API SC21 TASK GROUP ON MULTI-SEGMENT BOLTING TASK GROUP RECOMMENDATIONS

MEETING AGENDA

July 27, 2016 2:00 – 5:00 PM **TSP, 3303 W. 12th St. Houston, TX 77008**

1.0 Introduction of Participants

2.0 Task Group Charge

3.0 TGR- 8 (See attachments 3A) Proposed Action Plan

- 3.1 Review of relevant specifications (See attachments 3B, 3C)
- 3.2 Form sub-group

4.0 TRG-4 (See attachments 4A, 4B) Proposed Action Plan

- 4.1 Define scope of the document
  Product specified by product specification to 20E or 20F?
- 4.2 Form sub-group
- 4.3 Liaise with product subcommittees to write document (See attachment 4C)
  SC6, SC16, SC17

5.0 TGR-3 (See attachment 5A, 5B) Proposed Action Plan

- 5.1 Determine possible alternative coatings
  Market review
  Literature review
- 5.2 Prepare listing of possible alternative coatings (See attachment 5C)
  Coating type
  Advantages and disadvantages
- 5.3 Form sub-group
- 5.4 Provide information to product committee and SC21 TG sub-groups on TRG-1, TRG-4 and 8

6.0 TR-1 (See attachment 6A, 6B) Proposed Action Plan

- 6.1 Participate in ASTM Committees B08 and F16 on revision of ASTM coating/plating specifications
- 6.2 Research and report on existing data on coating and plating
  API, ASTM, IFI (See attachment 6C)
- 6.3 Evaluate data and determine additional testing needed
- 6.4 Proceed with testing
- 6.5 Report results to product subcommittees
- 6.6 Form sub-group to accomplish 6.2-6.4

7.0 Review proposed completion dates (See Attachment 7A)

8.0 Next Meeting

TGR-8

Do not allow use of B7 or L7 grades above 2.5" in diameter.TG recommends that this be included as part of the overarching document under SC21.

TABLE 1 Mechanical Requirements

Class and Grade, Diameter, in [mm]	Heat Treatment	Minimum Tempering Temperature °F [°C]	Tensile Strength, min, ksi [MPa]	Yield Strength, min, ksi [MPa] (0.2 % offset)	Elongation in 2 in. or 50 mm min, %	Reduction of Area, min, %	Hardness max
		Ferritic Steels					
L7, L7A, L7B, L7C, L70, L71, L72, L73			125	105	16	50	321 HBW or 35 HRC
2½ [65] and under[A]	quenched and tempered	1100 [593]	[860]	[725]			
L43			125	105	16	50	321 HBW or 35 HRC
4 [100] and under[A]	quenched and tempered	1100 [593]	[860]	[725]			
L7M			100	80	18	50	235 HBW[B] or 99 HRB
2½ [65] and under[A]	quenched and tempered	1150 [620]	[690]	[550]			
L1			125	105	16	50	. . .
1 [25] and under[A]	quenched and tempered		[860]	[725]			

TABLE 2 Mechanical Requirements — Inch Products

Grade	Diameter, in.	Minimum Tempering Temperature, °F	Tensile Strength, min, ksi	Yield Strength, min, 0.2 % offset, ksi	Elongation in 4D, min, %	Reduction of Area, min, %	Hardness, max
		Ferritic Steels					
B5 4 to 6 % chromium	up to 4, incl	1100	100	80	16	50	. . .
B6 13 % chromium	up to 4, incl	1100	110	85	15	50	. . .
B6X 13 % chromium	up to 4, incl	1100	90	70	16	50	26 HRC
B7 Chromium-molybdenum	2½ and under	1100	125	105	16	50	321 HBW or 35 HRC
	over 2½ to 4	1100	115	95	16	50	321 HBW or 35 HRC
	over 4 to 7	1100	100	75	18	50	321 HBW or 35 HRC
B7M[A] Chromium-molybdenum	4 and under	1150	100	80	18	50	235 HBW or 99 HRB
	over 4 to 7	1150	100	75	18	50	235 HBW or 99 HRB
B16 Chromium-molybdenum-vanadium	2½ and under	1200	125	105	18	50	321 HBW or 35 HRC
	over 2½ to 4	1200	110	95	17	45	321 HBW or 35 HRC
	over 4 to 8	1200	100	85	16	45	321 HBW or 35 HRC

TGR-4

TG recommends consideration of an overarching document issued by API through SC21 in cooperation with product SCs covering selection of proper bolting materials for different environments (including subsea) would be helpful.

Action on TGR-4 and TGR-8

- SC21 Task Group will investigate the development of an overarching document for selection of bolting materials:
  - TG will work with product subcommittees
  - TG will work with SC20E and SC20F task groups
- Based on results of the investigation Task Group will:
  - Develop an overarching document
  - Work with product subcommittees to include requirements in product specifications

(Example for Discussion)

Bolting Materials Specification Questionnaire - 20E and 20F Bolting

Subcommittee

1. Grade of bolting
    a. Minimum yield strength
    b. Maximum hardness
2. Size range
    a. nominal diameter
    b. length
3. Type of bolting
    a. Bolt
    b. Screw
    c. Stud
    d. Nut
4. Environment
    a. Media present
    b. Temperature

TGR-3

TG recommends prohibiting Zinc electroplating for Subsea/Marine application. TG further recommends that an investigation be conducted under the direction of SC21 to determine a better short term (storage) corrosion protection system that would not create hydrogen in service. The results of this study would then need to be adopted into product standards.

Action on TGR-3

- API 20E 2nd Edition now in ballot implements the recommended prohibition of zinc electroplating
- SC21 Task Group will investigate short term corrosion protection systems
- SC21 Task Group will make recommendations for the product specifications

Example

Coating / Plating Types

Name	Type	Specifications	Thickness	Description
Zn-Ni	Electropate	B841/F1941	5 -12 um	Sacreficial
Zn-Co	Electroplate	B994/F1941	5-25 um	Barrier
Fluorploymer	Spray-on			
Ceramic- Alumium				

TGR-1

TG notes that there is conflict between B633 and F1941 related to requirements for hydrogen embrittlement mitigation. B633 requires stress-relief and bake for product greater than 31 HRC. F1941 does not require stress-relief and requires bake for product greater than 39 HRC. API should contact ASTM to request resolution of this conflict. If this cannot be achieved through ASTM, then API needs to issue an equivalent document under API through SC21. In either case, the revised or new document will then need to be adopted by product SCs. This work should also include requirements for maximum hardness on bolting material.

Actions on TRG-1

- API (SC21) request sent to Committee B08 on Inorganic and Metallic Coatings (B633) and Committee F16 on Fasteners (F1941)
- B08 and F16 agreed the specifications should be harmonized
- Committee B08 ballot will seek to realign B633 requirements with F1941
- SC21 Task Group will provide liaison with ASTM groups and also begin work on an API document to be issued if API is not content with ASTM actions

Listing of some available Industry plating related references

1. Industrial Fasteners Institute (IFI) Bulletins:

   (Download from IFI website for fee)

   a. Galvanic Compatibility (Corrosion)
   b. Electroplating Thickness is not Uniform on Fasteners
   c. Measuring Plating Thickness on Fasteners
   d. Zinc-Nickel Alloy Plating provides a practical alternative to Zinc Plating on Socket Products and other high-hardness fasters
   e. Hydrogen Embrittlement in Fasteners – Scientific Information (2014)
   f. Hydrogen Embrittlement Testing in Critical for Some Hardened Fasteners
   g. Identifying Hydrogen Embrittlement Failures
   h. Here is what a Hydrogen Embrittlement Failure really looks like

2. IFI Reports:

   (Download from IFI website – no charge)

   a. Fundamentals of Hydrogen Embrittlement in Steel Fasteners
   b. Hydrogen Embrittlement in Coated Steel Fasteners

3. Industry Paper:

   (From publisher)

   - Hydrogen Embrittlement characteristics of two tempered martensitic steel alloys for high-strength bolting

     Department of Mining & Materials Engineering, McGill University,
     Montreal, QC, Canada
     Proc IMechE Part C:
     Mechanical Engineering Science 0(0) 1–14

4. ASTM Reports:

   (Order from ASTM)

   a. Research Report to F1940 Standards Test Method for Process Control Verification to Prevent Hydrogen Embrittlement in Plated or Coated Fasteners
   b. STP962 Hydrogen Embrittlement: Prevention Control

Attachment 7A

API SC21 TASK GROUP ON MULTI-SEGMENT BOLTING TASK GROUP RECOMMENDATIONS

Proposed Completion Dates

July 27, 2016 Meeting

1.0 TGR- 8 Sub-group

- Report recommendation for TG review: **8/23/16**

2.0 TRG-4 Sub-group

- Define scope of the document: **7/27/16**
- Provide outline of document based on liaison with product subcommittees: **8/23/16**
- Complete document for TG review: **Year end 2016**

3.0 TGR-3 Sub-group

- Report recommended alternative coatings for TG review: **8/23/16**

4.0 TR-1 (See attachment 6A, 6B) Proposed Action Plan

- Report on ASTM Committees B08 and F16 activities: **Monthly**
- Research and report on existing data on coating and plating: **8/23/16**
- Determine and report additional testing needed: **8/23/16**
- Complete initial testing: **Year end 2016**
- Report results to product subcommittees: **Winter 2017 Meeting**