Cleveland class and to register online. Space is limited!

**What's on the training calendar for September?**

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[www.fastenertraining.org](http://www.fastenertraining.org)

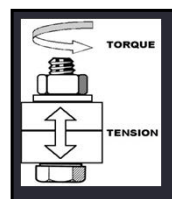
## Fastener Training Week - 2015

- July 28- August 1 - Independence, Ohio
- November 17-21 - Independence, Ohio

- **Content**

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Our core purpose is to enhance fastener use, reliability and safety

### Webinar: Thread Fit Matters

August 15, 2014  
8:00 - 9:30 am Pacific Time  
Webinar

Thread Fit Matters is a live, interactive webinar presented by Joe Greenslade, an acknowledged expert on this material. This webinar is an extraordinary opportunity to experience Joe presenting this important material and to have your fastener questions answered.

Topics include:

- Thread terminology (inch and metric)
- Classes of inch and metric threads
- Product thread acceptability rules from ASME B1.2, B1.3, and ISO 1502
- Rules regarding plated and coated threads
- Torque test procedure for nicked and plated or coated threads
- Types of thread gages and their proper use

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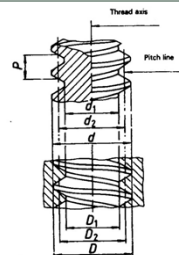
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## Q&A



*Joe Greenslade*  
*IFI Director of Engineering Technology*