MINUTES

Meeting of the
API SUBCOMMITTEE ON VALVES
AND WELLHEAD EQUIPMENT
(API SC6)

at the
2009 Winter Meeting
on Oilfield Equipment and Materials

of the

AMERICAN PETROLEUM INSTITUTE
Host: Shell Woodcreek Park Offices
(Located in West Houston's Energy Corridor District)
150A North Dairy Ashford
Houston, TX

February 3, 2009

***

David Cole, Chairman
Ed Baniak, API Staff Representative
Roy W. Benefield, Secretary

AMERICAN PETROLEUM INSTITUTE
Upstream Standards
1220 L Street, NW
Washington, DC 20005
Date: Tuesday, February 3, 2009

Location: Shell Woodcreek Park Offices (Located in West Houston's Energy Corridor District)
150A North Dairy Ashford
Houston, TX

Items:
1. Call to Order – David Cole, Chairman, called the meeting to order. Safety comments were made.

2. Attendance – Ed Baniak – sign up sheet was passed for attendance (See Attachment 1).

3. Adoption of the Agenda – David Cole Motion, Made, seconded and passed to accept the agenda, revision 3, as sent out.

4. Establish a Quorum – SC6 Membership – David Cole – A quorum was present.

5. Ratify the Summer 2008 Calgary meeting minutes (attached, see API website for attachments) – David Cole – Minutes are posted on the Web site. Motion made, seconded, passed to approve as published.

6. Review 2008 ballot outcomes – Ed Baniak – The following ballots were discussed.
   a. Ballot 1420 - Repair & Remanufacture (Annex Q) – Published as Addendum 3, December 2008 – Passed with comments and editorial changes. Is acceptable to API legal counsel.
   b. Ballot 1442 - Addition of Filler Grease – Published as part of Addendum 2, December 2008 – Passed.
   c. Ballot 1472 - Reaffirmation of API 6FD – Document Reaffirmed
   d. Ballot 1475 - Changes to TR 6AF2 – Document format updated and changes published.
   e. Ballot 1476 - Changes to TR 6AF – Document format updated and changes published.
   f. Ballot 1513 - Changes to API 6A Table 7 – Published as part of Addendum 2, December 2008
   g. Ballot 1564 – Bullplug Coatings, API Spec 6A – Published as part of Addendum 4, December 2008 – To be included in ISO 10423 FDIS.
   h. Ballot 1565 – Bullplug Dimensional Allowance, API Spec 6A – Published as part of Addendum 4, December 2008 - To be included in ISO 10423 FDIS.
7. API Ballot System – Ed Baniak

a. Recent (2009) SC6 Ballots – Ballot 1587 (Changes to API 6FC) – Ballot 1587 (reaffirming API 6FC) The Spec 6F (fire test) series was reaffirmed in 2006. However, due to an oversight that precedes the chair or the API staff involvement in SC6, technical comments to 6FC were never resolved. Ed Baniak is working with the submitter of the comments to resolve the ballot comments.

b. Improvements to ballot system. – As a result of an ANSI audit, the API ballot system is being changed. These changes will benefit subcommittees who with diverse user groups and have managed with separate voting groups. SC6 could change from separate 6A and 6D voting groups, but not likely in the short term. The change is that to obtain the required 50% of eligible voters required by API, the 50% voting will include abstentions in the calculation toward 50%. The requirement to have 2/3 of ballots cast to be in the affirmative has not changed (must be 2/3 of votes cast either yes or no).

8. Report/Updates from Task Groups

a. 20K Flanges - Shyam Patel – John Fowler reported for Shyam. See Attachment 2. New gasket design is being considered. Hydril has designed a very large flange with larger than normal bolting (3.75 diameter and higher strength materials). – non API. Design may include a lip-type gasket in lieu of the BX-164. It would help to have high-strength bolting. BX-164 gasket design is being evaluated for the 20K applications.

b. Use of Castings -Sterling Lewis – See Attachment 3. Two major issues that kept ISO and API from being identical. Cast verses forge is one of them. (Repair was the other.) ISO 10423 PSL 3 does not allow castings. Wording will be changed to advise against castings in 6A Annex A for PSL 3 and 4, and to provide guidance for use of castings. Can a manufacturer monogram and PSL 3 cast product? Yes, where applicable. ISO still says no casting for PSL 3. Wrought products will be specified for PSL 3 and 4 mandrel hangers. Text needs to designate PSL 3G as well as PSL 3. Ed pointed out that this is a technical change and may want to handle it as a Regional Annex, because ISO 10423 is in FDIS stage. It is preferred to be a normative text in the body of the ISO document. Could be a second DIS to 10423, but will open up all changes for comment. Will have to resolve with ISO for agreement. Action is for Sterling to get final language and send to ISO, and for Ed to contact ISO as to how and when to revise 10423 (if ISO likes the change).

c. API 6HP - Earl Shanks – Ken Young reporting for Earl. See Attachment 4. Next meeting is to be scheduled. Presented to ECS at Winter Conference. Some delay to convene another meeting because of process issues. Earl reported that these overheads are being used to explain the document to the industry on design validation and verification. This document is intended to be a reference for the API communities. There is concern that this document is being referenced in the industry before it is ready.

d. Pipeline Valves - Rick Faircloth – See Attachment 5. Updates on 6D. Some interpretations. Also will be looking at calibration and quality control issues. Reference ISO 7268 document that used “pn” numbers. The document is in ballot and “pn” numbers are being changed. This may cause problems and some are not happy. We want to stop reference to ISO 7268 in our documents. Ed says this might be done by an editorial change. Action by Ed: It was requested that the ISO 7268 communication (email) with ISO be put on the Web site or attached to the minutes of this meeting (Completed – See Attachment 6).

e. ASME Section 8 Div. II changes - John Fowler – See Attachment 7. Comments are being considered. They will enlist the Assistance of 16A, 16C and 17D people to help.
f. API 6A718 - Tim Haeberle – **See Attachment 8.** There was a meeting January 2. There was good interest and membership. Guidance from SC6 is requested on validation requirements need in API Spec 6A718 and what does it mean. API Q1 Section 7.5.2 requires a procedure. It was agreed that this applies to product and process specifications, and not necessarily material specifications. Ed suggested that API Spec 6A718 be designated as a “standard” instead of a “specification.” Process validation would then not be an applicable. There was some objection to this. There was also discussion concerning competence of testing and calibration laboratories. It was suggested that some sections of ISO/IEC 17025 be inserted in the API Spec 6A718, as applicable. This should probably be in the 6A parent document and driven by that document. The Work Group will continue to meet and hopes to have a completed ballot by the June meeting.

g. API 6AV1 - Eric Wehner – Eric reported that there is still work to be done on this issue. Southwest Research (San Antonio) is currently the only resource on this specification.

9. ISO 10423 Status – Ries Langereis – **See Attachment 9.** Eric Wehner reported for Ries. An action item list was reviewed.

10. API and ISO Cooperation - David Cole & Ries Langereis – In the short term, the plan will be to attempt to have representation from both API and ISO on any work groups affecting the shared documents. In a separate item, David Cole reported that API ECS is proposing formalizing the process to determine whether new documents and document revisions are handled by API alone or by API/ISO. The intent is for each subcommittee to look at the need for and the resources to support adopt-back. There appears to be little difference in what is proposed and what SC6 has been doing.

11. New Business

   a. AWHEM Reports - **Metallic Material Limits for Wellhead Equipment Used in High Temperature for API 6A And 17D Applications:** Phase I (dated 4-04); Phase II (dated 9-06); Phase III (dated 11-08) [Abstracts below]

   Ed reported on the status of this project. The abstracts were attached to the agenda of this meeting. Is there a need for SC6 task group or work group to utilize these reports? This could be used in Appendix G for de-rating of materials. Some of this is in ISO 10423 already. **Action:** Austin Freeman volunteered to lead in the effort to evaluate the status and determine a path forward (concerning AWHEM Reports - Metallic Material Limits for Wellhead Equipment Used in High Temperature for API 6A And 17D Applications: Phase I (dated 4-04); Phase II (dated 9-06); Phase III (dated 11-08)), with the help of Tim Haeberle. AWHEM should be requested put these reports in final form for publication. Eric will bring this up at AWHEM.

   b. SC6 PER-15K Membership Solicitation – ECS solicited each impacted SC to ensure that they had a liaison with the PER-15K effort. Shyam Patel, Ken Young and Morgan Bruck volunteered to represent SC6 in this effort.

   c. SC6 is to review product specification licensing categories to ensure their accuracy – We need to go through 6A and determine what products do not include design activities (i.e., ring gaskets, blind flanges, studs and nuts, etc.) We need to identify the products
that are manufacture designed products verse commodity products (i.e., standards designed products). Is the facility an assembler, tester, etc.  

Eric Wehner volunteered to develop a list of API Spec 6A products that do not require manufacture design.

d. SC6 determined that there were no additional processes requiring validation other than the default processes of welding, heat treating and NDE.

e. Color-coding requirements of SC6 documents – SC6 needs to notify Monogram Program – David reported that c, d and e are requests from Committee 18. Ed reported on the request from SC18 and what they mean. Action: SC 6 is to determine which documents are to be color-coded. (6A, 6D, 6H, and 6DSS.) SC6 determined that only 6DSS requires color coding at this time. 6A will be revisited later when newest revision is issued

f. Other – None Identified.

12. Adjourn (Next Meeting: June 2009, Westminster [Denver], Colorado)

Action Item Summary:

1. Action is for Sterling Lewis to get final casting language and send to ISO, and for Ed Baniak to contact ISO as to how and when to revise 10423 (if ISO likes the change).

2. Action by Ed: It was requested that the ISO 7268 communication (email) with ISO be put on the Web site or attached to the minutes of this meeting (Completed, see Attachment 6).

3. Austin Freeman volunteered to lead in the effort to evaluate the status and determine a path forward (concerning AWHEM Reports - Metallic Material Limits for Wellhead Equipment Used in High Temperature for API 6A And 17D Applications: Phase I (dated 4-04); Phase II (dated 9-06); Phase III (dated 11-08)), with the help of Tim Haeberle. AWHEM should be requested put these reports in final form for publication. Eric will bring this up at AWHEM

4. Eric Wehner volunteered to develop a list of API Spec 6A products that do not require manufacture design.
PHASE I Abstract:
This API-funded project was conducted by a Task Group charged by the Association of Well Head Equipment Manufacturers (AWHEM). The Task Group examined mechanical properties of metallic materials used for API 6A and 17D wellhead equipment for service above 250°F. Six different materials meeting API 6A, PSL 3 and 75 Ksi conditions were supplied “in condition” by a variety of suppliers. Yield strength reduction ratios at temperatures of 300, 350 and 400°F from “mid-radius” specimens were determined. As a result of testing, yield strength reduction ratios ranged from 93% at 300°F to 89% at 400°F by averaging results of heats for each type of material. Materials such as AISI 4130 showed the greatest variability due to hardenability issues. These results are intended to amplify data shown in API 6A, Appendix G. (11 page report)

PHASE II Abstract:
This API-funded project was conducted by a Task Group charged by the Association of Well Head Equipment Manufacturers (AWHEM). The Task Group examined mechanical properties of metallic materials used for API 6A and 17D wellhead equipment for service above 250°F. Phase I of the project tested six different Low Alloy materials meeting API 6A, PSL 3 and 75 Ksi conditions which were supplied “in condition” by a variety of suppliers. Similarly Phase II examined five different corrosion resistant alloys (CRAs). Yield strength reduction ratios at temperatures of 300, 350 and 400°F from “in condition” specimens were determined. As a result of testing, yield strength reduction ratios ranged from 99% at 300°F to 76% at 400°F by averaging results of heats for each type of material. Supplier-furnished data was used for some of the material due to the difficulty in obtaining CRA in tight market conditions. Test results from some labs on certain material produced widely varying results and were removed. Some bad data were due to movement of the specimen or extensometer extensions during testing. Shortages of material precluded retesting. (15 page report)

PHASE III Abstract:
This API-funded project was conducted by a Task Group charged by the Association of Well Head Equipment Manufacturers (AWHEM). The Task Group examined mechanical properties of metallic materials used for API 6A and 17D wellhead equipment for service above 250°F. The maximum test temperature for mechanical properties was 450°F. The work reported here investigates the short term effect of temperature on the mechanical properties and any long term effects at these temperatures on the microstructure of these age-hardenable CRA alloys is outside the scope of this work. Phase I of the project tested six different Low Alloy materials meeting API 6A, PSL 3 and 75 Ksi conditions which were supplied “in condition” by a variety of suppliers. Phase II tested five different corrosion resistant alloys where the two alloys, nickel alloys 925 and 625Plus/725, failed to achieve a correlation of elevated temperature properties. Phase III was approved by API for a new round of testing on nickel alloys 925 and 625Plus/725. Yield strength reduction factors at temperatures of 300, 350 and 450°F from “in condition” specimens were determined. As a result of testing, yield strength reduction factors ranged from 0.93 at 300°F to 0.89 at 450°F by averaging results of heats for each type of material. The results from Phase III were shown to be in good agreement with supplier-furnished data for the same alloys. (9 page report)
# RECORD OF MEETING ATTENDANCE

**GROUP** SCG  
**CHAIRMAN** D. COLE  
**MEETING** WINTER MEETING  
**TIME** 9:00 AM  
**DATE** 2/3/09

**COMMITTEE MEMBERS SHOULD MAKE CHANGES TO THEIR PERSONAL RECORD ON THE ATTACHED ROSTER. VISITORS ADDING NAMES TO ROSTER WILL NOT AUTOMATICALLY BECOME MEMBERS OF THE COMMITTEE.**

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**Indicate BEFORE YOUR NAME if you are:**  
(M) Member of the Committee in session  
(R) Representing a Committee Member (if so, state member's name)  
(V) Visitor – ONLY voting members or their Representatives may vote  
(S) Staff

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<tr>
<td>David Cole</td>
<td>Shell</td>
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<td>Ed Banik</td>
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<td>Roy W. Benefield</td>
<td>FMC Tech Inc.</td>
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<td>Jean Brunjes</td>
<td>VTCG</td>
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<td>Ken Young</td>
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<td>Robert Barnett</td>
<td>UGPC</td>
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<tr>
<td>John Fowler</td>
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**THIS FORM MUST BE RETURNED TO THE API STAFF**

API standards meetings are open to all interested parties. By participating in the standardization process, you agree: (1) to fully comply with API's policies and procedures governing standards, (2) that once balloted and approved by API, API shall have the sole and exclusive right to use any materials that are submitted by the participant for use in the standard, (3) you will not provide any material that will violate the rights of any third parties including, but not limited to, patents, copyrights, trade secrets, and trademarks, and (4) to disclose the existence of any patented technologies in the material that you provide.
**Indicate BEFORE YOUR NAME if you are:**

(M) Member of the Committee in session  
(R) Representing a Committee Member (if so, state member's name)  
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(S) Staff

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<td>Rob OLDE WEIGHUUS</td>
<td>MOUVELD VALUES R. OLDE <a href="mailto:WEIGHUUS@PLANET.NL">WEIGHUUS@PLANET.NL</a></td>
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<tr>
<td>M</td>
<td>Sterling LEWIS</td>
<td>ExxonMobil <a href="mailto:Sterling.F.Lewis@exxonmobil.com">Sterling.F.Lewis@exxonmobil.com</a></td>
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<tr>
<td>V</td>
<td>EARL SHANKS</td>
<td>DTC 281-366-3758 <a href="mailto:shank.e@exxon.com">shank.e@exxon.com</a></td>
</tr>
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Date: February 2, 2009.
Task Group met only one time in August 08, since June Standardization conference.

- Continued work on discussing probable solutions to Design challenges (reported in June 08), from preliminary static load design i.e. sizing of flange.

- Preliminary Flange Design is considered too large considering practical aspects such as large foot print, very large bolt diameter and very high bolt torque and resulting heavy equipment design.

- Performed comparative study of bolt sizes in existing 15K & 20K API Flanges. Only general observation was made that for 18-3/4”-20K Flange Design will need High Strength or CRA HS bolting.
Task Group Status Report

- BX-164 Gasket is inadequate. New Gasket is needed.
  - Existing API BX Gaskets were designed per Eichenberg’s method. Adopted in API 6A (Grandfathered). No references to Design Validation Testing.
  - Gasket Design and Validation Method to be determined.

Task Group Concerns:
- Flange Design Method & Allowable may differ from present API 6A Flanges.
- No past references known for existing Gasket validation procedure.
API 6A Workgroup on PSL 3 Castings

February 3, 2009

Castings allowed in 6A but not in ISO 10423 at PSL 3 and above.
Status

- Work Group meeting was held November 2008

- Proposed wording was circulated in workgroup, January 2009

- Propose workgroup will submit ballot wording that would:
  - Provide additional user guidance for cast bodies in Annex A
  - Accept ISO wording for prohibiting use of cast PSL3 and PSL4 mandrel hangers
  - Prohibit use of PSL 4 castings for bodies, bonnets, end and outlet connections
  - Provide additional restriction for repair of casting defects in PSL3 bodies
Two Trains of Thought

Restrict Quality
Castings may be inappropriate for some service conditions. Higher PSL levels are normally associated with more severe service conditions (Figure A.3). Limiting the available PSL levels will prevent use in severe service conditions.

Restrict Use
User is responsible to ensure products purchased are appropriate for service conditions. Limiting the PSLs does not limit/provide service conditions guidance for castings. User may wish for higher quality requirements for castings in the same service conditions (volumetric NDE & 100% surface NDE). Allowing PSL 3 castings will enable user to specify the desired level of quality for intended service.

API 6A is a manufacturing specification. The selection guide Annex A is informative.
**Annex A Guidance**

**Add New Section in Annex A (informative)**

**A.6 Use of Castings**

Purchaser should evaluate the use and requirements of cast pressure containing parts and mandrel hangers for an application. The manufacturing methods for forgings (wrought) and castings may produce differences in performance, quality, grain structure and corrosion resistance for the same PSL. However, castings may be beneficial by providing reduced manufacturing costs for parts of large size and complex shape.

Castings inherently have more problems with porosity, cavities and inclusions. The hot work practices of wrought parts tend to eliminate porosity and cavities. Additionally, grain structure is improved by hot work. Grain structure can affect corrosion resistance and toughness of the part. Specifying PSL 2 or PSL 3 will enable user to apply standard surface and volumetric inspections of castings for intended service.

Purchasers may limit applications or increase the PSL for a cast part as deemed appropriate for the classification of the equipment (primary / secondary) or service conditions. Table A.1 provides an example for the use of castings in different service conditions.
<table>
<thead>
<tr>
<th>Part</th>
<th>Rated Working Pressure (psi)</th>
<th>NACE MR-0175 / ISO 15156</th>
<th>High H2S Concentration &gt; 70 ppm</th>
<th>Classification</th>
<th>Well Type</th>
<th>PSL</th>
<th>Cast</th>
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<tbody>
<tr>
<td>Bodies</td>
<td>( \geq 103.5 \text{ MPA (15000 psi)} )</td>
<td>NACE or non-NACE</td>
<td>Any level</td>
<td>Primary &amp; Secondary</td>
<td>Gas</td>
<td>PSL 3G</td>
<td>Not Allowed</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Primary</td>
<td>Oil</td>
<td>PSL 3</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Secondary</td>
<td>Any Well</td>
<td>PSL 3</td>
<td></td>
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<td>Bodies</td>
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<td>Yes</td>
<td>Primary</td>
<td>Gas</td>
<td>PSL 3G</td>
<td>Not allowed</td>
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<td></td>
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<td>Bodies</td>
<td>( \leq 69.0 \text{ MPA (10000 psi)} )</td>
<td>Non-NACE</td>
<td>NA</td>
<td>Primary</td>
<td>Gas or Oil</td>
<td>PSL 2</td>
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<td></td>
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<td>Secondary</td>
<td>Any Well</td>
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<tr>
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<td>yes</td>
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<td>Gas</td>
<td>PSL 3</td>
<td>PSL 3G</td>
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<td></td>
<td></td>
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<td>Secondary</td>
<td>Any Well</td>
<td>PSL 2</td>
<td>PSL 3</td>
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5.3 Mandrel tubing and casing hangers
5.3.2.1 Casting practices
a) PSL 1 requirements
All castings used for hanger mandrels shall meet applicable requirements of Clause 5 and Clause 7.

*Remove Annex O wording*

b) PSL-2-4 requirements
The requirements for PSL 2-4 are identical to the requirements for PSL 1.

*Use ISO wording*

b) PSL 2 requirements
The requirements for PSL 2 are identical to the requirements for PSL 1. In addition the manufacturer shall document foundry practices which establish limits for sand control, core making, rigging, melting, heat treatment and NDE to ensure repeatability in providing castings which meet the requirements of this International Standard.

c) PSL 3 and PSL 4
Wrought products shall be used.
5.4 Bodies, bonnets, end and outlet connections

5.4.3 Processing

5.4.3.1 Casting practices

A recommended practice for heat-treating furnace calibration can be found in Annex P of this International Standard.

a) PSL 1 requirements

All castings used for bodies, bonnets end and outlet connections shall meet applicable requirements of Clause 5 and Clause 7.

*b) PSL 2-4 requirements

The requirements for PSL 2-4 are identical to the requirements for PSL1. In addition, the manufacturer shall document foundry practices which establish limits for sand control, core-making, rigging, melting and heat treatment and NDE to ensure repeatability in producing castings which meet the requirements of this International Standard.

Accept ISO wording for PSL 4

b) PSL 3 and PSL 4 requirements

Wrought products shall be used.
Weld Repair Of Castings

New Limit for PSL 3 repair welding on castings

6.4.2.1 Weld Repair of Castings
For PSL 3 castings only minor weld repairs are acceptable. The total volume of the excavations shall be less than 2% of the total volume of the raw casting.

Define minor weld repair (similar to ASTM A 703 S20.2)

3.1.X Minor weld repair of castings
A weld repair shall be considered minor when it is not meant to correct leakage on hydrostatic testing and when the depth of the cavity prepared for welding does not exceed 20% of the actual wall thickness, or 1 in. (25 mm) which ever is smaller, or when the extent of the cavity does not exceed approximately 10 in². (65 cm²).

3.1.X Major weld repair of castings
A weld repair shall be considered major when it is made to correct leakage on hydrostatic testing, or when the depth of the cavity prepared for welding exceeds 20% of the actual wall thickness, or 1 in. (25 mm), whichever is smaller, or when the extent of the cavity exceeds approximately 10 in². (65 cm²).

Update Table A1- Quality Control Requirements For Welding
Protocols for Equipment Rated Greater Than 15,000 PSI

PER15K - HPHT Equipment Development Process

PER15K TASK GROUP
API HPHT Task Group Deliverables

For the Development of Safe, Reliable, Fit-for-Use Products Outside of the Scope of Existing International E&P Standards Outline a Detailed Methodology for the:

Establishment of Product Essential Design Inputs (Basis of Design)

Identification of:
- Pressure, Temperature, & Applied Loads From Systems Analysis
- Product Life Cycle Requirements
- Product Reliability Requirements & Potential Failure Modes
- Material Data for Exposed Environments

Appropriate Product Design and Life Cycle Analysis Techniques

Establishment of Product Design Validation Protocols and Qualification Criteria

Identification of Essential:
- Manufacturing Process Control
- Inspection Requirements

Establishment of the Essential Storage, Handling and Use Parameters

Identification of Ongoing Data Collection and Product Performance Feedback
Drivers for API to Perform this Work

New product technology without significant industry experience

High Pressure thick wall forged bodies have a different failure mode which results in Fast Fracture as opposed to “Leak Before Burst” and requires different analysis techniques.

Challenging physical and environmental conditions of new E&P developments, beyond the limits of traditional industry standards.

Advanced design and analysis capabilities.

Industry commitment to the technical integrity and HSE associated with industry challenges.

Availability of significant historical experience and lessons-learned:
1980’s: 30,000 psi wellhead and Xmas tree equipment
1990’s: 300+ deg. F wellhead and Xmas tree equipment
2000’s: Advanced design analysis capabilities and design codes
Product Development Process For Existing or New Design Equipment

- **Basis of Design**
- **Functional Design Specification**
- **Design Equipment & Documentation**
  - **Design Verification**
  - **Design Validation**
    - **Both Legs Must Be Performed**

Fit for Purpose Qualification Process

- **Design Meets FDS**
  - **Yes**
    - **Production**
  - **No**
7.3.5 Design and development verification

ISO 9001:2000, Quality management systems—Requirements

7.3.5 Design and development verification

Verification shall be performed in accordance with planned arrangements (see 7.3.1) to ensure that the design and development outputs have met the design and development input requirements. Records of the results of the verification and any necessary actions shall be maintained (see 4.2.4).

Note: Design verification activities can include one or more of the following:

a. Confirming the accuracy of design results through the performance of alternative calculations.
b. Review of design output documents independent of activities of 7.3.4.
c. Comparing new designs to similar proven designs.
### 7.3.6 Design and development validation

ISO 9001:2000, *Quality management systems — Requirements*

#### 7.3.6 Design and development validation

Design and development validation shall be performed in accordance with planned arrangements (see 7.3.1) to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use, where known. Wherever practicable, validation shall be completed prior to the delivery or implementation of the product. Records of the results of validation and any necessary actions shall be maintained (see 4.2.4).

Note: Design validation can include one or more of the following:

a. Prototype tests.

b. Functional and/or operational tests of production products.

c. Tests specified by industry standards and/or regulatory requirements.

d. Field performance tests and reviews.
Project Basis of Design

Operational Specific Basis of Design

Equipment Location – Surface or Subsea
Location Environment – Max / Min
Pressure – Inside / Outside
  Maximum / Minimum / Transient / Steady State
  Various Flow Rates
Temperature – Inside / Outside
  Maximum / Minimum / Transient / Steady State
  Various Flow Rates
Environmental Exposure
  Outside (seawater, drilling and completion fluids, etc)
  Inside (seawater, drilling and completion fluids, etc)
Reservoir Surfaces Contact
Reservoir Chemistry
Anticipated Life Cycle Operating Requirements
  Interventions, Work Over, Shutdowns, etc.
Functional Design Specification

Operational Statement of Requirements

System Description

Operating Conditions based on Basis of Design Known Applied Loads

System Analysis to Obtain all Component Loads
  Include all Pertinent Equipment Interfaces
  Study Installation and Removal Loads
  Study Start-up, Steady State, Shut-down

Failure Modes & Effect Analysis of Components

Life Cycle Operations for System/Components

Environments in Contact w/ Wetted Surfaces
System Analysis Specification Breaks

Development Process:
- Basis of Design
- Functional Design Specification
- Design Equipment & Documentation
- Design Verification
- Design Validation
- Design Meets FDS
- Production

Above Wellhead

BOP or SS Tree

Wellhead Casing Tubing

Completion Equipment
Design & Documentation

Design Specifications and Practices
- Applicable Industry Standards
- Customer Specifications
- Company Proprietary IP

Determine Design Envelope & Interface Dimensions

Determine Physical Operating Envelope

Functional Issues (outlets, door openings, etc.)

Material / Welding Specifications

NDE Criteria

Specify Design Verification Analysis Requirements

Specify Design Validation Testing Requirements

Write Design Verification & Validation Quality Plans
Design Verification

Uses Functional Specification as Inputs

Design Material Properties
- Material Properties At Design Temperature (Inside & Out)
- Material Properties In Service Environment (Inside & Out)
- Determine Minimum Detectable Flaw Size (inspection)

Comprehensive Design Conditions Analyses
- Static, Dynamic, & Transient Pressure (Inside and Out)
- Thermal (Inside and Out)
- Loads (Tension, Bending, & Torsion)

Stress Analysis Using FEA
- Comprehensive Design Conditions (Operating)
- Hydrostatic Proof Test

Life Cycle Fatigue Analysis
- Fracture Mechanics/S-N Curves
- Cycles to Failure
Design Verification Analysis

- Design Verification
  - Design Analysis
  - LEFM Fatigue Analysis
    - Both Legs Must Be Performed
  - Design Verified
    - No
    - Yes
    - Design Validation
Design Analysis

Design Verification Analysis
- Applies to pressure containing parts
- Does not apply to pressure retaining parts
- Does not apply to closure bolting
- Does not apply to ring gaskets

Design Analysis

Plastic Collapse Analysis
ASME VIII-2 Par 5.2.4

Local Strain Limit Analysis
ASME VIII-2 Par 5.3.3

Ratcheting Analysis
ASME VIII-2 Par 5.5.7

Leak Before Burst

Yes
S-N Fatigue Analysis
ASME VIII-3 KD-3

No
LEFM Fatigue Analysis
ASME VIII-3 KD-4
LEFM Fatigue Analysis

- Analysis required for each critical section
- Assume initial crack size based upon NDE capability
- Crack aspect ratio should be updated as crack grows
- Use appropriate material crack growth rate data for environment and loading
- Allowable crack size based upon ASME Div 3 KD-412 or Other Acceptable Criteria
Design Validation

Design Test Program
- Use Functional Design Specifications
- Validate Design Verification
- Insitu Temperature Requirements
  - Inside and Outside
  - Dynamic, Transient, and Steady-State
- In-Service Load Conditions
  - Pressure & All Applied Loads (Tension, Bending, Etc)
  - Inside and Outside
  - Dynamic, Transient, and Steady-State
- Measure and Monitor Peak Stresses
- Establish Reliability Goals and Testing Methodology

If Physical Tests are Impractical
- Analytical Simulations
- Scale Model Tests
- Tests of Less Magnitude - Scale
Design Validation protocol development Using FMEA (Failure Mode and Effects Analysis)

- FMEA, Failure Mode and Effects Analysis is a bottoms up approach to analyzing system design and performance. FMEAs employ probability of failure categories based on probability ranges.

- FMECA, Failure Mode, Effects and Criticality Analysis is based on MIL-STD-1629, "Procedures for Performing a Failure Mode, Effects and Criticality Analysis". In a FMECA, the probability of a specific failure occurring is given as a numerical prediction.

- A FMEA is qualitative, whereas a FMECA is a quantitative analysis. The proper category is determined by the experience and expertise of the analyst, instead of a mathematical probability calculation involving actual component failure rates.
Design Meets Functional Design Specification (FDS)

Both Legs of Process Flowchart Must be Satisfied

The Design Validation Process Confirms the Design Verification Results

Document All Design, Verification & Validation Data

Design Specifications and Practices
  Applicable Industry Standards
  Customer Specifications
  Company Proprietary IP

Material / Welding Specifications

NDE Criteria

Design Verification Analysis

Design Validation Testing

Quality Plans
Elements Required to Complete The Manufacturing Process

Development Process

- Basis of Design
- Functional Design Specification
- Design Equipment & Documentation
- Design Verification
- Design Validation
- Design Meets FDS
- Production

Product / Manufacturing Elements
- API RECOMMENDED PRACTICE
- Design Basis
- Functional Specification
- Design Verification
- Design Validation
- Design / Prototype Elements
- Manufacture
- Purchase Specs
- Materials
- QA/QC
- Inspection
- FAT
- Use Documentation
- Repair
- Re-certify
Proposed Timeline for PER15K

**Protocol for Equipment Rated Greater than 15 ksi**

- Jim Raney/Earl Shanks

**Material’s Task Group**
- Jim Burk

**Design & Development Verification**
- Earl Shanks

**Design & Development Validation**
- Khedher Mellah

**PER15K**

PER15K form as a task group under the ESC.

### Proposed Time Line for PER15K

<table>
<thead>
<tr>
<th>Task</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation at the API Winter Meeting</td>
<td>Jan '09.</td>
</tr>
<tr>
<td>Set meeting with vendors and operators</td>
<td>Jan-June '09</td>
</tr>
<tr>
<td>Hold quarterly meeting to generate a draft document</td>
<td>Jan-Sept '09.</td>
</tr>
<tr>
<td>2nd Draft, Present at Winter API Meeting</td>
<td>Jan'10.</td>
</tr>
</tbody>
</table>
Materials Deliverables and Timeline

- Re-initiate Materials Task Group monthly meetings *February 2009*

- Establish lists of Materials and Property Requirements - *June 2009*
  - Elastic properties - Modulus & Poisson's ratio with temperature
  - Mechanical strength – yield and ultimate with temperature
  - Fracture Toughness – CVN, KIC/JIC with temperature
  - Fatigue – S/N and crack Growth rate
  - Environments – Air & Seawater

- Populate materials property tables – *October 2009*

- Establish additional data requirements – *December 2009*

- Propose testing (MMS F22 effort) – *2010 API Winter Meeting*
Verification Development & Timeline

Example Analysis Required by ECS Complete
Recommendations Have Been Received to Modify Doc
Formed a Design Analysis Team
  Review Recommended Changes
    Make Recommendations to Verification Work Group - March
Verification Work Group Will Act on Recommendations - April
Revise Verification Document - June
Establish Review Groups to Wordsmith Document - August
Merge Work Efforts into New Revision - Oct
Submit to PER15K Task Group - Nov
Validation Development Process

- Develop the test development protocol and use the 6HP example to demonstrate it. Develop the process.
- Perform the FMEA to come up with the test protocol for the completion equipment in question. Update the process.
- Produce a document with proposed test protocol list and test steps.
- Collect feedback and update the document
- 2009: Perform FMEA for:
  - Ask participant to share FMEA and test example.
  - SCSSV
  - If time allows: Gauges or Packer

Proposed 2009 timeline
February 3rd, 2009

Attention: SC6 Members

Subject: Report on status of 6D/6DSS Revisions and Corrections and ISO TC67 SC2

Location: Shell Woodcreek Park Offices
150A North Dairy Ashford
Houston, TX

- Pipeline Valves-6D

API published the 23rd Edition of API Spec 6D –Pipeline Valve as of April 1, 2008 with an effective date of October 1, 2008.

ISO 14313:2007 second edition was published December 15, 2007 will have a corrigenda issued in 1Q09 to correct editorial issues identified after publication and comments during the SC6 voting for the adopt back. As these are editorial, API plans to issue an ERRATA.

6DTG will be reviewing the possibility to add a new regional annex on “Recommended practice for qualification of heat-treating equipment” which is being added back to the next revision of ISO 10423/API 6A 20th edition.

- Subsea Pipeline Valves

API published the 1st Edition of the new API Spec 6DSS / ISO 14723 for Subsea Pipeline Valves including a API Regional Annex G as of August 2007. API Quality Programs has added this document to the list of product Standard and has issued six (6) API monogram licenses to date, with two (2) new applications in process.
• **ISO TC67 SC2 Pipeline Transportation Systems**

ISO TC67 SC2 WG9 (ISO 14723 Subea Pipeline Valves) has completed its DIS voting and review by TC67 SC2 EDC. The FDIS is planned for voting in 1Q09. After the required 2 months voting period, the 2nd Edition of ISO 14723 should be published by ISO in end of 2Q09 or early 3Q09.

Upon publication 6D TG plan to conduct a review of the standard and make a recommendation to SC6 to vote on the adopt back as the 2nd Edition of API6DSS.

Respectfully submitted,

*Rick Faircloth*

Chairman- 6D/6DSS TG on Revisions and Corrections and
Convener-ISO TC67 SC2 WG2 and WG9
Sir;
Your email arrived a day before closing of the ISO ballot for revision and updating of document ISO 7268. There was not sufficient time to convene a meeting of the USTAG to address your concerns.

Ms. Patricia Reddington, the Secretariat for ISO/TC 5/SC 10 and its ASME/US-TAG conferred consideration of an explanation to me. I am the Chair for the ISO/TC 5/SC 10 committee charged with the content of the draft ISO 7268 and I also Chair the US-TAG for this item, therefore I have some familiarity of its status. With reference to your commentary, I offer the following observations in the hope that they may be of value in your future consideration of this draft standard.

1. As a starting point, note that this revision simply elaborates the previous edition of ISO 7268 that dates back to a 1983 issue date and that only dealt with a definition for PN. Since this issue date, the ISO concept of market relevance has been introduced and this has signaled a need to recognize that the USA Class designation is by far the most referenced such designation with the balance split between the European PN and the Japanese K.

2. Fundamentally, ISO 7268 draft provides guidance in the selection of designators to be used in ISO standards, leaving it to the component standard writer to choose PN, Class or K with the listed non-dimensional numbers cited as appropriate for their need. The first para. of the draft Scope notes that “as specified in … component standards”. The second paragraph notes designation numeric’s that are appropriate for the alpha part of the designator.

3. The definition for PN is basically unchanged from the current edition. The numeric designators are those listed in ISO 7005-1 dating back to 1992 for European usage and are current in the European Standard EN 1092-1. Note the absence of a PN 20 as well as the absence of any other so called Class related PN's in EN 1092-1.
4. The number following PN is dimensionless and has no relation to a specific pressure value. It is described as so in the publication ISO 7268 : 1983, obviously not a new concept.

5. In EN 1092-1, it is true that most of the pressure ratings for \( ?10^\circ\text{C} = T = 50^\circ\text{C} \) correspond to the PN dimensionless number, however, it is not always true. For example Table 17, PN 100 has RT values of 84.4 bar, a 19% variation.

6. The TC 5/SC 10 committee has, over the course of many years asked for the calculation basis for determining the PN pressure/temperature values. These have been promised but have never been produced. The Class rating basis is detailed in ASME B16.5 and in ASME B16.34.

7. A very important aspect in attempting to have a proper relationship between PN and Class designations has to do with the wide variations that exist at temperatures above 50\(^\circ\)C. For example, PN20 (interpolated Table 17, EN 1092-1) at 400\(^\circ\)C would have an allowable pressure up to 10.4 bar whereas ASME B16.5, Class 150, Table 2-1.1 shows a maximum rating of 6.5 bar; a 40% variation. This clearly demonstrates that there is a need to avoid representing a PN number as an acceptable alternative to Class number.

8. The cross referencing of PN to Class that you identify was initiated in the 1972 edition of ISO 7005-1. This somewhat arbitrary contrivance was an attempt to displace the Class designation system used by ASME Standards. (Note in ISO 7005-1 that Class 600 is shown as PN 110 so as to not confuse it with (in 1992) a DIN flange designation.)

9. Your PN 100 example covers only one listing. Note that B16.5 CWP ratings for Class 600 cover a range of 33.1 = CWP = 103.4 bar. That is, in the Class system the CWP is not a constant value but varies with component material mechanical properties.

10. In regards the size designation DN, early on the European standard experts submitted DN, diamètre nominale, for ISO as an acknowledgment to their French members to replace the previously used ND, nominal diameter. Note that DN and NPS have a correspondence, see B16.5-2003, para. 1.9.
11. The number that follows NPS is indeed dimensionless and is used as described in the draft. For example, a pipe designated as NPS 6 is without any characteristic having a dimension of 6-inches. In order to determine the dimensions of a pipe one needs both an NPS number and a pipe schedule number.

12. Drawing the distinction between K for size and Kv for flow is the responsibility of the standards writer should the need arise for both to be used in the same standard.

13. In summary,

   a. The draft ISO 7268 does correctly define pressure designations as used in relevant market sectors.

   b. The draft does not change the substance of the definition of PN from the definition of that in the current edition ISO 7268. The draft does introduce a proper definition for the Class designation. Note that work is in progress with a draft FDIS 7005-1 that will eliminate the PN numbers that were subjectively assigned to Class numbers pre 1992. The ISO standards (and ASME standards) that use these now outdated PN numbers will have to be edited.

Your concern is very much appreciated. You can be assured that the USTAG is doing all it can to accommodate present day market place needs of the USTAG members some of whom currently participate in API upstream standards writing.

Sincerely,

Bill McLean
Revisions to API 6A to accommodate the 2007 ASME Code Section VIII Division 2

Progress to date:
1. Proposed changes were presented at the summer 2008 Standardization Conference. Fowler tasked to present final recommendations at the winter 2009 meeting.
2. Several active stress-wise engineers from several companies were sent e-mail copies of those recommendations and asked to comment.
3. A number of issues were brought up which will require further investigation:
   a. How to specify the QC required for each method (classical vs. new ASME)?
   b. How to handle the other non-standard material allowable stresses if membrane stress is allowed to go to 0.9 Sy at test pressure?
   c. Should we include the classical ASME method as an annex to 6A since ASME no longer permits it?
   d. Should we further clarify the design methods including when to use stress intensity vs. equivalent stress in which methods?
4. Meanwhile SC16 requested Fowler to recommend similar changes to Specs 16A and 16C, which differ from 6A. It would be a good opportunity to harmonize the requirements of these three specifications.

Recommendation:
Enlist the assistance of engineers who perform or review design verification calculations of 16A, 16C and 17D equipment to join the task group and recommend common design requirements for the three specifications. Since 17D refers to 6A for design requirements, by revising 6A, 16A and 16C we cover 17D as well.

Presented by John H. Fowler to the API SC6 winter meeting, February 3, 2009
API SUBCOMMITTEE 6
WORK GROUP ON API SPEC
6A718

3 February 2009
Tim Haeberle – Work Group Chairman
Houston, Texas
6A718 Work Group Objectives

• API Spec 6A718 1st Edition was issued in March of 2004

• API policy requires specifications be reviewed every 5 years

• The options are as follows:
  • Reaffirm as is
  • Revise and re-release
  • Withdraw if no longer needed
Work Group membership

Allvac               GE Oil & Gas – VetcoGray
Baker Hughes         Halliburton
BP                  Howco
Cameron              Latrobe Steel
Cartech              Shell
Chevron              Schlumberger
CRA Alloys           Special Quality Alloys
ExxonMobil            ThyssenKrupp VDM
FMCTI                  Tube Supply
Foroni                  Wood Group
First WG Meeting – 2 December 2008

- 21 Attendees
- Decision made to revise and re-release API Spec 6A718
- 15 proposed revisions presented
Second Meeting – 2 February 2009

- 23 attendees
- Revision status:
  - 6 revisions approved
  - 7 revisions rejected
  - 2 revisions tabled, pending further input
Input requested from SC6 on Q1 issue

- Proposed revision:
- Section 2: Add

“ANSI / API Specification Q1 Specification for Quality Programs for the Petroleum, Petrochemical and Natural Gas Industry”

- Section 4: Insert a new section that reads,

“4.1 General

The Manufacturer shall validate non-destructive examination and heat treating processes in accordance with ANSI / API Specification Q1”
Justification

It was stated that this is required by API Q1 clause 7.5.2.1 (see below) and needs to be addressed in the product standards according to API ECS meeting minutes (January 21, 2008, Ft. Worth, Texas).

API Specification Q1, Eighth Edition (Effective Date: June 15, 2008):

“7.5.2.1 Validation of processes for production and service provision — Supplemental

The organization shall validate those processes identified by the applicable product specification as requiring validation. If these processes are not identified, or there is no product specification involved, the processes requiring validation shall include, as a minimum, non-destructive examination, welding and heat treating, if applicable to the product.”
Input requested from SC6

- Is this really required for API Spec 6A718?
- What does “validation” mean?
Input requested from SC6 on quality issue

Proposed revision

Section 2: Add

“ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories “

Section 4: Insert a new section after Section 4 that reads as follows, and renumber all the subsequent sections in Section 4.

“4.1 General”

“When specified on the purchase agreement, the test laboratory and test equipment calibration laboratory shall comply with ISO/IEC 17025 and shall have been subject to formal accreditation by a recognized body.”
Justification

This will add test laboratory and equipment calibration laboratory requirements that are not addressed by API Q1 / ISO 9001.
Input requested from SC6

• Should this be in a quality system spec?
• Should this be in another spec such as API Spec 6A, the parent to API Spec 6A718?
• Should specs contain statements such as, “When specified on the purchase agreement,…”
The path forward

• One more Work Group meeting is all that should be needed to finalize proposed revisions.

• Work Group Chairman to present proposed revisions to API 6A718 2nd Edition to API staff.

• API staff to prepare API 6A718 2nd Edition for ballot.

• Subcommittee 6 to vote on API 6A718 2nd Edition.
End of presentation on
API SC6 Work Group on API Spec 6A718
ISO WG3 Meeting
October 20-21, 2008

Attending:
Eric Wehner - Cameron
Maxwell Cerqueira - Petrobras
Richard Preston - FMC
Joel Russo - FMC
David Zollo - FMC
Scott Higgins - BP
Jean Brunjes – Vetco Gray
Jerry Janszen – original 10423 Convenor

Dag Ketil Freidheim - StatoilHydro
Maarten Kuipers - Mokveld
David Cole - Shell
Austin Freeman - Halliburton
Ries Langereis – Cameron ISO 10423
Convenor
Alfred Kruijer – Shell Secretary

Opening Remarks:
The meeting was called to order, hotel safety instructions for evacuation reviewed and the
attendees welcomed. The purposes of the meeting were outlined as following:

Purposes:
1. Action comments from DIS circulation of ISO 10423.
2. Discuss further differences remaining between ISO 10423 and API Spec 6A.

The possibilities for how to action comments in ISO were reviewed. These were stated as:
• Accepted:
  – Text revised identically to the comment.
• Accepted in principle:
  – State what text changes are required to make the comment acceptable to the work group.
• Rejected:
  – State why the comment was rejected.
• Noted:
  – Normally used when no specific action is proposed. Explanation of why a comment was
    “noted” is not required.
  – Used when scope of change is so significant requiring significant textual changes to
    incorporate and may be deferred to the next revision.

The review of comments commenced. On the first day, approximately 20 pages were
completed. On the second day the remaining 13 pages were completed. All of the action
items related to actually making the changes to the document using the ISO template
would be completed by Alfred Kruijer. Other action items by various members of
workgroup are captured below.

Action Items:
1. If desired, Petrobras is suggested to develop proposal to API and/or ISO for the
development of life-cycle performance validation methods under actual/adverse
production environment conditions to supplement existing text in Annex F.
2. After discussion and agreement by the workgroup present, it was decided that Eric Wehner to provide new Table 7 showing new subsize Charpy specimens that was balloted for approval in API SC6.

3. Austin Freeman to notify workgroup for ISO 13628-4/API 17D that ISO 10423 does not define pressure controlling equipment. (clause 1001.7 in current document)

4. Alfred Kruijer to circulate proposed text for clause 10.3.3.2 to provide more guidance in how to approach external environmental exposure of Gr 660 flange bolting.

5. Scott Higgins to propose text for electrical and or hydraulic monitoring devices.

6. David Zollo to provide table, figure and text from API SC6 summer meeting figures for Table 85 and B.85.

7. Alfred Kruijer and Eric Wehner to work and develop revised Table 26 in 10.23.3 and then circulate to rest of workgroup for approval.

8. Joel Russo to keep up with use of ppm units workgroup for ISO 15156 and report to WG3 if it changes prior to publication.

9. Alfred Kruijer to circulate text proposal among workgroup members regarding F.1.6.3.b to state that all production testing requirements have been met prior to the prototype test.

10. Austin Freeman to inquire with workgroup for ISO 13628-4/API 17D.

11. WG3 Workgroup to validate proposed Figure F.1 supplied by Petrobras so Alfred Kruijer can re-draw in AutoCAD for inclusion in the document.

12. David Zollo to provide new figures and tables for L.7 and L.8.

13. Jean Brunjes to provide metric dimensions for Figure L.11.

14. After completion of the above action items, Alfred Kruijer to circulate FDIS document showing implementation of comment resolution as "tracked changes" in Word but distributed in PDF due to file size.

Other discussions
David Cole overviewed the issue of lubrication vs. API interpretations. It was agreed that it would need to be resolved by December, 2008 to be included in the current edition.

The applicability of Annex F (validation testing) was discussed as one comment had proposed to make it normative instead of informative. It was proposed to circulate an enquiry through the API monogram program (API 6A license holders) as well as end users to test the acceptance of making Annex F normative in the next revision of the standard. David Cole to take this to API.

Forward Plan:
The forward plan for the document was discussed. The target is to have FDIS to Geneva out this year before the holidays. It was noted that a taskgroup was still working the castings/forgings issue on the API side. If no resolution is reached on API side by the time the FDIS is ready, the ISO document will issue as is.