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THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD INSPECTION CODE COMMITTEE

MINUTES

Meeting of January 17, 2013
Mobile, AL

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The National Board of Boiler & Pressure Vessel Inspectors
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1. **Call to Order - 8:00 a.m.**

   NBIC Chairman, Mr. Don Cook called the meeting to order at 8:00 a.m.

2. **Introduction of Members/Visitors**

   All members and visitors introduced themselves and an attendance sheet was passed for attendees to sign.

3. **Announcements**

   a. In Mr. David Douin's absence, Mr. Chuck Withers spoke and thanked all of the Committee Members for their hard work this week and throughout the past year.

   b. Mr. Gary Scribner gave a brief summary of the Executive Committee meeting held on Monday, January 14, 2013. The first half of the meeting was devoted to a S.W.O.T. analysis. The second half of the meeting the Committee members discussed a survey to be sent to shareholders regarding a Part 4 of the NBIC exclusively for pressure relief valves, the publication of the 2013 edition, and the preparation of a new guide containing administrative requirements.

   c. Mr. Don Cook presented Mr. Frank Hart with a 5- year membership pin.

4. **Adoption of the Agenda**

   a. Mr. Cook announced a format change to the agenda. The public review comments from each subcommittee would be addressed prior to discussing action items.

   b. Action item NB13-0402 to approve the 2013 edition was also added.

   c. Mr. Joe Frey, Chairman of B31.1 Committee, will make a presentation to the Committee regarding piping. **(Attachment 11)**

   There was a motion to adopt the agenda as modified. The motion was unanimously approved.

5. **Approval of the Minutes of July 2012 Meeting**

   There was a motion to approve the minutes of the July 2012 meeting. The motion was unanimously approved.

6. **Review of Rosters/Resignations/Nominations/Reappointments (Attachment 1)**

   a) Changes to rosters

      1. Resignations

         - There were no resignations to report at this time.

      2. Nominations and reappointments for NBIC Committee members and subgroups that serve all four subcommittees.

         - Mr. Michael Richards, User, is eligible for reappointment to the NBIC Committee. There was a motion to reappoint Mr. Richards to the NBIC Committee pending the approval of

the Chairman of the Board of Trustees. The motion was unanimously approved.

- Mr. Paul Welch, Authorized Inspection Agency, would like to become a member of the SC on Inspection. There was a motion to appoint Mr. Welch to the SC on Inspection pending the approval of the Chairman of the Board of Trustees. The motion was unanimously approved.

- Mr. Brandon Nutter, "VR" Stamp Holder, would like to become a member of the SC on PRD. There was a motion to appoint Mr. Nutter to the SC on PRD pending the approval of the Chairman of the Board of Trustees. The motion was unanimously approved.

- Mr. Paul Schuelke, Manufacturer, would like to become a member of the SC on Installation. There was a motion to appoint Mr. Schuelke to the SC on Installation pending the approval of the Chairman of the Board of Trustees. The motion was unanimously approved.

- Ms. Melissa Wadkinson, Manufacturer, would like to become a member of the SC on Installation. There was a motion to appoint Ms. Wadkinson to the SC on Installation, pending the approval of the Chairman of the Board of Trustees. The motion was unanimously approved.

- Mr. Craig Hopkins would like to be transferred from the SC Inspection to the SC on Repairs and Alterations. There was a motion to approve the transfer. The motion was unanimously approved.

- Mr. Ray Milletti would like to become a member of the SC on Repairs and Alterations. There was a motion to appoint Mr. Milletti to the SC on Repairs and Alterations pending the approval of the Chairman of the Board of Trustees. The motion was unanimously approved.

3. The following committee members were eligible for reappointment to their respective subcommittees:

   - Mr. Buddy Dobbins, Authorized Inspection Agency, and Mr. Thakor Patel, Manufacturer, are eligible for reappointment to the SC on PRD. There was a motion to reappoint Messrs. Dobbins and Patel to the SC on PRD pending the approval of the Chairman of the Board of Trustees. The motion was unanimously approved.

   - Mr. Mark Ray is eligible for reappointment to the SG on Locomotive Boilers. There was a motion to reappoint Mr. Ray to the SG on Locomotive Boilers pending the approval of the Chairman of the Board of Trustees. The motion was unanimously approved.

7. Report of Subcommittees' Public Review Comments (No Attachment)

a. <u>SC Installation</u>

PR13-0201 ***Part 1, 4.7 SC on Installation*** - In 4.7.1 and 4.7.2 change "should" to "shall". Should indicates good practice. The referenced statements need to be stronger.

- There was a motion to approve this comment and incorporate the changes into the next draft. The motion was approved with one abstention and one disapproved vote.

PR13-0202 ***Part 1 ,S3.4 SC on Installation*** Revise to read," Alarms shall be designed to activate a low level alarm at 1.5% concentration of CO_2 and a high alarm level at 3% concentration of CO_2.

- There was a motion to reject this comment. The Committee considers the current wording to be appropriate for the venues where the system is utilized.

PR13-0203 ***Part 1, S3.5 a) SC on Installation*** - Revise instruction to say instructional. (Attachment 2, p. 5)

- There was a motion to accept this comment and incorporate it into the 2013 Edition of the NBIC.

PR13-0204 ***Part 1, S3.6 a) SC on Installation*** - Revise a) to read: Components shall be compatible with CO_2 in the phase (gas or liquid) in the applicable circuit.

- There was a motion to accept this comment and incorporate the change into the 2013 Edition. The motion was unanimously approved.

PR13-0205 ***Part 1, S3.6.1 SC on Installation*** **-** The description of the system should be at the beginning of Supplement 3. Renumber S3.6.1 to S3.2 and renumber the following paragraphs appropriately.

- There was a motion to reject this comment. The Committee determined that a person who installs these items would already know what the system is. The motion was unanimously approved.

PR13-0501 ***Part 1, S3.2 SC on Installation*** **-** Recommend deleting "Should not have a roof or overhead cover." In the northern US and Canada it is preferable to have an overhead cover on CO2 storage tanks that are located outside. This prevents the buildup of show and/or ice in the cold months. Having overhead cover on a gas that is heavier than air does not pose any potential hazard by allowing high concentrations to accumulate. S3.2b also allows for weather protection making the statement in S3.2 , "Should not have a roof or overhead cover.", confusing to readers.

- There was a motion to accept this comment and incorporate the changes into the 2013 Edition. The motion was unanimously approved.

PR13-0502 ***Part 1, S3.2 a) SC on Installation*** **-** Change the following section to read: a) LCDSV's shall not be installed within 36' of the front of electrical panels.

- There was a motion to reject this comment. The Committee determined that the current wording is correct. The motion was unanimously approved.

PR13-0503 ***Part 1, S3.2 c) SC on Installation*** **-** Recommend changing 1) a) as follows: a) Shall be equipped with a gas detection system installed in accordance with paragraph S3.4, if the area that the tank is located in cannot be determined to have adequate ventilation to prevent a hazardous concentration of CO_2 buildup. Because the publication defines any indoor installation as an enclosed area, there needs to be provisions in this publication that identifies indoor installations that are located in kitchens that have very high rate of ventilation that would not result in a hazardous concentration of CO_2 even if a leak was to develop.

- There was a motion to reject this comment. This section only applies to enclosed areas. The

motion was unanimously approved.

PR13-0601 ***Part 1, S3.2 SC on Installation*** - S3.2 GENERAL REQUIREMENTS STORAGE TANK LOCATION LCDSV's should be installed in an unenclosed area whenever possible. LCDSV's that do not meet all criteria for an unenclosed area shall be considered an enclosed area installation.
An unenclosed area:

- Shall be outdoors
- Shall be above grade
- ~~Should not have a roof or overhead cover~~
- Shall not obstruct more than three sides of the perimeter with supports and walls. At least 25% of the perimeter area as calculated from the maximum height of the storage container shall be open to atmosphere and openings shall be in direct conveyance with ground level.

Rationale: For the northern climates, overhead coverings are preferred in order to prevent the buildup of ice and snow. For southern climates, solar heat load affects container temperature. This statement conflicts with S3.2b of this draft standard. Note: Dissipation of carbon dioxide is not affected by a roof or cover since it is heavier than air.

- There was a motion to accept this comment and incorporate the changes into the 2013 Edition. The motion was unanimously approved.

SC on Inspection

PR13-0209 ***Part 2, 2.2.10.6 SC on Inspection*** **-** The NBIC is supposed to be a safety code so why is a good practice only a good practice if required by a jurisdiction. For example, 2.2.10.6 a) is or is not that paragraph a good practice? A Jurisdiction only makes a good practice mandatory but without the jurisdictional requirement a good practice is optional with the owner/user. This section should be revised to indicate "good practices" should be complied with but are mandatory when required by the jurisdiction.

- There was a motion to accept this comment and open up a new action item to address it further. The motion was unanimously approved. Action item, NB13-1201 was opened to examine this comment further.

PR13-0210 ***Part 2, S2.10.6 h) SC on Inspection*** **-** Revise h)On forced circulation boilers the flow sensing device shall be tested to verify the boiler shuts down on loss of flow.

- There was a motion to accept this comment and open a new action item to address it further. The motion was unanimously approved. Action item NB13-1202 was opened to examine the comment further.

PR13-0211 ***Part 2, 2.3.6.5 b) 1) SC on Inspection*** **-** How is intended service of a tank determined when the service is not marked on the nameplate, and most likely is not listed on the Manufacturer's Data Report? Further, what does welding have to do with a missing or illegible nameplate? Also, the paragraph states welding is prohibited, but the next sentence indicates post construction welding is permitted. The paragraph is confusing and contradictory. Please revise.

- There was a motion to reject this comment. The Committee determined that the commenter was reading too much into the wording. The motion was unanimously approved.

PR13-0212 ***Part 2, 2.3.6.5 b) 4) SC on Inspection*** - Z87 rated goggles: List the rating organization and the full identification of the specification.

- There was a motion to accept this comment in principle. The Committee will add the delegation ANSI in front of Z87. The motion was unanimously approved.

PR13-0213 ***Part 2, 2.3.6.7 a)SC on Inspection*** Change "must" and "should" to "shall".

- There was a motion to accept this comment and open a new action item to discuss it further. The motion was unanimously approved. Action item, NB13-1203 was opened to examine the comment further.

PR13-0214 ***Part 2, 2.3.6.7 a) 3) SC on Inspection*** - Change "should" to "shall". The vessel will not be in operation during an inspection so I don't understand how this requirement can be verified. This is an operational requirement and should not be in Part 2 of the NBIC.

- There was a motion to reject this comment. The Committee determined that the commenter was confused about when inspections are done. The motion was unanimously approved.

PR13-0215 ***Part 2, 2.3.6.7 a) 4) SC on Inspection*** **-** Change "should" to "shall".

- There was a motion to reject this comment. The motion was unanimously approved. After further discussion, the Committee decided to strike this line completely from the document.

PR13-0216 ***Part 2, 2.3.6.7 b) 2) and 3)SC on Inspection*** **-** Change "should" to "shall". In many cases, these are lifesaving vessels. The owner/operator should be told in strong terms the vessel needs to be in excellent condition. Should indicates "when you get around to it, minor inconvenience."

- There was a motion to reject this comment. The motion was unanimously approved.. The Committee disagreed with the commenter's reasoning and determined the current wording is correct.

PR13-0217 ***Part 2, 2.3.6.7 b) 4) SC on Inspection*** Change "should" to "shall" Also, if the opening is for exhaust, then it is an outlet for the vessel. How is this inspection to be accomplished? Are there grates over the outlets?

- There was a motion to reject this comment. The Committee disagreed with your reasoning and determined that the current wording is correct.

b. <u>SC Repairs and Alterations</u>

PR13-0218 ***Part 3, 2.5.3.2d) SC Repair and Alteration*** **-** Please revise the text. The paragraph is written as confusing.

- There was a motion to reject this comment. The Committee needed more information. The motion was unanimously approved,

PR13-0219 ***Part 3, 4.4.1.4 SC Repair and Alteration*** **-** Pre-warming? That is the temperature of the liquid before it is warmed. Revise to read: "... and Table 4.4.1.4 may be used in lieu of notch toughness tests. Table 4.4.1.4 contains minimum liquid temperatures based on metal thickness of the pressure retaining part."

- There was a motion to accept this comment in principle. The motion was unanimously approved. The text will be revised to correct the mathematical nomenclature.

PR13-0220 ***Part 3, Table 4.4.1.4 SC Repair and Alteration*** **-** Revise the math symbol. The correct symbol for less than or equal is: <=. There is no slash.

- There was a motion to accept this comment and incorporate the suggested changes. The motion was unanimously approved.

PR13-0221 ***Part 3, Table 4.4.2*** **-** Delete this table. It should be identical to Table 4.4.1.4. Also the math symbols in Table 4.4.2 need corrected. The slash through the equal sign means not equal. The correct symbol for less than or equal is <=. There is no slash in the symbol.

- There was a motion to accept this comment in principle and correct the mathematical nomenclature of the tables. The motion was unanimously approved.

PR13-0222 ***Part 3: 4.4.1.3.4 SC Repair and Alteration*** Delete grade 70 from the SA-515 reference. There are grades 55, 60, and 65 in addition to grade 70. The table should apply to all.

- There was a motion to accept this comment and incorporate the suggested changes. The motion was unanimously approved.

PR13-0223 ***Part 3: 5.5a) SC Repair and Alteration*** **-** Why are R forms exempt from registration? It is expected and many jurisdictions require registration of pressure vessels. It is not logical to register other organizations paper, but not your own. Registration is also a safety issue. There should be cradle to grave documentation for vessels. There is a considerable market in used vessels, and the documentation does not go with the vessels. All repairs and alterations should be registered.

- There was a motion to reject this comment. The Committee determined that this issue has already been discussed. The motion was unanimously approved.

c. <u>SC PRD</u>

PR13-0101 ***Part 1, 4.7.3 SC on PRD*** - Revise text. 4.7.3 a) Each hot water storage tank that is designed to operate at or below 210˚ F (99˚C) and served by a hot water supply boiler shall have a temperature relief valve installed and set to relieve at or below 210˚ F (99˚ C). This valve shall be installed within the top 6 in. of the system's hot water storage tank. b) The temperature and pressure relieving device shall meet the requirements of NBIC Part 1, 4.5.

- There was a motion to reject this comment but incorporate the editorial change into the draft of the NBIC. The Committee felt that all hot water storage tanks are operated below 210˚ F. The motion was unanimously approved.

PR13-0206 ***Part 1, S3.6 SC on PRD*** **-** S3.6: Relief Valves: Two comments: 1) The note concerning the discharge line does not comply with ASME Code. A line smaller in diameter than the relief valve will increase the back pressure and reduce the flow; 2) the sizing of discharge lines need to be moved to the paragraph on Safety Relief/Vent Lines.

- There was a motion to accept the first half of the comment and incorporate it into the 2013 Edition. The Committee rejected the second half of the comment. The Committee determined that the wording placement was accurate. The motion was unanimously

approved.

PR13-0207 ***Part 1, S3.6 SC PRD*** **-** Safety Relief/Vent Lines: The term "PRD" is located in the third line, and is the only place in S3.6. For consistency, change "relief valves" and "relief" to PRD or change “PRD” to relief valve.

- There was a motion to accept this comment and incorporate the suggested changes. The motion was unanimously approved.

PR13-0208 ***Part 2, 2.3.6.5 b)2) SC on PRD*** **-** The hydrostatic relief valve is not part of the nurse tank but is in the plumbing and typically mounted on the toolbar. Also it is bad practice to mount a valve on a valve in these types of applications without support for the valves. Why the high set pressure for this valve? The pressure relief valve (set pressure around 250 psi) will have vented, preventing the pressure in the vessel from reaching the set pressure of the hydrostatic relief valve.

- There was a motion to reject this comment. The hydrostatic relief valve protects the hose when isolated from pressure vessel. The motion was unanimously approved.

PR13-0301 ***Part 3, 4.5.3 SC on PRD*** **-** This qualification shall be documented and provisions made to retain such documentation for a period of at least five years after the lift device is retired. Documentation of this qualification shall include but not be limited to: We should add "assist" or delete "lift" for consistency, i.e. Lift Assist Device or just plain device rather than Lift Device. It is called Lift Assist Device everywhere else in the document.

- There was a motion to accept this comment and incorporate the suggested changes. The motion was unanimously approved.

PR13-0401 ***Part 3, S7.10.5SC on PRD*** **-** Only external adjustments to restore the set pressure shown on the repair nameplate or stamping and/or performance of a pressure relief valve shall be made under the provisions of NBIC Part 3, S7.10.1 and Part 2, 2.5.7. Reasoning: Clarification to ensure that the adjustment is made only to return the valve to its current set pressure. If the valve previously underwent a set pressure change properly executed under a "VR" repair, the adjustment should be to the set pressure marked on the repair nameplate, not the original nameplate set.

- There was a motion to accept this comment and incorporate the suggested changes. The motion was unanimously approved.

PR13-0402 ***Part 3, 1.7.3-1.7.6 SC on PRD*** **-** Do not remove these sections. Leave existing text. These are requirements related to the “VR” program and should remain in the NBIC. If the intention is to move these requirements to another document other than the NBIC, I would oppose that action as all aspects of the “VR” program should be subject to the oversight of the consensus NBIC Committee and Subcommittees. Additionally, such action would likely require "VR" programs to obtain and track an additional National Board documentation creating additional and unnecessary burden.

- There was a motion to accept this comment in principle. The NBIC Committee has approved removing all administrative requirements. The motion was unanimously approved.

PR13-0403 ***Part 3, 1.8.2-1.8.4 and 1.8.6 SC R and A*** **-** Do not remove these sections. Leave existing text. These are requirements related to the “NR” program and should remain in the NBIC. If the intention is to move these requirements to another document other than the NBIC, I

would oppose that action as all aspects of the “NR” program should be subject to the oversight of the consensus NBIC committee and subcommittees. Additionally, such action would likely require "NR" programs to obtain and track an additional National Board documentation creating additional and unnecessary burden.

- There was a motion to accept this comment and incorporate the suggested changes. The “NR” administrative requirements will remain in the book. The “NR” program wording is still being developed. The motion was unanimously approved.

PR13-0404 SC on R and A Part 3, 5.12.4 Where a valve has been tested and adjusted to restore set pressure shown on the repair nameplate or unmodified original nameplate or stamping as permitted by NBIC Part 3, S7.10.1 but not otherwise repaired, a "Test Only" nameplate shall be applied that contains the following information: Reasoning: Clarification to ensure that the adjustment is made only to return the valve to its current set pressure. If the valve previously underwent a set pressure change properly executed under a "VR" repair, the adjustment should be to the set pressure marked on the repair nameplate, not the original nameplate set.

- There was a motion to accept this comment and incorporate the suggested changes. The motion was unanimously approved.

PR13-0405 Part 3, S7.10.1 SC on R and A - The Jurisdiction may authorize properly trained and qualified employees of boiler and pressure vessel owners/users or the designees to confirm or restore the set pressure shown on the repair nameplate or unmodified original nameplate or stamping and/or performance of pressure relief valves. Reasoning: Clarification to ensure that the adjustment is made only to return the valve to its current set pressure. If the valve previously underwent a set pressure change properly executed under a "VR" repair, the adjustment should be to the set pressure marked on the repair nameplate, not on the original nameplate set.

- There was a motion to accept this comment and incorporate the suggested changes. The motion was unanimously approved.

PR13-0602 ***Part 1, S3.2 SC on Installation*** - S3.6 VALVES, PIPING, TUBING AND FITTINGS SAFETY RELIEF/VENT LINES-Safety relief/vent lines shall be as short and straight as possible with a continuous routing to an unenclosed area outside the building and installed in accordance with the manufacturer’s instructions. The vent line shall be a continuous run from the vessel PRD vent piping to the outside vent line discharge fitting, without any splices. Mechanical joints in metallic piping and tubing shall be visible and inspectable. Any splices in plastic or polymeric tubing shall be done within three feet of the vessel and must be visible and inspectable. These lines shall be free of physical defects such as cracking or kinking and all connections shall be securely fastened to the LCDSV and the fill box. The minimum size and length of the lines shall be in accordance with table S3.6a and S3.6b. Fittings or other connections may result in a localized reduction in diameter have been factored into the lengths given by the tables S3.6a and S3.6b.

Rationale: Allows the use of connectors but requires that they are seen and can be inspected.

- There was a motion to accept this comment. The motion was approved with three abstentions and two disapproved votes. Following the meeting the Committee reconsidered their original vote and changed their vote to disapprove.

NB13-0402 ***2013 Edition NBIC Committee*** Approval of the 2013 Edition.

January 2013
There was a motion to approve the 2013 Edition. The motion was unanimously approved.

7. Report of Subcommittees

a) SC Inspection

Charge: Responsible for developing new rules, revising, interpreting and maintaining existing rules which address administrative and technical requirements for inspection of pressure retaining items. This subcommittee also directs, supports, reviews and approves any items forwarded by each subgroup functioning under this subcommittee.

Membership: Tim Barker, Domenic Canonico, Mark Horbaczewski, Jim Getter, Greg McRae, Mark Mooney, Venus Newton, Ralph Pate, Bob Reetz , John Richardson, Jim Riley, Jason Safarz, Mike Schwartzwalder, Stan Staniszewski, and Bill Smith (Secretary).

The SC Vice Chair Stan Staniszewski reported on the following:

1) Inquiries

IN12-0201 ***Part 2, 5.5.2-5.5.2.3 SC Inspection*** – Question 1: If a National Board Commissioned Inspector has verified the replacement of stamped data or nameplate by an "R" Certificate Holder on corrugated rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, is the application of an NB-136 "Replacement of Stamped Data" form required? Answer 1: No, if performed by an "R" Certificate Holder and verified by a National Board Commissioned Inspector the responsibility of traceability and nameplate accuracy is on the Certificate Holder similar to nameplate replacement in NBIC Part 3, 5.5.9.5. (Attachment 2, pp. 1-2)

January 2013
The SC has developed a question and reply for this inquiry. There was a motion to letter ballot this inquiry to the NBIC Committee. The motion was unanimously approved.

IN12-0202 ***Part 2, 5.2, SC on Inspection*** **–** Question 1: Can an NB-136 "Replacement of Stamped Data Form" which is required to be signed by a National Board Commissioned Inspector, for corrugated rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, be filed with The National Board and copied ` to the applicable Jurisdiction in lieu of obtaining an approval signature from the Jurisdiction? Answer 1: Yes, the approval from one Jurisdiction should not be incumbent on any other Jurisdiction due to transient nature of Corrugated Roll Pressure Equipment. Similarly, if there was no Jurisdiction in the location of installation, another Jurisdiction would be compelled to accept National Board filing if the equipment is moved. (Attachment 2, pp. 1-2)

January 2013
The SC has developed a question and reply for this inquiry. There was a motion to letter ballot this inquiry to the NBIC Committee. The motion was unanimously approved.

2) Action Items

NB07-0910 ***Part 2 S6 SG Inspection Specific*** **-** Review DOT supplement. A task group of S. Staniszewski (Chair), G. McRae and J. Riley has been assigned. This specific Supplement should be reviewed by the task group for completeness and accuracy. (Attachment 2, p. 3)

January 2013
Mr. Staniszewski gave a progress report and a handout for Committee Members. There was no action to vote on at this time.

NB08-0321 ***Part 1, 4.3 SC Inspection*** - Add a new paragraph in 4.3 General Requirements to address change of service for a pressure vessel. These requirements should caution installers, inspectors, owners, and jurisdictional authorities of the inherent dangers involved when changing service. A new supplement should be added to address the specific requirements for installation of pressure vessels that are being converted from one service to another. (No Attachment)

January 2013
Mr. Wielgoszinski reported that he is developing a Revision 6 of wording. He will take all of the comments that he has received thus far and create a new document. He plans on sending this out for letter ballot for comment only to all subgroups, subcommittees and the Main Committee simultaneously before the next meeting.

NB08-0701 ***Part 2 S7 SG on Inspection Specific*** - Add a requirement for change of service from above ground to below ground installation of LPG tanks. We also need requirements for how to inspect these tanks. A task group of V. Mullins (Chair), G. Galanes, J. Getter, G. McRae,, D. Cook, J. Richardson and V. Newton has been assigned. (No Attachment)

January2013
Mr. Staniszewski gave a progress report. He stated that Mr. Virgil Mullins has become the project manager of this item.

NB10-0601 ***Part 2, SC S9, SG on Fiber Reinforced Plastic*** - Inspection of high pressure composite vessels. (Attachment 3, pp. 1-27)

January 2013
Mr. Staniszewski reported that the SC Inspection will letter ballot this item to the SC Inspection.

NB11-0201 ***Part 2, S2 SG Historical Boilers*** **-** Address limits for bulged stayed firebox sheets. A task group of R. Bryce, D. Cook and F. Johnson has been assigned. (No Attachment)

July 2012
Mr. Reetz reported that the SG Historical Boilers has worked on this item for two years and they have wording prepared for the main committee's consideration. There was a motion to letter ballot this item to the NBIC Committee. The motion was unanimously approved.

NB11-0204 ***Parts 2 & 3, S2 SG Historical Boilers*** **-** Review NDE requirements of stayed areas**.** A task group of M. Wahl (Chair), J. Larson and F. Johnson has been assigned. (No Attachment)

January 2013
Mr. Reetz gave a progress report. He stated that the task group is finding inconsistencies within the language and that they are continuing to work on this item.

NB11-1101 ***Part 2, S2.6.2 b)*****,** ***SG on Historical Boilers*** - This section should be revised to provide more guidelines for evaluating local pitting corrosion versus general corrosion. (No Attachment)

January 2013
Mr. Reetz gave a progress report.

NB12-1201 ***Part 2, S2.10.2 SG on Historical Boilers*** - Review requirements for stayed areas. A task group of D. Cook, T. Dillon, and R. Bryce was assigned. (Attachment 4, pp. 1-10)

January 2013
The SC Inspection unanimously approved a proposal that came from the subgroup on Historical Boilers. There was a motion to letter ballot the NBIC Committee on this proposal. The motion was unanimously approved.

NB12-1501 ***Part 2 SG Inspection General*** - Review inspection requirements so as to align with installation requirements in Part 1. (No Attachment)

January 2013
Mr. Staniszewski gave a progress report. He stated that the task group has identified two new items that pertained to this action item. Action item, NB13-1302 to examine cryogenic tanks and action item NB13-1303 to examine biomass boilers were opened as a result of this item.

NB12-1801 ***Part 2, 5.5.2-5.5.3, SG Inspection Specific*** - Replacement of stamping during inservice inspection. (No Attachment)

January 2013
A progress report was given. This action item is linked to interpretations IN12-0201 and IN12-0202. The Subcommittee hopes to have something prepared for the next meeting.

NB13-0601 ***Part 2, 4.4.7 and 4.4.8*****,** ***SG Inspection General*** - List item "j" in part be relocated to 4.4.8.7 Evaluating Pressure Retaining Items Containing Local thin areas, with the relocated text place between current list item "e" and "f" of section 4.4.8.7 with the existing list items following this insert then re-designated as list items "g" and "h" respectively. (Attachment 5, pp.1-6)

January 2013
The Subcommittee on Inspection unanimously approved a proposal of wording. There was a motion to letter ballot the Main Committee on this proposal. The motion was unanimously approved.

NB13-0701 ***Part 2 4.4.7 j) 1) SG Inspection General*** - Revise wording to clarify the rule in this section. (No Attachment)

January 2013
Mr. Staniszewski gave a progress report of no progress. A Task Group will be assigned.

b) SC on Repairs and Alterations (Attachments 6-7)

Charge: Responsible for developing new rules, revising, interpreting and maintaining existing rules which address administrative and technical requirements for repairing or altering pressure retaining items. This subcommittee also directs, supports, reviews, and approves any items forwarded by each subgroup functioning under this subcommittee.

Membership: George Galanes (Chair), Brian Boseo, Chad Bryan, Paul Edwards, Wayne Jones, Jim Larson, Lawrence McManoman, Ed Ortman, Jim Pillow, Bryan Schulte, Jim Sekely, William Vallance, Mike Webb and Jim McGimpsey (Secretary).

G. Galanes reported on the following:

1) Inquiries

IN13-0201 ***SC on Repair and Alteration, Part 3, 3.2.2 c)*** **- Question 1:** In accordance with Part 3, 5.7.2 c), is the attachment of a repair nameplate to be by a method such as welding, brazing, solderig, or tamper-resistant mechanical fasteners which will not allow easy removal of the nameplate? **Answer 1**: Yes

Question 2: In accordance with Part 3, 5.7.3, is the attachment of an alteration nameplate to be by a method such as welding, brazing, soldering, or tamper-resistant mechanical fasteners which will allow easy removal of the nameplate? **Answer 2**: Yes. (No Attachment)

January 2013
Mr. Ray Miletti reported that the SC on Repairs and Alterations would like to send the inquiry back to the inquirer and ask him to withdraw the question and open an action item to address his concerns.

IN13-0301 ***SC on Repair and Alteration, Part 3, 3.2.2 c)*** **- Question 1**: Does Part 3, 3.2.2 c) prevent an "R" Certificate Holder with the capabilities within his shop from rolling and welding a shell or other such items as headers, nozzles, (flange to pipe) for replacement in a vessel or boiler is repairing or altering? **Answer 1**: No

Question 2: If the answer is “No” to the above question, if the same Certificate Holder could not fabricate the replacement items within his capabilities and received these parts from an outside source, then these items would have to be fabricated by an organization holding the appropriate Code Certificate of Authorization**. Answer 2**: Yes. (No Attachment)

January 2013
Mr. Galanes reported that the subcommittee had prepared a question and reply to present but the information was lost electronically. Mr. Wielgoszinski will regenerate the text and the SC on R/A will revisit it.

IN13-0401 ***Part 3, 3.2.5, SC Repair and Alteration*** **- Question 1**: Is it the intent of the requirements in paragraph 3.2.5 that calculations be both completed and also made available to the Inspector for review prior to the start of any physical work? **Answer 1**: Yes

Question 2: Does the requirement in paragraph 3.2.5 that calculations be completed and also mean that the calculations as required by paragraph 3.2.5 be an "R" Certificate Holder? **Answer 2**: No. However the “R”-Certificate Holder responsible for executing the "Design Certification" portion of the R-2 Form, must assure himself that the design complies with the NBIC and by signing the Design Certification accepts responsibility for the design.

Alternate Proposed Reply Question 2: Yes; "the organization" in paragraph 3.2.5 refers to the "R" Certificate holder responsible for preparing and executing "Design Certification" portion of the R-2 Form. This does not preclude the "R" Certificate Holder from having the calculations prepared or otherwise obtaining the calculations from others, but the "R"

Certificate older must assure himself that the design complies with the NBIC and by signing the Design Certification accepts responsibility for the design.

Question 3: If an alteration involves the installation of a replacement part (as defined in Paragraph 3.2.2 c) that has been designed, fabricated, inspected and stamped in accordance with the original code of construction and for which the part fabricator has documented on the partial data report that they have certified the design of the part for a specific set of design conditions (MAWP,MAWT,MDMT, corrosion allowance, etc.), must the "R" Certificate Holder responsible for executing the Design Certification on the R-2 Form obtain the calculations from the part fabricator and make available for review by the Inspector? **Answer 3**: No, however the "R" Certificate holder responsible for executing the Design Certification must assure that the design conditions certified for the new part are consistent with the original vessel design conditions. Additionally the R Certificate holder would be responsible for assessing whether the installation of the new part impacted in any manner the existing components in the overall vessel design and for completing any calculations that might be required to address such impact. (No Attachment)

January 2013
Mr. Randy Cauthon reported that these questions need to go back to the inquirer for clarification on why he is asking the questions so the SC can better understand how to answer the inquiry.

2) Action Items

NB10-0110 ***Part 3 S6.19.1 TG on DOT*** - Combine and clarify requirements within S6.15 for TR-Forms, S6.18 Preparation of TR-Forms and S6.19 for Reports of Repairs, Alterations and Modifications. (No Attachment)

January 2013
Mr. Staniszewski provided an update of the D.O.T. progress on this item. He would like to letter ballot the subgroups and subcommittee on Repair and Alteration for comment only.

NB11-0701 ***Part 3, S3.5.4 SG on Graphite*** **-** Address graphite tube replacement. (No Attachment)
January 2013
Mr. Galanes had no progress to report at this time.

NB11-1001 ***Part 3, 3.3.4.9, SG on R/A Specific*** **-** Tube plugging for fire tube boilers. (No Attachment)

January 2013
Mr. Pillow gave a progress report. He reported that the subgroup cannot agree if plugs should be used or not in this repair.

NB11-1201 ***Part 3, 1.8, SG on R/A General***- Revise Part 3, 1.8 “NR” Accreditation requirements to include repairs to ASME Section III stamped components. (No Attachment)

January 2013
Mr. Galanes reported that because the TG on NR did not meet there was nothing to report at this time.

NB12-0403 ***Part 3 R/A Specific*** CSEF Weld Repair Options using temper bead welding. (Attachment 6, pp. 1-17)

January 2013
Mr. Galanes gave a progress report. Mr. Galanes reported that a presentation was given to the SC on Repairs and Alterations and that a copy of this presentation would become a part of the NBIC Committee minutes.

NB12-0501 ***Part 3, 3.2.2 c) SG R/A General-*** Hydrostatic testing of pressure parts. (Attachment 7, p. 18)

January 2013
Mr. Wielgoszinski gave a progress report. He stated that ASME Section I Committee has refused to act on this issue and that there is a need to bridge the gap between what is required by the code of construction and what is permitted for hydrostatic pressure parts within the NBIC. A proposal was presented at the SC level and was unanimously approved. There was a motion to letter ballot this proposal to the NBIC Committee. The motion was unanimously approved.

NB12-0801 ***Part 3, SG R/A General*** - Repair and Alteration of Gasketed PHE's in the field. (No Attachment)

January 2013
Mr. Ortman gave a progress report. He stated that discussions continue and that the task group hopes to have a proposal before the next meeting.

NB13-0501 Part 3, 3.3.4.6 b) SG R/A Specific Add a cautionary or informational note: "Air currents within the tube (i.e. chimney effect) may affect the retention of the shielding gas at the welding arc when using the gas tungsten-arc welding process on the inside of the tube." (No Attachment)

January 2013
There was a motion to close this item with no action taken. Mr. Pillow reported that this is a common problem and that it did not warrant discussion. The motion was unanimously approved.

c) Subcommittee on PRD (Attachment 10)

Charge: To develop new rules, revise, interpret and maintain existing rules which address administrative and technical requirements for installation, inspection and repairs of pressure relief devices.

Membership: Frank Hart (Chair), Marianne Brodeur, Sid Cammeresi, Alton Cox, Denis DeMichael, Robert Dobbins, Robert Donalson, Thakor Patel, Raymond McCaffrey, Kevin Simmons and Tom Beirne (Secretary).

Mr. Hart reported on the following:

1) Inquiries

There were no inquiries assigned to this subcommittee.

2) Action Items

NB11-0401 ***Part 4, SC PRD*** **-** The development of a possible fourth part of the NBIC to cover pressure relief topics. (No Attachment)

January 2013
Mr. Hart gave a progress report. He stated that the SC has come up with a five- question survey to be sent to stakeholders regarding the development of a Part 4 of the NBIC.

NB12-0901 ***Part 4 SC on PRD*** - Prepare a guide for repair of tank vents. (No Attachment)

January 2013
Mr. Hart gave a progress report.

d) Subcommittee on Installation (Attachment 8)

Charge: Responsible for developing new rules, revising, interpreting and maintaining existing rules which address administrative and technical requirements for installing pressure retaining items. This subcommittee also directs, supports, reviews and approves any items forwarded by each subgroup functioning under this subcommittee.

Membership: Michael Richards (Chair), Paul Bourgeois, Geoff Halley, Craig Hopkins, Stan Konopacki, Brian Moore, Don Patten, Gary Scribner, Raymond Snyder, Harold Tyndall, and Jeanne Bock (Secretary).

Mr. Richards is expected to report on the following:

1) Inquiries

There were no inquiries submitted for this subcommittee.

2) Action Items

NB08-2101 ***Part 1 Installation SG on Boilers*** **-** CSD-1 does not address solid fuel firing and it would be appropriate for the NBIC to look into it. A task group of G. Halley (Chair), M. Richards, G. Scribner and B. Moore has been assigned. (Attachment 8, pp. 1-8)

January 2013
Mr. Richards gave a progress report. Mr. Halley has produced a new handout for review and has added Mr. Mark Mooney to the task group for assistance with wording.

NB10-0201 ***Part 1 S3*** **-** Expand the section on installation of thermal fluid heaters. This action item is a result of splitting NB09-0601into two parts. A task group of G. Halley and P. Bourgeois has been assigned. (No Attachment)

January 2013
Mr. Patten gave a progress report. He stated that the task group has wording to review and hopes to have something for the subgroup by the next meeting.

NB10-1201 ***Part 1 SC Installation*** **-** Request for a format change to NBIC Part 1 Code Rules. A task group of G. Scribner, S. Konopacki and D. Patten has been assigned.(No Attachment)

January 2013
Mr. Scribner gave a progress report. He stated that the language is not consistent and needs to be addressed.

NB11-0802 ***Part 1, 1.4.5 SG Boilers*** **-** Boiler Installation Report review. A task group of G. Scribner (Chair), B. Moore and M. Richards has been assigned. (No Attachment)

January 2013
Mr. Patten gave a progress report.

NB11-1901 ***Part 1, SG Fiber Reinforced Plastic*** **-** Installation of High Pressure Composite Pressure Vessels The FRP Subgroup initiated this proposal to provide guidance for a safe installation of high pressure vessels operating in close proximity to the public. (No Attachment)

January 2013
Mr. Richards gave a progress report. He stated that he had spoken with Francis Brown and that the SG on FRP has resolved the negative comments that they had received from the SC Installation. The item is currently out for letter ballot within the SG.

NB11-2001 ***Part 1, 2.9.4 SG Pressure Vessels and Piping*** **-** Address the safe venting of isolatable economizers where the outlet is below the inlet of other communicable chambers (headers, drums, etc.). (No Attachment)

January 2013
Mr. Patten gave a progress report. He reported that they have sent a formal inquiry to ASME regarding this question and that they are still waiting for a response.

NB12-0302 ***Part 1, SG Pressure Vessels and Piping*** **-** Define installation requirements for PVHO (hyperbaric chambers). (No Attachment)

January 2013
Mr. Scribner gave a progress report. He stated that he has been in contact with the chair of PVHO and they are working on wording for the different types of PVHO vessels.

NB12-1401- ***Part 1, SG on Boilers*** **-** Reference item NB09-0204. Address the installation of Potable Water Heaters. A task group of G. Scribner, P. Bourgeois, B. Moore, and H. Tyndall was assigned. (No Attachment)

January 2013
Mr. Scribner gave a progress report. He stated that the task group is developing general language within this section and finding common terminology for use in different kinds of potable water heaters.

8. Liaison Activities

a. ASME

- Mr. Jim Pillow remarked that the task group on modernization is still progressing with their task and that ASME is heading toward a Dev. 2 of Section I.

b. AWS

- Mr. Jim Sekely was not present at the meeting to make comments.

c. API

- Mr. Jim Riley submitted a handout of API happenings. (Attachment 9)

d. I.C.C.

- Mr. Scribner reported that the I.C.C held their final action meeting in October and the National Board was involved for the first time. The most significant thing that happened was that some places that do not have a jurisdiction to report to will be using the NBIC as a reference tool.

9. New Business

NB12-1602 *NBIC* Procedure -This action item was opened as a result of the negative votes received for the NBIC procedure Rev. 11. (No Attachment)

January 2013
A letter ballot was sent to address this action item and was still in process during the meeting. The letter balloting period has closed and the revised procedures were unanimously approved. The revised procedures will be forwarded to the BOT for their review.

NB13-0401 Address the revised NBIC Procedures, Rev. 12.

January 2013
Mr. Wielgoszinski reported that there is nothing to report at this time.

10. Future Meetings

The NBIC Executive Committee chose three locations to choose from for the January 2015 meeting: San Diego, CA, Phoenix, AZ and Orlando, FL. After a show of hands, the winning city was Orlando, FL.

The following meetings have been scheduled:

July 15-19, 2013, Columbus, Ohio
January 13-16, 2014, San Antonio, Texas

11. Adjournment

Respectfully submitted,

Robin Hough
Secretary, NBIC Committee

ATTACHMENT 1

Attendance List NBIC Committee

Meeting Date: January 17, 2013

Stanley Staniszewski, Jr. US Dept. of Transportation, Pipelines & Administration Hazardous Materials Safety 1200 New Jersey Ave. S.E. Washington, DC 20590 Ph: 202-366-4545 x 0453 Fax: 202-366-3753 E-mail: stanley.staniszewski@dot.gov	Attended: Yes ☑ No ☐ Initial	**Domenic A. Canonico** Canonico & Assoc. 1423 East Brown Road Signal Mountain, TN 37377 CELL 423 322 1797 Ph: 423-886-1008 Fax: E-mail: canonicod@bellsouth.net	Attended: Yes ☑ No ☐ Initial
James T. Pillow Common Arc Corporation 67 Wyndemere Lane Windsor, CT 06095 CELL 860-539-9160 Ph: 860-688-2531 Fax:860-688-2531 E-mail: JPillow@Commonarc.com	Attended: Yes ☑ No ☐ Initial	**Paul D. Edwards** Director, ASME Programs Stone & Webster, Inc. ~~100 Technology Center Drive~~ ~~Stoughton, MA 02072~~ 150 ROYALL ST, CANTON, MA 02021 Ph: 617-589-5690 Fax: 617-589-~~1792~~ 5476 E-mail: paul.edwards@shawgrp.com	Attended: Yes ☑ No ☐ PE Initial
Robin Hough NBIC Coordinator The National Board of B&PVI 1055 Crupper Ave. Columbus, OH 43229 Ph; 614-888-8320 Fax: 614-847-1828 E-mail: rhough@nationalboard.org	Attended: Yes ☑ No ☐ RMH Initial	**George W. Galanes, PE** ~~Manager, Metallurgy and QA~~ ~~Edison Mission Group/Midwest Generation~~ ~~235 Remington Blvd.~~ ~~Bollingbrook, IL 60440~~ See NBIC web site Ph: ~~630-771-7927~~ Fax: 312-788-5218 E-mail: ~~ggalanes@MWGen.com~~	Attended: Yes ☑ No ☐ Initial
Frank Hart Director Valve Services Furmanite COE Worldwide 6330 Dixie Drive Houston, TX 77087 C: 832-244-7840 Ph: 713-844-7623 Fax: 713-844-9245 E-mail: fhart@Furmanite.com	Attended: Yes ☑ No ☐ Initial	**Craig Hopkins** Seattle Boiler Works 500 South Myrtle Street Seattle, WA 98108 Ph: 206-762-0737 Fax: 206-762-3516 E-mail: chopkins@seattleboiler.com	Attended: Yes ☑ No ☐ Initial
Robert V. Wielgoszinski Hartford Steam Boiler I & I of CT. One State Street Hartford, CT 06103 Ph: 860-722-5064 Fax: 860-722-5705 E-mail: Robert_wielgoszinski@hsbct.com	Attended: Yes ☑ No ☐ RW Initial	**Mark Mooney** Liberty Mutual Insurance ~~Engineering Manager-Eastern Region~~ CHIEF ENGINEER 20 Riverside Road MS:03BN Weston, MA Ph: 781-891-890 x ~~27329~~ 37107 Fax: 781-642-6512 E-mail: Mark.Mooney@Libertulmual.com	Attended: Yes ☑ No ☐ MAM Initial

Attendance List NBIC Committee

Meeting Date: January 17, 2013

Don Cook Principal Safety Engineer Dept. of Industrial Relations Div. of Industrial Safety & Health 1515 Clay Street, Suite 1302 Oakland, CA 94612-1302 Ph: 510-622-3050 Fax: 510-622-3063 E-mail: dcook@dir.ca.gov	Attended: Yes ☑ No ☐ DC *Initial*	**Benjamin Anthony** Chief B&PV Inspector Department of Labor & Training Division of Occupational Safety 1511 Pontiac Ave., Bldg. 70-2 PO Box 20157 Cranston, RI 02920-0942 Ph: 401-162-8574 Fax: 401-462-8576 Email: banthony@dlt.state.ri.us	Attended: Yes ☑ No ☐ BA *Initial*
Larry McManoman Great Lakes Apprenticeship Program 566 W. 95th Street Oak Lawn, IL 60453 Ph: 708.636.6656 Fax: E-mail: Lmac@gLabap.com	Attended: Yes ☐ No ☑ RMH *Initial*	**H. Michael Richards** Southern Company 42 Inverness Center Pkwy. Birmingham, AL 35242 Ph: 205-992-7111 Fax: 205-992-0361 E-mail: hmrichar@southernco.com	Attended: Yes ☑ No ☐ *Initial*
John Richardson Consultant - ~~Dresser, Inc.~~ GE OIL + GAS 980 Richardson Road Colfax, LA 71417 Ph: 318-627-5504 Fax: 318-627-2969 E-mail: jwrichar@aol.com	Attended: Yes ☑ No ☐ *Initial*	**James Sekely** Welding Services, Inc. 716 Vanderbilt Drive Monroeville, PA 15146 Ph: 412-389-5567 Fax: 724-327-7381 E-mail: jsekely@comcast.net	Attended: Yes ☐ No ☑ RMH *Initial*
Raymond Snyder Arise 150 Costa Loop Auburndale, FL 33823 Cell. 863-956-7939 Ph:865-965-4417 Cell: ~~732-778-6024~~ Fax: 865-967-0185 E-mail: Raymond.snyder@ariseinc.com	Attended: Yes ☑ No ☐ *Initial*	**Gary Scribner** Missouri Division of Fire Safety P.O. Box 844 Jefferson City, MO 65102 Ph: 573-751-8708 Cell:573-230-3160 Fax: 573-526-5971 E-mail: gary.scribner@dfs.mo.gov	Attended: Yes ☑ No ☐ *Initial*

Attendance List NBIC Committee

Meeting Date: January 17, 2013

Robert Reetz Chief Boiler Inspector North Dakota Insurance Department Boiler Inspection Program 1701 S. 12th Street Bismarck, ND 58504-6644 Ph: 701/328-9607 Fax: 701/328-9610 E-mail: **breetz@nd.gov**	Attended: Yes ☒ No ☐ *Initial*	**Paul Bourgeois** Travelers Insurance ~~11441 Sarasota Lane~~ 6812 54th ST Northport, AL ~~35475~~ 35476 Ph:205-339-6314 Fax: 888-803-1522 E-mail: pcbourge@travelers.com	Attended: Yes ☒ No ☐ *Initial*
Bryan Schulte NRG Maintenance Services 12307 Kurland Drive Houston, TX 77034 Ph: 713-795-1456 Fax: 713-795-1451 E-mail: bryan.schulte@nrgenergy.com	Attended: Yes ☐ No ☒ RMH *Initial*	**Ron Pulliam** Power Generation Group Babcock & Wilcox ~~Construction~~ ~~74 Robinson Ave. BR07~~ Barberton, OH 44203 20 S. Van Buren Ave. BV502E Ph; 330-860-2856 Fax: 330-860-2180 Email: RLPulliam@babcock.com	Attended: Yes ☒ No ☐ *Initial*
Mike Webb Xcel Energy 9500 Interstate 76 Henderson, CO 80640 Ph:303-628-2840 Fax: 303-628-2928 E-mail: mike.webb@xcelenergy.com	Attended: Yes ☒ No ☐ Initial	**Jim Riley** ~~Conoco~~Phillips 66 1380 San Pablo Ave. Rodeo, CA 94572-1354 P: 510-245-5895 F: E-mail: jim.riley@P66.com ~~conocophillips.com~~	Attended: Yes ☒ No ☐ Initial
Name: Ralph Pate Address: State of Alabama Department of Labor 649 Monroe Street Montgomery, AL 36131 Phone: 334 242-3066 Fax: 334 353-4528 E-mail: ralph.pate@labor.alabama.gov		Name: Terry Parks Address: NBBI Phone: Fax: E-mail:	

Attendance List NBIC Committee

Meeting Date: **January 17, 2013**

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Attendance List NBIC Committee

Meeting Date: **January 17, 2013**

Name: Jeanne Bock Address: NB Phone: Fax: E-mail:	Name: DAREN DAILY MARQUIP, LLC Address: 1300 N. AIRPORT RD. PHILLIPS, WI 54555 Phone: 715-339-2191 - EXT. 2303 Fax: E-mail: DAREN.DAILY@MARQUIPWARDUNITED.COM
Name: Thomas P. Beirne Address: NB Staff Phone: Fax: E-mail: Name: JOSEPH BALL Address: NB STAFF Phone: Fax: E-mail:	Name: EDORTMAN Address: Phone: Fax: E-mail: edward.m.ortman@powersalstom.com Name: Address: Phone: Fax: E-mail:
Name: MARK ANDERSON Address: MARQUIP, LLC 1300 NORTH RD. PHILLIPS, WI. 54555 Phone: 715:339:2191 ext. 2407 Fax: E-mail: MARK.ANDERSON@MARQUIPWARD UNITED.COM	Name: Gregory Humphrey Address: State Ah Dept of Labor Phone: 334-546-9413 Fax: E-mail: gregory.humphrey@labor.alabama.gov

Attendance List NBIC Committee

Meeting Date: **January 17, 2013**

Name: Paul Schuelke Address: Weil-McLain 500 Blaine St Michigan City, IN 46360 Phone: 219-879-6561 EXT 407 Fax: 219-877-0535 E-mail: pschuelke@weil-mclain.com	Name: Melissa Wadkinson Address: Fulton Companies PO Box 257 Pulaski NY 13142 Phone: 315 298 7112 Fax: 315 298 6390 E-mail: melissa.wadkinson@fulton.com
Name: Brian W. Moore Address: Hartford Steam Boiler One State Street P.O. Box 5024 Hartford, CT. 06102-5024 Phone: 860-722-5657 Fax: 860-722-5530 E-mail: brian_moore@hsb.com	Name: DON PATTEN Address: R.F. MACDONALD CO. 25920 EDEN LANDING RD. HAYWARD, CA. 94545 Phone: 510-784-0110 Fax: 510-784-1004 E-mail: don.patten@rfmacdonald.com

Attendance List NBIC Committee

Meeting Date: **January 17, 2013**

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ATTACHMENT 2

DRAFT RESPONSE LANGUAGE

IN12-0201
IN12-0202
RE: Code Interpretation – NBIC Part 2, Section 5.2.2 through 5.2.3 Replacement of Stamping

Inquiry #1
If a National Board Commissioned Inspector has verified the replacement of stamped data or nameplate by an "R" Certificate holder on Corrugated rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, is the application of NB-136 "Replacement of Stamped Data Form" required?

Reply #1:
Yes, Section 5.2.1 clearly states that that requests for permission to re-stamp or replace nameplates shall be made to the Jurisdiction in which the pressure retaining item is installed, and that such application must be made on the NB-136 form. If the vessel is not stationary, application should be made in the jurisdiction where the nameplate is re-applied.

Inquiry #2
Can an NB-136 "Replacement of Stamped Data Form", which is required to be signed by a National Board Commissioned Inspector, for Corrugated Rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, be filed with the National Board and copied to the applicable Jurisdiction in lieu of obtaining an approval signature from the Jurisdiction?

Reply #2:
No, Section 5.2.1 allows the action of the National Board in this manner only when there is no jurisdiction wherein the restamping or nameplate replacement is performed

Background Information

Although corrugated rolls are not stationary and are routinely transported to an "R" Certificate holder's facility for refurbishment, frequently requiring the replacement of lost or illegible nameplates, there is no exemption or distinction between vessels that are stationary or not with regard to the requirement to request permission of the jurisdiction and the application of the NB-136 form.

Task Group for NB12-1801 will work on potential draft language that would seek to address the concerns of the party requesting the interpretation.

Reference: NBIC Part 2, Section 5.2.1 -5.2.3

5.2.1 Authorization

a) When the stamping on a pressure-retaining item becomes indistinct or the nameplate is lost, illegible, or detached, but traceability to the original pressure-retaining item is still possible, the Inspector shall instruct the owner or user to have the stamped data replaced. All re-stamping shall be done in accordance with the original code of construction, except as modified herein. Requests for permission to re-stamp or replace nameplates shall be made to the Jurisdiction in which the pressure-retaining item is installed. Application must be made on the *Replacement of Stamped Data Form*, NB-136 (See 5.3.2). Proof of the original stamping and other such data, as is available, shall be furnished with the request. Permission from the Jurisdiction is not required for the reattachment of nameplates that are partially attached. When traceability cannot be established, the Jurisdiction shall be contacted.

b) When there is no Jurisdiction, the replacement of stamped data shall be authorized and witnessed by a National Board Commissioned Inspector and the completed Form NB-136 (See 5.3.2) shall be submitted to the National Board.

5.2.2 Replacement of Stamped Data

a) The re-stamping or replacement of data shall be witnessed by a National Board Commissioned Inspector and shall be identical to the original stamping.
b) The Re-stamping or replacement of a code symbol stamp shall be performed only as permitted by the governing code of construction.
c) Replacement nameplates shall be clearly marked "replacement."

5.2.3 Reporting

Form NB-136 shall be filed with the Jurisdiction (if required) or the National Board by the owner or user together with a facsimile of the stamping or nameplate, as applied, and shall also bear the signature of the National Board Commissioned Inspector who witnessed the replacement.

5.3 NATIONAL BOARD INSPECTION FORMS

5.3.1 SCOPE

The following forms may be used for documenting specific requirements as indicated on the top of each form.
Note: Jurisdictions may have adopted other forms for the same purpose and may not accept these forms.

Staniszewski, Stanley (PHMSA)

From: Staniszewski, Stanley (PHMSA)
Sent: Thursday, January 10, 2013 9:34 AM
To: Staniszewski, Stanley (PHMSA)
Subject: NB07-910 January2013 Update

NB07-0910 January 2013

Status Report on DOT Rulemaking Activities

Current regulatory action on incorporating by reference the latest NBIC continues to progress. PHMSA is preparing responses to address public review comments and has given briefings to DOT modal administrations and senior management. The focus is to provide a Notice of Proposed Rulemaking (NPRM) that will detail what the regulations will look like for the course of action chosen, and to again request public review and comment on the proposed rulemaking.

(3) 1/1

NB10-0601

SUPPLEMENT 9

INSPECTION OF STATIONARY HIGH PRESSURE (3000-15000 psi) COMPOSITE PRESSURE VESSELS

S9.1 SCOPE

This supplement provides specific guidelines for inspection of high pressure composite pressure vessels, hereafter referred to as vessels. This supplement is applicable to pressure vessels with a design pressure that exceeds 3000 psi but no greater than 15000 psi, and is applicable to the following four classes of pressure vessels:

a) Metallic vessel with a hoop Fiber Reinforced Plastic (FRP) wrap over the straight shell cylindrical part of the vessel (both load sharing).b) Fully wrapped FRP vessel with a non-load sharing metallic liner.

c) FRP vessel with a non-load sharing non-metallic liner.

d) Fully wrapped FRP vessel with load sharing metallic liner.

S9.2 INSERVICE INSPECTION

a) Section 1 of this Part shall apply to inspection of high pressure vessels, except as modified herein. This supplement covers vessels, and was not written to cover piping and ductwork, although some of the information in this supplement may be used for the inspection of piping and ductwork.

b) The inspection and testing for exposed load sharing metallic portions of vessels shall be in accordance with Part 2, Section 2.3 and 4 of this Code.

c. All composite vessels shall have an initial acoustic emission examination per S9.11 after the first 3 years from the date of manufacture. Thereafter, vessels shall have a maximum examination interval of 5 years which shall be shortened based on the results of any external inspection per paragraph S9.7.

d. All vessels shall be subject to the periodic inspection frequency given in S9.9.

S9.3 GENERAL

a) High pressure composite vessels are used for the storage of fluids at pressures up to 15000 psi. Composite vessels consist of the FRP laminate with load sharing or non-load sharing metallic shells/liners, or non metallic liners. The FRP laminate with load sharing metallic liners form the pressure retaining system. The FRP laminate is the pressure retaining material for composite vessels with non-load sharing metallic and non metallic liners. The purpose of the non-load sharing metallic and the non metallic liners is to minimize the permeation of fluids through the vessel wall.
b) Fluids stored in vessels are considered to be non corrosive to the materials used for vessel construction. The laminate is susceptible to damage from:

1) External Chemical attack
2) External Mechanical damage(i.e. abrasion, impact, cuts, dents, etc.)
3) Structural damage (i.e. over pressurization, distortion, bulging, etc.)
4) Environmental degradation [i.e. ultraviolet (if there is no pigmented coating or protective layer), ice, etc.]
5) Fire or excessive heat

S9.4 VISUAL EXAMINATION

a) Acceptable Damage

Acceptable damage or degradation is minor, normally found in service, and considered to be cosmetic. This level of damage or degradation does not reduce the structural integrity of the vessel. This level of damage

or degradation should not have any adverse effect on the continued safe use of the vessel. This level of damage or degradation does not require any repair to be performed at the time of in-service inspection. When there is an external, non load bearing, sacrificial layer of filaments on the vessel, any damage or degradation should be limited to this layer. Damage or degradation of the structural wall shall not exceed the limits specified in Table 1.

b) Rejectable Damage (Condemned—Not Repairable)

Rejectable damage or degradation is so severe that structural integrity of the vessel is sufficiently reduced so that the vessel is considered unfit for continued service and must be condemned and removed from service. No repair is authorized for vessels with rejectable damage or degradation.

c) Acceptance Criteria

Certain, specific types of damage can be identified by the external in-service visual inspection. Indications of certain types and sizes may not significantly reduce the structural integrity of the vessel and may be acceptable so the vessel can be left in service. Other types and larger sizes of damages may reduce the structural integrity of the vessel and the vessel must be condemned and removed from service. Table 1 is a summary of the acceptance/rejection criteria for the indications that are found by external visual inspection of the vessel.

d) Fitness-for-service

1) If a visual inspection reveals that a vessel does not meet all criteria of Table 1 satisfactorily, it shall be taken out of service immediately, and either be condemned or a fitness-for-service examination be conducted by the original vessel

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manufacturer who must also hold a National Board R certificate. When the vessel is taken out of service, its contents shall be immediately safely vented or transferred to another storage vessel per the owner's written safety procedures.

2) If a fitness-for-service examination is to be conducted, the original vessel manufacturer shall be contacted as soon as possible after the rejectable defects have been found. The manufacturer shall then determine the vessel fitness-for-service by applicable techniques, i.e., acoustic emission testing, ultra-sonic testing, and/or other feasible methods. The manufacturer shall have documentation that the evaluation method(s) used is satisfactory for determining the condition of the vessel. Repairs to the outer protective layer may be made by a R certificate holder other than the original manufacturer following the original manufacturer's instructions.

Table 1 - Visual Acceptance/ Rejection Criteria for Composite Pressure Vessels

Type of Degradation or Damage	Description of Degradation or Damage	Acceptable Level of Degradation or Damage	Rejectable Level of Degradation or Damage
Abrasion	Abrasion is damage to the filaments caused by wearing or rubbing of the surface by friction	Less than 0.050 in. depth in the pressure bearing thickness.	$\geq$ 0.050 in. depth in the pressure bearing thickness
Cuts	Linear indications flaws caused by an impact with a sharp object	Less than 0.050 in. depth in the pressure bearing thickness.	$\geq$ 0.050 in. depth in the pressure bearing thickness
Impact Damage	**Damage to the vessel caused by striking the vessel with an object or by being dropped. This may be indicated by discoloration of the composite or broken filaments and/or cracking.**	**Slight damage that causes a frosted appearance or hairline cracking of the resin in the impact area**	**Any permanent deformation of the vessel or damaged filaments**
Delamination	Lifting or separation of the filaments due to impact, a cut, or fabrication error.	Minor delamination of the exterior coating	Any loose filament ends showing on the surface. Any bulging due to interior delaminations
Heat or Fire Damage	Discoloration, charring or distortion of the composite due to temperatures beyond the curing temperature of the composite	Merely soiled by soot or other debris, such that the cylinder can be washed with no residue	Any evidence of thermal degradation or discoloration or distortion

Structural Damage - bulging, distortion, depressions	Change in shape of the vessel due to sever impact or dropping	None	Any visible distortion, bulging, or depression
Chemical attack	Environmental exposure that causes a change in the composite or failure of the filaments	Any attack that can be cleaned off and that leaves no residue	Any permanent discoloration or loss or softening of material under the exterior coat.
Cracks	Sharp, linear indications	None	None
Scratches/Gouges	Sharp, linear indications caused by mechanical damage.	Less than 0.050 in. depth in the pressure bearing thickness No structural fibers cut or broken	$\geq$ 0.050 in. depth in the pressure bearing thickness or structural fibers cut or broken
Soot	A deposit on the composite caused by thermal or environmental exposure	Soot that washes off and leaves no residue	Any permanent marking that will not wash off the surface under the exterior coating
Over pressurization	Excessive pressure due to operational malfunction	None reported	Any report of pressurization beyond the MAWP or any indication of distortion
Corrosion	Degradation of the composite due to exposure to specific corrosive environments	None visible	Any surface damage to structural identified as corrosion
Dents	A depression in the exterior of the vessel caused by impact or dropping	< 1/16 in. in depth	Any dents with a depth $\geq$ 1/16 in. Or with a diameter greater than 2 inches

<table>
<tr><td colspan="4">Reported collision, accident, or fire</td><td>Damage to the vessel caused by unanticipated excursion from normally expected operating conditions</td><td>None reported</td><td>Any indication or report of impact or heat damage</td></tr>
<tr><td colspan="4">Environmental Damage or Weathering</td><td>Ultraviolet or other environmental attack under the exterior coating.</td><td>None</td><td>Any discoloration that can not be washed off*</td></tr>
<tr><td>Damage to a protective or sacrificial layer</td><td>Abrasion, cuts, chemical attack, scratches/gouges, corrosion, environmental damage, or crazing that are limited only to the protective or sacrificial layer.</td><td>The depth of any damage to the protective or sacrificial layer that does <u>not</u> <u>exceed</u> the thickness of the protective or sacrificial layer plus 0.050 inch.</td><td>The depth of any damage to the protective or sacrificial layer that <u>exceeds</u> the thickness of the protective or sacrificial layer plus 0.050 inch.</td><td>Hairline surface cracks only in the composite resin</td><td>Light hairline cracks only in the resin</td><td>Any damage to the filaments</td></tr>
<tr><td colspan="4">Note: Only damage beyond the sacrificial or coated layer should be considered, and that any damage to sacrificial or coated layers should be repaired by suitable techniques (i.e. epoxy filler). Refer to ASME data report for sacrificial layer thickness.

* - Washing off UV scale will accelerate attack into lower composite layers Crazing</td><td colspan="3"></td></tr>
</table>

. For this reason, if there is superficial UV damage the affected area should be cleaned and painted with a UV tolerant paint. If broken, frayed, or separated fibers, to the non sacrificial layer, are discovered during the cleaning process then the vessel shall be condemned.

S9.5 INSPECTOR QUALIFICATIONS

The Inspector shall be familiar with vessel construction and qualified by training and experience to conduct such inspections. The Inspector should have a thorough understanding of all required inspections, tests, test apparatus, inspection procedures, and inspection techniques and equipment applicable

to the types of vessels to be inspected. The Inspector should have basic knowledge of the vessel material types and properties. Refer to Part 2 Para. S4.2.

The acoustic emission technician conducting the examination required per S9.2(c) and in accordance with S9.11 shall be certified per the guidelines of ASNT SNT-TC-1A or CP-189 AE Level II or III. A technician performing this test shall have training in and experience with measuring C_e and C_f in composites and identifying wave modes.

S9.6 ASSESSMENT OF INSTALLATION

a) The visual examination of the vessel requires that all exposed surfaces of the vessel are examined to identify any degradation, defects, mechanical damage, or environmental damage on the surface of the vessel.

The causes of damage to vessels are: (1) abrasion damage, (2) cut damage, (3) impact damage, (4) structural damage, (5) chemical or environmental exposure damage or degradation, and (6) heat or fire damage.
The types of damage found are: (1) cracks, (2) discolored areas, (3) gouges and impact damage, (4) leaks, (5) fiber exposure, (6) blisters, (7) delaminations, (8) surface degradation, and (9) broken supports.

b) The visual examination of the vessel requires that the identity of the vessel must be verified. This should include the ASME Code to which the vessel was constructed, vessel serial number, maximum allowed operating pressure, date of manufacture, vessel manufacturer, date of expiration of the service life of the vessel, and any other pertinent information shown on the vessel or available from

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vessel documents. The overall condition of the vessel should be noted.

S9.7 EXTERNAL INSPECTION

a) Vessel Service Life

Vessels have been designed and manufactured for a limited lifetime; this is indicated on the vessel marking. This marking should first be checked to ensure that such vessels are within their designated service lifetime.

b) Identification of External Damage

The external surface should be inspected for damage to the laminate. Damage is classified into two levels as shown in Section 9 of these guidelines. The acceptance/rejection criteria shown in section 10 of these guidelines should be followed, as a minimum.

The external surface of the vessel is subject to mechanical, thermal, and environmental damage. The external surface of a vessel may show damage from impacts, gouging, abrasion, scratching, temperature excursions, etc. Areas of the surface that are exposed to sunlight may be degraded by ultraviolet light which results in change in the color of the surface and may make the fibers more visible. This discoloration does not indicate a loss in physical properties of the fibers. Overheating may also cause a change in color.

The size (area or length and depth) and location of all external damage should be noted.

Vessel support structures and attachments should be examined for damage such as cracks, deformation, or structural failure.

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c) Types of External Damage

1. General

Several types of damage to the exterior of vessels have been identified. Examples of specific type of damage are described below. The acceptance/rejection criteria for each type of damage are described in Table 1 of this supplement.

2. Abrasion Damage

Abrasion damage is caused by grinding or rubbing away of the exterior of the vessel. Minor abrasion damage to the protective outer coating or paint will not reduce the structural integrity of the vessel. Abrasion that results in flat spots on the surface of the vessel may indicate loss of composite fiber overwrap thickness

3. Damage from Cuts

Cuts or gouges are caused by contact with sharp objects in such a way as to cut into the composite overwrap, reducing its thickness at that point.

4. Impact Damage

Impact damage may appear as hairline cracks in the resin, delamination, or cuts of the composite fiber overwrap.

5. Delamination

Delamination is a separation of layers of fibers of the composite overwrap. It may also appear as a discoloration or a blister beneath the surface of the fiber.

6. Heat or Fire Damage

Heat or fire damage may be evident by discoloration, charring or burning of the composite fiber overwrap, labels, or paint. If there is any suspicion of damage, the vessel shall be re-qualified using an acoustic emission examination.

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7. Structural Damage

Structural damage will be evidenced by bulging, distortion, or depressions on the surface of the vessel.

8. Chemical Attack

Some chemicals are known to cause damage to composite materials. Environmental exposure or direct contact with solvents, acids, bases, alcohols, and general corrosives can cause damage to vessels. Long-term contact with water can also contribute to corrosive damage. Chemicals can dissolve, corrode, remove, or destroy vessel materials. Chemical attack can result in a significant loss of strength in the composite material. Chemical attack can appear as discoloration and in more extreme cases the composite overwrap can feel soft when touched.

S9.8 INTERNAL INSPECTION

a) Requirements for Internal Visual Inspection

Internal visual inspection is normally not required. When vessels have been filled only with pure fluids, corrosion of the interior of the liner should not occur. Internal visual inspection of the tanks should only be carried out when:

1. There is evidence that any commodity except a pure fluid has been introduced into the tank. In particular, any evidence that water, moisture, compressor cleaning solvents, or other corrosive agents have been introduced into the vessel will require an internal visual inspection.
2. There is evidence of structural damage to the vessel, such as denting or bulging.
3. The vessel valve is removed for maintenance or other reason. Internal inspection in this case is limited to inspection of the threads and sealing surface. When an internal visual inspection is conducted, the following procedures should be followed.

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b) Identification of Internal Damage

1. Vessels with Metallic Liners

For vessels with metallic liners, the objective of the internal visual inspection is primarily to detect the presence of any corrosion or corrosion cracks.
The internal surface of the vessel should be inspected with adequate illumination to identify any degradation or defects present. Any foreign matter or corrosion products should be removed from the interior of the vessel to facilitate inspection. Any chemical solutions used in the interior of the vessel should be selected to ensure that they do not adversely affect the liner or composite overwrap materials. After cleaning the vessel should be thoroughly dried before it is inspected.
All interior surfaces of the vessel should be inspected for any color differences, stains, wetness, roughness, or cracks. The location of any degradation should be noted. Any vessel showing significant internal corrosion, dents or cracks should be removed from service.

2. Vessels with Non-metallic Liners or No Liners

Vessels with non-metallic liners may show corrosion on the plastic liner or metal boss ends. Vessels with non-metallic liners or no liners may also show internal degradation in the form of cracks, pitting, exposed laminate, or porosity.
The internal surface of vessels should be inspected with adequate illumination to identify any degradation or defects present. Any foreign matter or corrosion products should be removed from the interior of the vessel to facilitate inspection. Chemical solutions used in the interior of the vessel should be selected to ensure they do not adversely affect the liner or composite overwrap materials. After cleaning the vessel should be thoroughly dried before it is inspected.

The inspector should look for cracks, porosity, indentations, exposed fibers, blisters, and any other indication of degradation of the liner and/or laminate. Deterioration of the liner may include softening of the matrix or exposed fibers.

SX.9 INSPECTION FREQUENCY

a) Initial inspection

The vessel shall be given and external visual inspection by the Inspector or the Authority having jurisdiction after the vessel has been installed and during the initial filling operation. The inspection shall check for any damage during installation prior to initial filling and for any leaks or damage during and at the conclusion of filling.

b) Subsequent Filling Inspections

Before each refilling of the vessel, the manager of the facility shall visually inspect the vessel exterior for damage or leaks. Refilling operations shall be suspended if any damage or leaks are detected and the vessel shall be emptied and subsequently inspected by the Inspector to determine if the vessel shall remain in service.

c) Periodic Inspection

Within 30 days of the anniversary of the initial operation of the vessel during each year of its service life, the vessel shall be externally inspected by the Inspector or the Authority having jurisdiction. Internal inspections shall only be required if any of the conditions of S9.8 are met. These inspections are in addition to the periodic acoustic emission examination requirements of S9.2(c).

SX.10 DOCUMENT RETENTION

A detailed record of external and internal inspection shall be retained by the owner of the vessel for the life of the vessel.

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After satisfactory completion of the periodic in-service inspection, vessels should be permanently marked or labeled with the date of the inspection, the mark of the Inspector, and the date of the next periodic in-service inspection. ASME data report shall be kept on file for the life of the vessel if the vessel was not registered with the National Board.

S9.11 ACOUSTIC EMISSION EXAMINATION

a) Use and Test Objectives

All Section X Class III vessels shall be subject to an acoustic emission examination to detect damage that may occur while the vessel is in service. This method may be used in conjunction with the normal filling procedure.

b) Test Procedure

AE transducers shall be acoustically coupled to the vessel under test and connected to waveform recording equipment. Waveforms shall be recorded and stored on digital media as the vessel is pressurized. All analysis shall be done on the waveforms. The waveforms of interest are the E (Extensional Mode) and F (Flexural Mode) plate waves.

Prior to pressurization, the velocities of the earliest arriving frequency in the E wave and the latest arriving frequency in the F wave shall be measured in the circumferential direction in order to characterize the material and set the sample time (the length of the wave window).

The E and F waves must be digitized and stored for analysis. The test pressure shall be recorded simultaneously with the AE events. Permanent storage of the waveforms is required for the life of the vessel.

c) Equipment

1. Testing System

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A testing system shall consist of 1) sensors, 2) preamplifiers, 3) high pass and low pass filters, 4) amplifier, 5) A/D (analog-to-digital) converters, 6) a computer program for the collection of data, 7) computer and monitor for the display of data, and

8) a computer program for analysis of data. Examination of the waveforms event by event must always be possible and the waveforms for each event must correspond precisely with the pressure and time data during the test. The computer program shall be capable of detecting the first arrival channel. This is critical to the acceptance criteria below. Sensors and recording equipment shall be checked for a current calibration sticker or a current certificate of calibration.

2. Sensor Calibration

Sensors shall have a flat frequency response from 50 kHz to 400 kHz. Deviation from flat response (signal coloration) shall be corrected by using a sensitivity curve obtained with a Michelson interferometer calibration system similar to the apparatus used by NIST (National Institute for Standards and Technology). Sensors shall have a diameter no greater than 0.5 inches for the active part of the sensor face. The aperture effect must be taken into account. Sensor sensitivity shall be at least 0.1 V/nm.

3. Scaling Fiber Break Energy

The wave energy shall be computed by the formula

$$U = \int V^2 dt / Z ,$$

which is the formula for computing energy in the AE signal, where V is the voltage and Z is the input impedance.

A rolling ball impactor shall be used to create an acoustical impulse in an aluminum plate. The measured energy in the wave shall be used to scale the fiber break energy. This scaling is illustrated later on.

Figure 1. Rolling Ball Impact Calibration Setup.

The impact setup, an example of which is shown in Figure 1, shall be arranged as follows. The steel ball shall be ½ inch in diameter. The steel ball is a type typically used in machine shops for measuring taper and is commercially available. The ball shall made of chrome steel alloy hardened to R/C 63, ground and lapped to a surface finish of 1.5 micro-inch, within .0001 of actual size and sphericity within 0.000025 inch. The plate shall be made of 7075 T6 aluminum, be at least 4′ x 4′ in size, the larger the better to avoid reflections, be 1/8″ in thickness and be simply supported by steel blocks. The inclined plane shall be aluminum with a machined square groove 3/8″ wide which supports the ball and guides it to the impact point. The top surface of the inclined plane shall be positioned next to the edge of the plate and stationed below the lower edge of the plate such that the ball impacts with equal parts of the ball projecting above and below the plane of the plate. A mechanical release mechanism shall be used to release the ball down the plane.

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The ball roll length shall be 12" and the inclined plane angle shall be six degrees. The impact produces an impulse that propagates to sensors coupled to the surface of the plate twelve inches away from the edge. The sensors shall

be coupled to the plate with vacuum grease. The energy of the leading edge of the impulse, known as the wave front shall be measured. The vertical position of the ball impact point shall be adjusted gradually in order to "peak up" the acoustical signal, much as is done in ultrasonic testing where the angle is varied slightly to peak up the response. The center frequency of the first cycle of the E wave shall be confirmed as 125 kHz ± 10 kHz. See Figure 2. The energy value in joules of the first half cycle of the E wave shall be used to scale the fiber break energy in criterion 2, as illustrated there. This shall be an "end to end" calibration meaning that the energy shall be measured using the complete AE instrumentation (sensor, cables, preamplifiers, amplifiers, filters and digitizer) that are to be used in the actual testing situation.

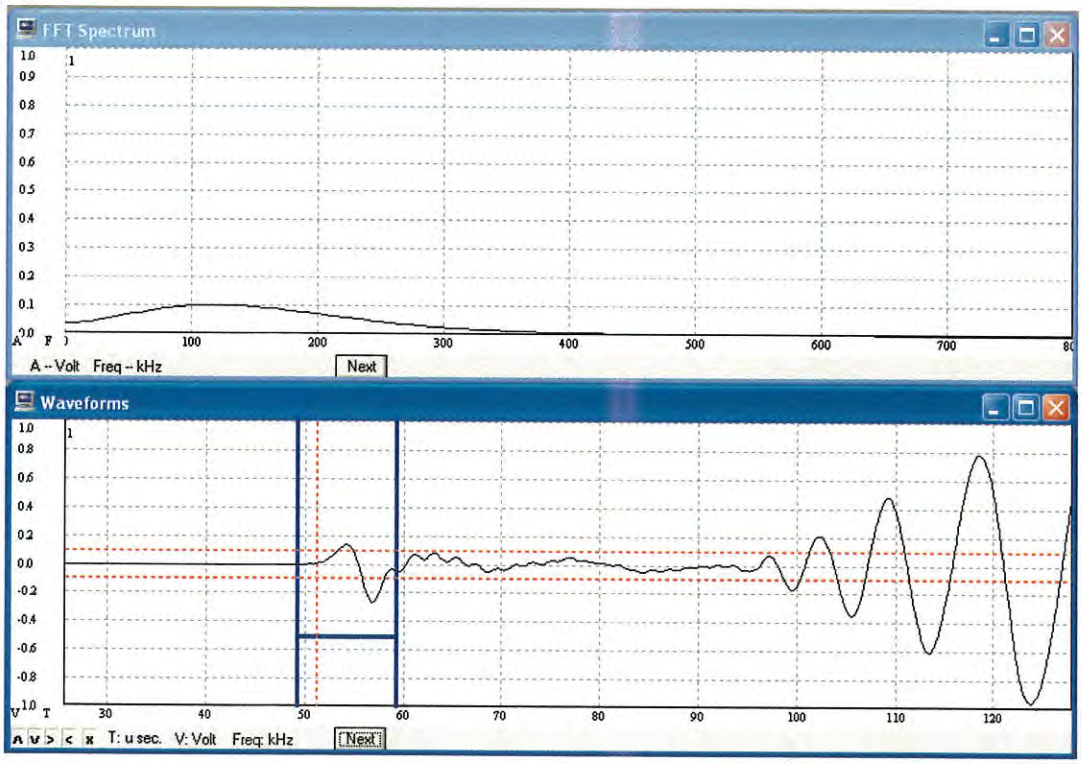


Figure 2. Front End Waveform

Front end of waveform created by rolling ball impact calibration setup described herein. FFT shows center frequency of first cycle is approximately 125kHz.

The energy linearity of the complete AE instrumentation (sensor, cables, preamplifiers, amplifiers, filters and digitizer) shall be measured by using different roll lengths of 8, 12 and 16 inches. The start of the E wave shall be from the first cycle of the waveform recognizable as the front end of the E wave to the end of the E wave which shall be taken as 10 µs later. (The time was calculated from the dispersion curves for the specified aluminum plate.) A linear regression shall be applied to the energy data and a goodness of fit $R^2 > 0.9$ shall be obtained.

4. Preamplifiers and Amplifiers - See ASME Sec. V Article 11.

5. Filters

A high pass filter of 20 kHz shall be used. A low pass filter shall be applied to prevent digital aliasing that occurs if frequencies higher than the Nyquist frequency (half the Sampling Rate) are in the signal.

6. A/D

The sampling speed and memory depth (wave window length) are dictated by the test requirements and calculated as follows: Vessel length = L inches (meters). Use C_E = 0.2 in./µs (5080 m/s) and C_F = 0.05 in./µs (1270 m/s), the speeds of the first arriving frequency in the E wave and last arriving frequency in the F wave, respectively, as a guide. The actual dispersion curves for the material shall be used if available.

L / C_E = T1 µs. This is when the first part of the direct E wave will arrive.

L / C_F = T2 µs. This is when the last part of the direct F wave will arrive.

(T2 - T1) x.1.5 is the minimum waveform window time and allows for pretrigger time.

The recording shall be quiescent before front end of the E wave arrives. This is called a "clean front end". Clean is defined in SX.11(f)(2)(b)below.

The sampling rate, or sampling speed, shall be such that aliasing does not occur.

The recording system (consisting of all amplifiers, filters and digitizers beyond the sensor) shall be calibrated by using a 20 cycle long tone burst with 0.1 V amplitude at 100, 200, 300, and 400 kHz. The system shall display an energy of $U= (V^2 \cdot N \cdot T)/2Z$ joules at each frequency, where V=0.1 volts, N = 20, Z is the preamplifier input impedance and T is the period of the cycle.

d) Sensor Placement

At least two sensors shall be used in any AE test regardless of vessel size so that EMI is easily detected by simultaneity of arrival.

Sensors shall be placed at equal distances around the circumference of the vessel on the cylindrical portion of the vessel adjacent to the tangent point of the dome such that the distance between sensors does not exceed 24 inches. Adjacent rings of sensors shall be offset by ½ a cycle. For example if the first ring of sensors is placed at 0, 120 and 240 degrees, the second ring of sensors is placed at 60, 180 and 300 degrees. This pattern shall be continued along the vessel length at evenly spaced intervals, such intervals not to exceed two feet, until the other end of the vessel is reached. See Figure 3. The diameter referred to is the external diameter of a vessel.

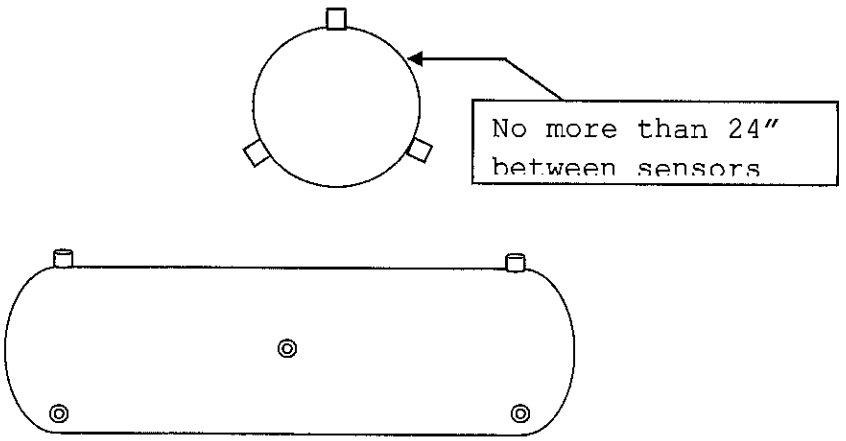


Figure 3. Sensor spacing and pattern.

Maximum distance between sensors in the axial and circumferential directions shall not exceed two feet unless it is demonstrated that the essential data can still be obtained using a greater distance and the authority having the jurisdiction concurs.

This spacing allows for capturing the higher frequency components of the acoustic emission impulses and high channel count wave recording systems are readily available.

e) Test Procedure

Couple sensors to vessel and connect to the testing equipment per Section V Article 11. Connect pressure transducer to the recorder. Conduct sensor performance checks prior to test to verify proper operation and good coupling to the vessel. The E and F waveforms shall be observed by breaking pencil lead at approximately 8 in. (20 cm) and 16 in. (40.6 cm) from a sensor along the fiber direction. All calibration data shall be recorded.

Recording threshold shall 60 dB re 1 μV at the transducer.

Performance checks shall be carried out by pencil lead breaks (Pentel 0.3 mm, 2H) six inches from each transducer in the axial direction of the cylinder and a break at the center of each group of four sensors.

Pressurize vessel to >98% of normal fill pressure and monitor AE during pressurization and for 15 minutes after fill pressure is reached. See Figure 4 for a schematic of the pressurization scheme. If at any time during fill the fill rate is too high in that it causes flow noise, decrease fill rate until flow noise disappears. Record events during pressurization and for 15 minutes after fill pressure is reached and save the data. Then conduct a post-test performance check and save data. Test temperature shall be between 50°F (10°C) 120°F (49°C).

A threshold of 60 dBAE ref 1 μV at the sensor shall be used during all phases of testing.

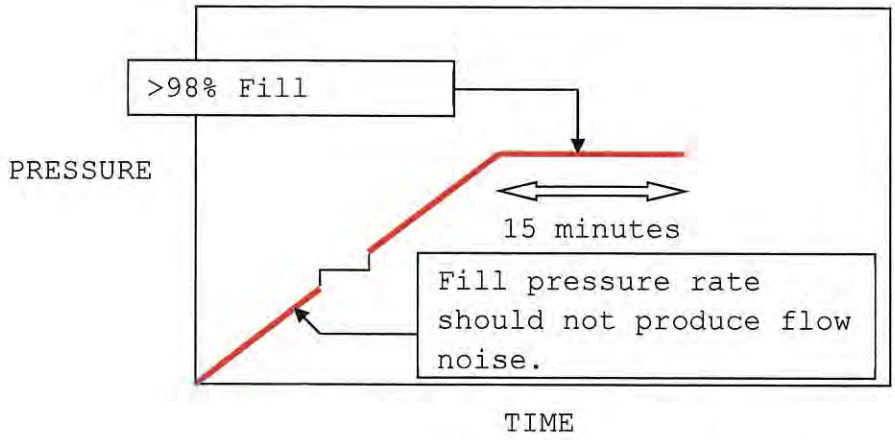


Figure 4. Typical Pressurization Plan When Filling Vessels.

AE shall be monitored for 15 min after operating fill pressure is reached.

f) Accept/Reject Criteria

1. Stability Criterion

Theory of AE Monitoring of high pressure composite pressure vessels for stability - A stable vessel will exhibit cumulative curves with exponentially decaying curvature. The shape of the cumulative events curve is similar for pressure vessels made of fiberglass, aramid and carbon fiber that exhibit a fiber dominated failure mode. This is essentially a test that demonstrates the composite is not progressing to failure at the hold pressure.

2. Analysis Procedure

Data will include matrix splits, matrix cracks, fiber breaks, and matrix chirps due to fracture surface fretting, and fiber/matrix debonding. Extraneous noise, identified by waveform characteristics, may also be included in the data.

a. Filter data to eliminate any external noise such as electromagnetic interference (EMI), mechanical rubbing, flow noise, etc. Identify noise events by their shape, spectral characteristics, or other information known about the test such as a temporally associated disturbance due to the pressurization system or test fixturing. EMI is characterized

by a lack of any mechanical wave propagation characteristics, particularly a lack of dispersion being apparent. EMI can be further identified by simultaneity of arrival on more than one channel. The two criteria shall be considered together to ensure it's not simply an event that happened to be centered between the sensors. Mechanical rubbing frequencies are usually very low and can be determined by experiment. There should be no flow noise. If the vessel, or a fitting, leaks, this will compromise the data as AE is very sensitive to leaks. Leak noise is characterized by waves that look uniform across the entire length of the waveform window. If a leak occurs during the load hold, the test must be redone. Flow noise is characterized by waves that fill the waveform window.

b. Use only events that have clean front ends and in which first arrival channel can be determined. Clean means having a pre-trigger energy of less than 0.01×10^{-10} joules. Energy is computed by the integral of the voltage squared over time.

c. Plot first arrival cumulative events versus time. Plots shall always show the pressure data.

d. Apply exponential fits by channel for pressure hold time and display both data and fit. The values are determined by the fit to $y = Ae^{Bt} + C$.

The B value is the shape factor of the cumulative curves. C is an intercept and A is a scale factor. The time t shall be equal intervals during the hold with events binned by time interval. Record exponents and goodness of fit (R^2). Plot energy decay curves. One third or one fourth of hold time shall be used for event energy binning (cumulative energy). The formula is $y=Ae^{Bt}$.
The sequence of energy values must monotonically decrease. This is similar to using other energy criteria, such as Historic Index. A sequence that is not properly decreasing will be indicated by a low R^2 value.

e. Save all plots (all channels) to report document.

f. Record exponents and R^2 values.

g. Vessel B values shall be tracked and compiled in order to develop a statistically significant database.
ii) B is the critical value that measures the frequency of occurrence of events during pressure hold.
iii) Not every vessel will have the exact same B value.
iv) Data on B values should cluster.

The criteria given below apply to each individual sensor on the vessel.

1. The stability criteria as described above shall be met. (Also see ASME Section X Mandatory Appendix 8.) Any vessel that does not meet the stability criteria must be removed from service. The criteria are:

a. Cumulative Event Decay Rate $-0.1 < B < -0.0001$, $R^2 \geq 0.80$
b. Cumulative Energy Decay Rate $-0.2 < B < -0.001$, $R^2 \geq 0.80$

If these criteria are not met, the vessel does not pass. The vessel may be retested. An AE Level III inspector must review the data from the initial testing and the subsequent loading test before the vessel can be passed. Retest loadings shall follow the original pressurization rates and pressures and use a threshold of 60 dBAE. If the vessel fails the criteria again, the vessel shall not be certified by the Inspector as meeting the provisions of this Section.

2. Events that occur at the higher loads during pressurization having significant energy in the frequency band $f > 300$ kHz are due to fiber bundle, or partial bundle, breaks. These should not be present at operating pressure in a vessel that has been tested to a much higher pressures and is now operated at the much lower service pressure. For fiber bundles to break in the upper twenty percent of load during the test cycle or while holding at operating pressure, the vessel has a severe stress concentration and shall be removed from service.

g) Fiber Breakage Criterion

1. Analysis Procedure

In order to determine if fiber bundle breakage has occurred during the filling operation the frequency spectra of the direct E and F waves shall be examined and the energies in certain frequency ranges shall be computed as given below.

2. Definitions

Energies (U) in the ranges are defined as
50 - 400 kHz: U_0
100 - 200 kHz: U_1
250 - 400 kHz: U_2

The criteria for determining if high frequency spectrum events have occurred is given by the following formulas:
$U_0 / (U_{FBB}) \geq 10\%$
$U_2 / (U_1 + U_2) \geq 15\%$
$U_2 / U_0 \geq 10\%$

U_{FBB} is the energy of a fiber bundle break calculated using the average breaking strength found in the literature, either from the manufacturer's data or independent test data. The formula that shall be used for calculating average fiber break energy is

$$U_{FB} = \frac{E\varepsilon^2}{2} Al ,$$

where ε is the strain to failure of the fiber, E the Young's modulus of the fiber, A is area of the fiber and l is the ineffective fiber length for the fiber and matrix combination. If the ineffective length is not readily available, four (4) times the fiber diameter shall be used. We take U_{FBB} = 100 x U_{FB}, where U_{FB} has been calculated and scaled by the rolling ball impact energy as in the examples below. If these criteria are met, fiber bundle break damage has occurred during the test and the vessel should be removed from service.

3. Example of Fiber Break Energy Calculation

Suppose d = 7 μm, E = 69.6 GPa and ε = 0.01 (average breaking strain) for some carbon fiber. Using $A = \pi d^2/4$ and l = 4d,

$$U_{FB} = 3\text{x}10^{-8} \text{ J}.$$

4. Example of Scaling Calculation

Suppose that the rolling ball impact (RBI) acoustical energy measured by a particular high fidelity AE transducer is U^{AE}_{RBI} = 5 x 10^{-10} J and the impact energy U_{RBI} = 1.9 x 10^{-3} J (due to gravity). Fiber break energy of T300 carbon fiber U_{FB} = 3x10^{-8} J would correspond to a wave energy

$$U^{AE}_{FB} = U_{FB} \text{ x } U^{AE}_{RBI} / U_{RBI}$$

$$= 3\text{x}10^{-8} \text{ J x } 5 \text{ x } 10^{-10} \text{ J / } 1.9 \text{ x } 10^{-3} \text{ J}$$

$$= 7.9 \text{ x } 10^{-15} \text{ J}.$$

This is the number that is used to calculate the value of U_{FBB} that is used in the fiber break criterion in this the second acceptance criterion and the energy acceptance criterion in the third criterion below.

5. Amplifier Gain Correction

All energies shall be corrected for gain. (20 dB gain increases apparent energy 100 times and 40 dB gain 10,000 times.)

Fiber break waves may look similar to matrix event waves in time space but in frequency space the difference is clear. A fiber break is a very fast source, while a matrix crack evolves much more slowly due to greater than ten to one difference in their tensile moduli. The speed of the fiber break produces the high frequencies, much higher than a matrix crack event can produce. Frequencies higher than 2 MHz have been observed in proximity to a fiber break, however these very high frequencies are attenuated rapidly as the wave propagates. Practically speaking, the observation of frequencies above 300 kHz, combined with certain other

characteristics of the frequency spectrum and pressure level, is enough to confirm a fiber break. It should also be noted that it is fiber bundle breaks that are usually detected in structural testing and not the breaking of individual fibers. The energies of individual fiber breaks are very small, about $3x10^{-8}$ Joules for T-300 carbon fibers for example.

h) Friction between Fracture Surfaces

Friction between fracture surfaces plays a very important role in understanding AE in fatigue testing. It is an indicator of the presence of damage because it is produced by the frictional rubbing between existing and newly created fracture surfaces. Even the presence of fiber bundle breakage can be detected by examining the waveforms produced by frictional acoustic emission or FRAE. Increasing FRAE intensity throughout a pressure cycle means more and more damage has occurred.
Therefore, for a vessel to pass, no AE event shall have an energy greater than (F) x U_{FB} at anytime during the test. F is the acoustic emission allowance factor. The smaller the allowance factor, the more conservative the test. An F = 10^4 shall be used in this testing. It is the equivalent of three plus fiber tows, each tow consisting of 3,000 fibers, breaking simultaneously near a given transducer.

i) Background Energy

Background energy of any channel shall not exceed 10 times the quiescent background energy of that channel. After fill pressure is reached, any oscillation in background energy with a factor of two excursions between minima and maxima shows that the vessel is struggling to handle the pressure. Pressure shall be reduced immediately and the vessel removed from service.

Attachment 4

Subject: Part 2, Supplement 2, S2.10.4 – Average Staybolt Pitch

File Number: NB12-1201

Proposal: Update text in S2.10.4, S2.10.6 to include provisions and mathematics for rectangular staybolt patterns found on many historical boilers.

Current text:

S2.10.4 STAYED SURFACES

The maximum allowable working pressure for stayed flat plates and those parts which, by these rules, require staying as flat plates with stays or staybolts of uniform diameter symmetrically spaced, shall be calculated using the following formula or Tables S2.10.4 and S2.10.4.1:

A07 $P = \frac{T^2 \times S \times C}{p^2}$

See definitions of nomenclature in S2.10.6

A08 S2.10.4.1 STAYBOLTS

Table S2.10.4.1 may be used to determine the MAWP for corroded staybolts. The table
A09 is based on a stress value of 7,500 psi (51.7 MPa) for staybolts that was the value used in the ASME Section 1, 1971 Edition. The table identifies a calculated MAWP based on measuring the staybolt spacing on the crownsheet and the minimum diameter of the corroded staybolt. See Table S2.10.4.1.

Reword as follows:

S2.10.4 STAYED SURFACES

The maximum allowable working pressure for stayed flat plates and those parts which, by these rules, require staying as flat plates with stays or staybolts of uniform diameter, uniformly spaced, shall be calculated using the following formula or Table S2.10.4.

$$P = \frac{t^2 \times S \times C}{p^2}$$

When pitches of stays or staybolts of uniform diameter are symmetrical and form a rectangle, the equation may be replaced with the following equation:

$$P = \frac{2 \times t^2 \times S \times C}{l^2 + w^2}$$

See definitions of nomenclature in S2.10.6.

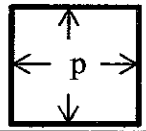
[...]

S2.10.6 NOMENCLATURE

[...]

- p = maximum pitch measured between straight lines passing through the centers of the staybolts in the different rows, which lines may be horizontal, vertical, or inclined, inches or mm
- l = the pitch of stays in one row, passing through the centers of the staybolts, which line may be horizontal, vertical, or inclined, inches or mm
- w = the distance between two rows of staybolts, inches or mm
- h = the hypotenuse of a square or rectangle, defined as either $\sqrt{2p^2}$ or $\sqrt{l^2 + w^2}$, inches or mm
- d = minimum diameter of corroded staybolt, inches or mm

[...]



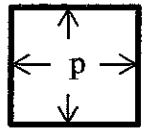
Thickness of Stayed Surface, in.	Staybolt Spacing (Square Pitch), in. (p)																				
	3.500	3.625	3.750	3.875	4.000	4.125	4.250	4.375	4.500	4.625	4.750	4.875	5.000	5.125	5.250	5.375	5.500	5.625	5.750	5.875	6.000
0.19	85	80	74	70	65	61	58	55	52	49	46	44	42	40	38	36	35	33	32	30	29
0.2	95	88	82	77	72	68	64	61	57	54	51	49	46	44	42	40	38	37	35	34	32
0.21	104	97	91	85	80	75	71	67	63	60	57	54	51	49	46	44	42	40	39	37	36
0.22	115	107	100	93	88	82	78	73	69	66	62	59	56	53	51	49	46	44	42	41	39
0.23	125	117	109	102	96	90	85	80	76	72	68	65	61	58	56	53	51	48	46	44	43
0.24	136	127	119	111	104	98	92	87	82	78	74	70	67	64	61	58	55	53	50	48	46
0.25	148	138	129	121	113	106	100	95	89	85	80	76	72	69	66	63	60	57	55	52	50
0.26	160	149	139	130	122	115	108	102	97	92	87	82	78	75	71	68	65	62	59	57	54
0.27	172	161	150	141	132	124	117	110	104	99	94	89	85	80	77	73	70	67	64	61	59
0.28	185	173	162	151	142	134	126	119	112	106	101	96	91	87	82	79	75	72	69	66	63
0.29	199	185	173	162	152	143	135	127	120	114	108	103	97	93	88	84	81	77	74	71	68
0.3	213	198	185	174	163	153	144	136	129	122	116	110	104	99	95	90	86	82	79	76	72
0.31	227	212	198	185	174	164	154	146	138	130	123	117	111	106	101	96	92	88	84	81	77
0.32	242	226	211	198	185	174	164	155	147	139	132	125	119	113	108	103	98	94	90	86	82
0.33	258	240	224	210	197	185	175	165	156	148	140	133	126	120	115	109	104	100	95	91	88
0.34	273	255	238	223	209	197	185	175	165	157	148	141	134	128	122	116	111	106	101	97	93
0.35	290	270	252	236	222	209	197	185	175	166	157	149	142	135	129	123	117	112	107	103	99
0.36	307	286	267	250	235	221	208	196	185	176	166	158	150	143	136	130	124	119	114	109	104
0.37	324	302	282	264	248	233	220	207	196	185	176	167	159	151	144	137	131	125	120	115	110
0.38	342	318	298	279	262	246	232	219	207	196	185	176	167	159	152	145	138	132	127	121	116
0.39	360	335	313	294	275	259	244	230	218	206	195	185	176	168	160	153	146	139	133	128	122
0.4	379	353	330	309	290	273	257	242	229	217	206	195	185	177	168	160	153	147	140	134	129
0.41	398	371	346	324	304	286	270	255	241	228	216	205	195	185	177	169	161	154	147	141	135
0.42	417	389	364	340	320	300	283	267	252	239	227	215	204	195	185	177	169	162	155	148	142
0.43	437	408	381	357	335	315	297	280	265	251	237	225	214	204	194	185	177	169	162	155	149
0.44	480	447	418	391	367	345	325	307	290	275	261	247	235	224	213	203	194	186	178	170	163
0.45	502	468	437	409	384	361	340	321	304	287	272	259	246	234	223	213	203	194	186	178	171
0.46	524	489	457	428	402	378	356	336	317	300	285	270	257	245	233	222	212	203	194	186	178
0.47	547	510	477	447	419	394	371	350	331	314	297	282	268	255	243	232	222	212	203	194	186
0.48	571	532	497	466	437	411	387	365	345	327	310	294	280	266	254	242	231	221	212	203	194

TS = Tensile Strength, 55,000 psi
S = 13,800 psi
t = Thickness of Stayed Surface, in.
p = staybolt spacing, in.

$$P = \frac{t^2 \times S \times C}{p^2}$$

For thicknesses 0.4375" and less, C = 2.1
For thicknesses larger than 0.4375", C = 2.2
P = MAWP, psi

Table S2.10.4 [US Customary Units]
Maximum Allowable Working Pressure for Square Stayed Surfaces, Formula per ASME Section 1, PG-46.1



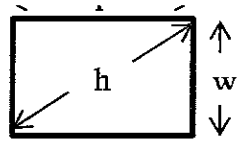
Thickness of Stayed Surface, mm	Staybolt Spacing (Square Pitch), mm (p)																					
	89	92	95	98	101	104	107	110	113	116	119	122	125	128	131	134	137	140	143	146	149	152
5	630	589	553	519	489	461	436	412	391	371	352	335	319	304	291	278	266	254	244	234	225	216
5.25	694	650	609	573	539	508	480	454	431	409	388	369	352	336	320	306	293	281	269	258	248	238
5.5	762	713	669	628	592	558	527	499	473	448	426	405	386	368	352	336	322	308	295	283	272	261
5.75	833	779	731	687	647	610	576	545	517	490	466	443	422	403	384	367	351	337	323	309	297	285
6	907	849	796	748	704	664	627	594	562	534	507	483	460	438	419	400	383	366	351	337	323	311
6.25	984	921	863	811	764	721	681	644	610	579	550	524	499	476	454	434	415	398	381	366	351	337
6.5	1064	996	934	878	826	779	736	697	660	626	595	566	539	514	491	469	449	430	412	395	380	365
6.75	1148	1074	1007	946	891	840	794	751	712	676	642	611	582	555	530	506	484	464	445	426	409	393
7	1234	1155	1083	1018	958	904	854	808	766	726	690	657	626	597	570	544	521	499	478	459	440	423
7.25	1324	1239	1162	1092	1028	970	916	867	821	779	740	705	671	640	611	584	559	535	513	492	472	454
7.5	1417	1326	1243	1168	1100	1038	980	927	879	834	792	754	718	685	654	625	598	573	549	526	505	486
7.75	1513	1416	1328	1248	1175	1108	1047	990	938	890	846	805	767	731	698	667	638	611	586	562	540	519
8	1612	1509	1415	1329	1252	1180	1115	1055	1000	949	902	858	817	779	744	711	680	651	624	599	575	553
8.25	1714	1604	1505	1414	1331	1255	1186	1122	1063	1009	959	912	869	829	791	756	723	693	664	637	612	588
8.5	1820	1703	1597	1501	1413	1333	1259	1191	1129	1071	1018	968	922	880	840	803	768	735	705	676	649	624
8.75	1928	1805	1692	1590	1497	1412	1334	1262	1196	1135	1079	1026	978	932	890	851	814	779	747	717	688	661
9	2040	1909	1791	1683	1584	1494	1411	1335	1266	1201	1141	1086	1034	986	942	900	861	824	790	758	728	699
9.25	2155	2017	1891	1777	1673	1578	1491	1411	1337	1269	1205	1147	1092	1042	995	951	909	871	835	801	769	739
9.5	2273	2127	1995	1875	1765	1665	1573	1488	1410	1338	1271	1210	1152	1099	1049	1003	959	919	880	845	811	779
9.75	2394	2241	2101	1975	1859	1753	1656	1567	1485	1409	1339	1274	1214	1158	1105	1056	1010	968	927	890	854	821
10	2519	2357	2211	2077	1956	1844	1743	1649	1562	1483	1409	1340	1277	1218	1163	1111	1063	1018	976	936	899	863
10.25	2646	2476	2322	2182	2055	1938	1831	1732	1641	1558	1480	1408	1341	1279	1221	1167	1117	1069	1025	983	944	907
10.5	2777	2599	2437	2290	2156	2034	1921	1818	1723	1635	1553	1478	1408	1342	1282	1225	1172	1122	1076	1032	991	952
10.75	2911	2724	2555	2401	2260	2132	2014	1905	1806	1713	1628	1549	1476	1407	1343	1284	1228	1176	1127	1082	1038	998
11	3048	2852	2675	2513	2366	2232	2108	1995	1890	1794	1705	1622	1545	1473	1407	1344	1286	1232	1180	1132	1087	1045
11.25	3339	3125	2931	2754	2593	2446	2310	2186	2072	1966	1868	1777	1693	1614	1541	1473	1409	1350	1294	1241	1191	1145
11.5	3489	3266	3063	2878	2710	2555	2414	2284	2165	2054	1952	1857	1769	1687	1611	1539	1473	1410	1352	1297	1245	1196
11.75	3643	3409	3197	3004	2829	2668	2520	2385	2260	2144	2038	1939	1847	1761	1681	1607	1537	1472	1411	1354	1300	1249
12	3800	3556	3335	3134	2950	2783	2629	2487	2357	2237	2125	2022	1926	1837	1754	1676	1603	1536	1472	1412	1356	1303
12.25	3959	3705	3475	3266	3075	2900	2739	2592	2456	2331	2215	2107	2007	1914	1828	1747	1671	1600	1534	1471	1413	1357

TS = Tensile Strength, 380,000 kPa
S = 95,000 kPa
t = Thickness of Stayed Surface, mm
p = staybolt spacing, mm

$$P = \frac{t^2 \times S \times C}{p^2}$$

For thicknesses 11mm and less, C = 2.1
For thicknesses larger than 11mm, C = 2.2
P = MAWP, kPa

Table S2.10.4 [Metric Units]
Maximum Allowable Working Pressure for Square Stayed Surfaces, Formula per ASME Section 1, PG-46.1



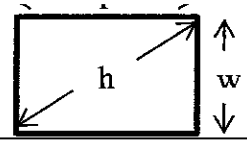
Thickness of Stayed Surface, in.	Staybolt Spacing (Rectangular Pitch), in. (h)																				
	5.000	5.125	5.250	5.375	5.500	5.625	5.750	5.875	6.000	6.125	6.250	6.375	6.500	6.625	6.750	6.875	7.000	7.125	7.250	7.375	7.500
0.19	84	80	76	72	69	66	63	61	58	56	54	51	50	48	46	44	43	41	40	38	37
0.2	93	88	84	80	77	73	70	67	64	62	59	57	55	53	51	49	47	46	44	43	41
0.21	102	97	93	88	84	81	77	74	71	68	65	63	60	58	56	54	52	50	49	47	45
0.22	112	107	102	97	93	89	85	81	78	75	72	69	66	64	62	59	57	55	53	52	50
0.23	123	117	111	106	101	97	93	89	85	82	78	75	73	70	67	65	63	60	58	56	55
0.24	134	127	121	116	110	106	101	97	93	89	85	82	79	76	73	71	68	66	64	61	59
0.25	145	138	131	125	120	114	110	105	101	97	93	89	86	83	80	77	74	71	69	67	64
0.26	157	149	142	136	130	124	119	114	109	104	100	96	93	89	86	83	80	77	75	72	70
0.27	169	161	153	146	140	134	128	122	117	113	108	104	100	96	93	89	86	83	80	78	75
0.28	182	173	165	157	150	144	137	132	126	121	116	112	108	104	100	96	93	90	86	84	81
0.29	195	186	177	169	161	154	147	141	135	130	125	120	115	111	107	103	99	96	93	90	87
0.3	209	199	189	181	172	165	158	151	145	139	134	128	123	119	114	110	106	103	99	96	93
0.31	223	212	202	193	184	176	168	161	155	148	143	137	132	127	122	118	114	110	106	102	99
0.32	237	226	215	205	196	188	180	172	165	158	152	146	140	135	130	126	121	117	113	109	106
0.33	252	240	229	218	209	199	191	183	175	168	162	155	149	144	139	134	129	124	120	116	112
0.34	268	255	243	232	221	212	203	194	186	179	172	165	159	153	147	142	137	132	127	123	119
0.35	284	270	258	246	235	224	215	206	197	189	182	175	168	162	156	150	145	140	135	131	126
0.36	300	286	273	260	248	237	227	218	209	200	192	185	178	171	165	159	153	148	143	138	134
0.37	317	302	288	275	262	251	240	230	220	212	203	195	188	181	174	168	162	156	151	146	141
0.38	335	319	304	290	277	265	253	242	232	223	214	206	198	191	184	177	171	165	159	154	149
0.39	353	336	320	305	291	279	267	255	245	235	226	217	209	201	193	187	180	174	168	162	157
0.4	371	353	336	321	307	293	280	269	258	247	237	228	219	211	204	196	189	183	176	170	165
0.41	390	371	353	337	322	308	295	282	271	260	249	240	231	222	214	206	199	192	185	179	173
0.42	409	389	371	354	338	323	309	296	284	273	262	252	242	233	224	216	209	201	195	188	182
0.43	429	408	389	371	354	339	324	310	298	286	274	264	254	244	235	227	219	211	204	197	191
0.44	470	448	426	407	389	372	356	341	327	313	301	289	278	268	258	249	240	232	224	216	209
0.45	492	468	446	426	406	389	372	356	342	328	315	303	291	280	270	260	251	242	234	226	219
0.46	514	489	466	445	425	406	389	372	357	342	329	316	304	293	282	272	262	253	244	236	228
0.47	537	511	487	464	443	424	406	389	373	358	343	330	317	306	294	284	274	264	255	247	238
0.48	560	533	508	484	462	442	423	405	389	373	358	344	331	319	307	296	286	276	266	257	249

TS = Tensile Strength, 55,000 psi
S = 13,800 psi
t = Thickness of Stayed Surface, in.
h = Hypothenusal staybolt spacing, in.

$$P = \frac{2 \times t^2 \times S \times C}{h^2}$$

For thicknesses 0.4375" and less, C = 2.1
For thicknesses larger than 0.4375", C = 2.2
P = MAWP, psi

Table S2.10.4.a [US Customary Units]
Maximum Allowable Working Pressure for Rectangular Stayed Surfaces



Thickness of Stayed Surface, mm	Staybolt Spacing (Rectangular Pitch), mm (h)																					
	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230
5	638	590	547	509	474	443	415	390	366	345	326	308	291	276	262	249	237	226	216	206	197	189
5.25	704	651	603	561	523	489	458	430	404	381	359	339	321	305	289	275	262	249	238	227	217	208
5.5	772	714	662	616	574	536	502	471	443	418	394	373	353	334	317	302	287	274	261	249	238	228
5.75	844	781	724	673	627	586	549	515	485	456	431	407	385	365	347	330	314	299	285	273	261	249
6	919	850	788	733	683	638	598	561	528	497	469	443	420	398	378	359	342	326	311	297	284	272
6.25	998	922	855	795	741	693	649	609	572	539	509	481	455	432	410	390	371	353	337	322	308	295
6.5	1079	998	925	860	802	749	702	659	619	583	550	520	493	467	443	421	401	382	365	348	333	319
6.75	1163	1076	998	928	865	808	757	710	668	629	594	561	531	504	478	454	433	412	393	376	359	344
7	1251	1157	1073	998	930	869	814	764	718	677	638	603	571	542	514	489	465	443	423	404	386	370
7.25	1342	1241	1151	1070	998	932	873	819	770	726	685	647	613	581	552	524	499	476	454	433	414	396
7.5	1436	1328	1231	1145	1067	998	934	877	824	777	733	693	656	622	590	561	534	509	486	464	443	424
7.75	1534	1418	1315	1223	1140	1065	998	936	880	829	783	740	700	664	630	599	570	543	518	495	473	453
8	1634	1511	1401	1303	1215	1135	1063	998	938	884	834	788	746	707	672	638	608	579	552	528	504	483
8.25	1738	1607	1490	1386	1292	1207	1130	1061	998	940	887	838	793	752	714	679	646	616	587	561	536	513
8.5	1845	1706	1582	1471	1371	1281	1200	1126	1059	998	941	890	842	799	758	721	686	654	624	596	569	545
8.75	1955	1808	1676	1559	1453	1358	1272	1193	1122	1057	998	943	893	846	803	764	727	693	661	631	603	577
9	2068	1912	1773	1649	1537	1436	1345	1262	1187	1118	1055	998	944	895	850	808	769	733	699	668	638	611
9.25	2185	2020	1873	1742	1624	1517	1421	1334	1254	1181	1115	1054	998	946	898	853	812	774	739	705	674	645
9.5	2305	2131	1976	1837	1713	1600	1499	1407	1323	1246	1176	1111	1052	998	947	900	857	817	779	744	711	681
9.75	2428	2244	2081	1935	1804	1686	1579	1482	1393	1312	1239	1171	1108	1051	998	948	903	860	821	784	749	717
10	2554	2361	2189	2036	1898	1773	1661	1559	1466	1381	1303	1231	1166	1105	1049	998	949	905	863	824	788	754
10.25	2683	2480	2300	2139	1994	1863	1745	1637	1540	1451	1369	1294	1225	1161	1102	1048	998	951	907	866	828	792
10.5	2815	2603	2414	2244	2092	1955	1831	1718	1616	1522	1436	1358	1285	1219	1157	1100	1047	998	952	909	869	832
10.75	2951	2728	2530	2353	2193	2049	1919	1801	1694	1595	1506	1423	1347	1277	1213	1153	1097	1046	998	953	911	872
11	3090	2857	2649	2463	2296	2146	2010	1886	1773	1671	1576	1490	1411	1337	1270	1207	1149	1095	1044	998	954	913
11.25	3386	3130	2903	2699	2516	2351	2202	2067	1943	1831	1727	1633	1546	1465	1391	1323	1259	1200	1144	1093	1045	1000
11.5	3538	3271	3033	2820	2629	2457	2301	2159	2031	1913	1805	1706	1615	1531	1454	1382	1315	1254	1196	1142	1092	1045
11.75	3693	3415	3167	2944	2745	2565	2402	2254	2120	1997	1884	1781	1686	1599	1518	1443	1373	1309	1248	1192	1140	1091
12	3852	3562	3303	3071	2863	2675	2505	2351	2211	2083	1965	1858	1759	1667	1583	1505	1432	1365	1302	1244	1189	1138
12.25	4014	3712	3442	3200	2983	2788	2611	2450	2304	2170	2048	1936	1833	1738	1650	1568	1493	1422	1357	1296	1239	1186

TS = Tensile Strength, 380,000 kPa
S = 95,000 kPa
t = Thickness of Stayed Surface, mm
h = Hypothenusal staybolt spacing, mm

$$P = \frac{2 \times t^2 \times S \times C}{h^2}$$

For thicknesses 11mm and less, C = 2.1
For thicknesses larger than 11mm, C = 2.2
P = MAWP, kPa

Table S2.10.4.a [Metric Units]
Maximum Allowable Working Pressure for Rectangular Stayed Surfaces

Explanation: All known course materials and interpretations of all editions of ASME interpret PG-46.1 (STAYED SURFACES) to require application of the largest dimension of the rectangular pattern as the dimension of '*p*' in the familiar equation:

$$P = \frac{t^2 \times S \times C}{p^2}$$

(also used in S2.10.4). This wording and interpretation is duplicated in ASME Section VIII UG-47. However, ASME 1971 PFT-27.1 and ASME 2002 PFT-26.1 both use similar wording stating "*The full pitch dimensions of the stays shall be employed in determining the area to be supported by a stay...*". We interpret this wording to mean true dimensions of a rectangle.

All editions of the Canadian Interprovincial Standard (1910-1938) provide a variation for the same equation for flat stayed surfaces. Specifically, the dimensions of a theoretical square with the same hypotenuse as that of the rectangle, is used. It is believed that, in this respect, the ASME code and the historic Canadian code share underlying theories. Additionally, traction engine blueprints and registration documents have shown that many historical boilers were built to this Canadian standard. For these reasons, this proposal is based on this precedent.

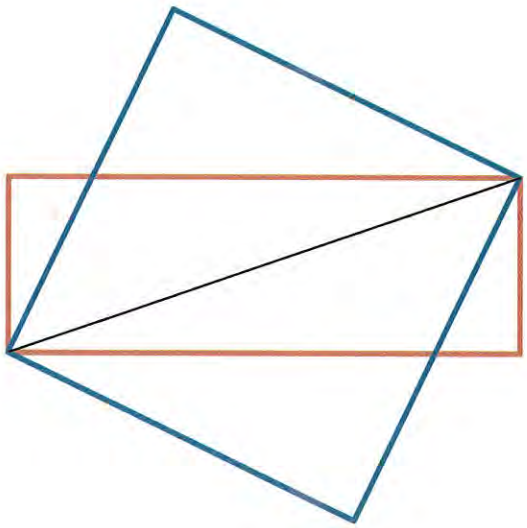
Unequal Stay Pitches

216. When the pitches of stays are unequal $\frac{l^2+w^2}{2}$ is to be taken instead of P^2 in the formulae given in Section 213 to 215.

l = the pitch of stays in inches in one row.

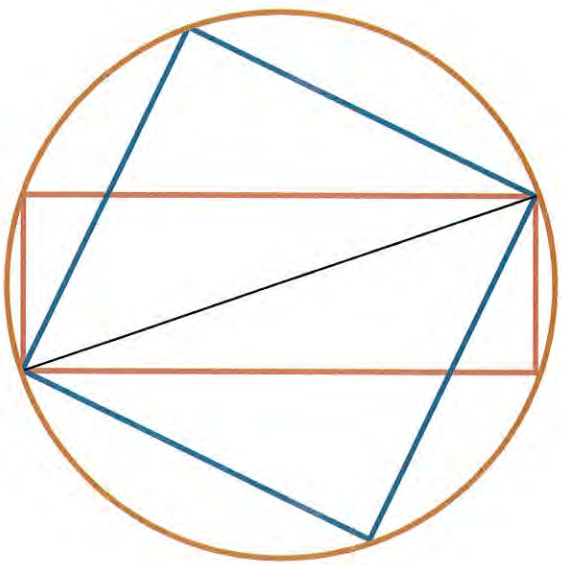
w = distance in inches between two rows of stays.

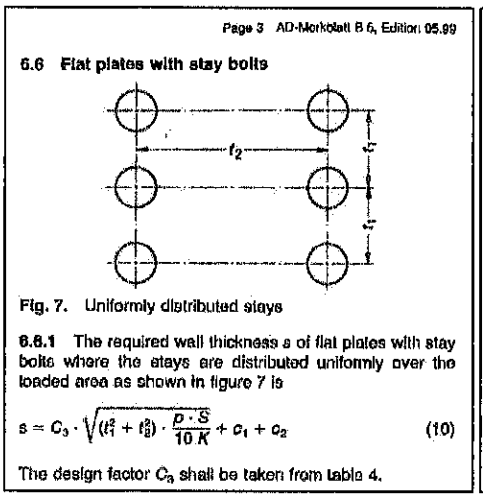
As shown in the following diagram, the red rectangle and the blue square share the same hypotenuse (black), although the blue square actually covers more surface area. The origins of this theory appear to be based in consideration for *unsupported* area *and* distance between stays, not *supported* area of each stay.



When the staybolt pattern is square, both equations yield the same results. Most staybolt patterns are very close to being square.

Furthermore, the current Swedish, Dutch (*"AD-Merkblatt" by Verband der Technischen Uberwachuns-Vereine e.V.*) and German (*"Drutscher DampfkesselausschuB (DDA)" by Vereinigung der Technischen Uberwachungsvereine e.V. Essen)* boiler codes provide equations that replace a rectangle with a circle. Here, the (brown) circle's diameter is equivalent to the hypotenuse of both the original rectangle and of the theoretical square.





Page 3 AD-Merkblatt B 6, Edition 05.99

6.6 Flat plates with stay bolts

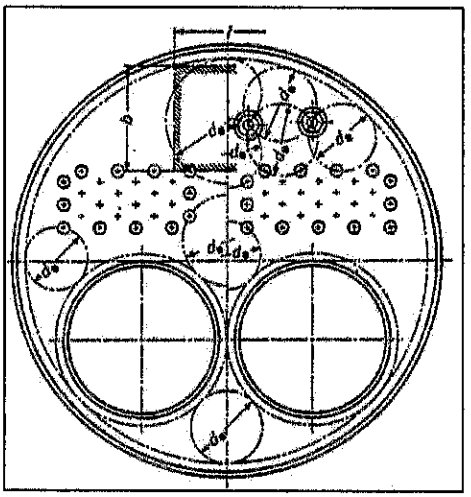
Fig. 7. Uniformly distributed stays

6.6.1 The required wall thickness s of flat plates with stay bolts where the stays are distributed uniformly over the loaded area as shown in figure 7 is

$$s = C_3 \cdot \sqrt{(t_1^2 + t_2^2) \cdot \frac{p \cdot S}{10\,K}} + c_1 + c_2 \qquad (10)$$

The design factor C_3 shall be taken from table 4.

Dutch code



German Code

Of note, that the approach to using a theoretical square or a theoretical circle is equal. The same results can be obtained by applying a *linear* scale from the square's area to the circle's area. Hence, we believe that *all* of these boiler codes apply the same underlying geometric theories, but apply different criteria and limitations to these theories. Since the European equations would require an additional scale factor and the historic Canadian equations do not, the proposal uses the Canadian equations only for clarity of presentation.

Example: Representative boiler dimensions and thicknesses: dimensions retrieved from a historical boiler blueprints, stated thickness deteriorated to 0.300 inches, staybolt pitch of 4.375x4.07.

$l = 4.375$
$w = 4.07$
$t = 0.300$

Currently:

$$P = \frac{t^2 \times S \times C}{p^2} \qquad P = \frac{0.300^2 \times 13750x2.1}{4.375^2} \qquad P = 135.8psi$$

Rectangular equations:

$$P = \frac{2 \times t^2 \times S \times C}{l^2 + w^2} \qquad P = \frac{2 \times 0.300^2 \times 13750x2.1}{4.375^2 + 4.07^2} \qquad P = 145.6psi$$

In this real-world example, the historical boiler MAWP has increased approximately 10psi, or about 7%.

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c) Damage may also be caused by mechanical forces such as thermal shock, cyclic temperature changes, vibration, pressure surges, excessive temperature, external loading, and material and fabrication defects.

4.4.7 DETERMINING INSPECTION INTERVALS

a) The maximum period between internal inspections or a complete inservice evaluation of pressure-retaining items shall not exceed one-half of the estimated remaining service life of the vessel or ten years, whichever is less. The method for estimating inspection intervals of pressure-retaining items subject to internal erosion or corrosion is discussed in NBIC Part 2, 4.4.7.1 and 4.4.7.2.

b) Inspection intervals can be revised beyond the maximum period stated above, provided the owner-user has submitted technical justification for revising the inspection interval, subject to review and acceptance by the Jurisdiction, where required.

c) Data used in engineering assessment methods to develop revised inspection intervals for pressure-retaining items shall be re-evaluated every five years, when a change in operation occurs, or after discovery of new and/or altered damage mechanisms.

4.4.7.1 METHOD FOR ESTIMATING INSPECTION INTERVALS FOR PRESSURE-RETAINING ITEMS SUBJECT TO EROSION OR CORROSION

Assessment guidelines for pressure-retaining items subject to corrosion or erosion are provided in this section. These guidelines are based on actual thickness measurements within the area of concern. Minimum required wall thickness shall be based on allowable stress of the material. Applicability and limitations of this guideline are as follows:

a) Original design criteria are known;

b) Item is not operating in the creep range;

c) Item does not contain crack-like indications;

d) Service stresses are known; and

e) Maintenance and operating history are known.

4.4.7.2 METHOD FOR ESTIMATING INSPECTION INTERVALS FOR EXPOSURE TO CORROSION

a) When the pressure-retaining item is exposed to service temperatures below the creep range, and the corrosion rate controls the remaining wall thickness of the pressure-retaining item, the inspection interval shall be calculated by the formula below or by other industry methods as accepted by the Jurisdiction.

$$\text{remaining life (years)} = (t_{actual} - t_{required}) / \text{corrosion rate}$$

t_{actual} = thickness in inches (mm) measured at the time of inspection for the limiting section used in the determination of $t_{required}$

$t_{required}$ = minimum allowable thickness in inches (mm) for the limiting section of the pressure-retaining item or zone. It shall be the greater of the following:

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1) The calculated thickness, exclusive of the corrosion allowance, required for the pressure relieving device set pressure, static head, or other loading and design temperature, or

2) The minimum thickness permitted by the provision of the applicable Section of the original code of construction.

Corrosion Rate = inches (mm) per year of metal removal as a result of corrosion.

b) Any suitable nondestructive examination method may be used to obtain thickness measurements provided the instruments employed are calibrated in accordance with the manufacturer's specification or an acceptable national standard.

1) If suitably located existing openings are available measurements may be taken through the openings.

2) When it is impossible to determine thickness by nondestructive means, a hole may be drilled through the metal wall and thickness gage measurements taken.

c) For new pressure-retaining items or PRI's for which service conditions are being changed, one of the following methods shall be employed to determine the probable rate of corrosion from which the remaining wall thickness, at the time of the next inspection, can be estimated:

1) The corrosion rate as established by data for pressure-retaining items in the same or similar service;

2) If the probable corrosion rate cannot be determined by the above method, on-stream thickness determinations shall be made after approximately 1,000 hours of service. Subsequent sets of thickness measurements shall be taken after additional similar intervals until the corrosion rate is established.

d) Corrosion Resistant Lining
When part or all of the pressure-retaining items have a corrosion resistant lining, the interval between inspections of those sections so protected may be based on recorded experience with the same type of lining in similar service, but shall not exceed ten years, unless sufficient data has been provided to establish an alternative inspection interval. If there is no experience on which to base the interval between inspections, performance of the liner shall be monitored by a suitable means, such as the use of removable corrosion probes of the same material as the lining, ultrasonic examination, or radiography. To check the effectiveness of an internal insulation liner, metal temperatures may be obtained by surveying the pressure-retaining item with temperature measuring or indicating devices.

e) Two or More Zones
When a pressure-retaining item has two or more zones of pressure or temperature and the required thickness, corrosion allowance, or corrosion rate differ so much that the foregoing provisions give significant differences in maximum periods between inspections for the respective zones (e.g., the upper and lower portions of some fractionating towers), the period between inspections may be established individually for each zone on the basis of the condition applicable thereto, instead of being established for the entire vessel on the basis of the zone requiring the more frequent inspection.

f) Above-Ground Pressure Vessels
All pressure vessels above ground shall be given an external examination after operating the lesser of five years, or one quarter of remaining life, preferably while in operation. Alternative intervals resulting in longer periods may be assigned provided the requirements of this section have been followed. Inspection shall include determining the condition of the exterior insulation, the supports, and the general alignment of the vessel on its supports. Pressure vessels that are known to have a remaining life of over ten years or that are prevented from being exposed to external corrosion (such as being installed in a cold box in which the atmosphere is purged with an inert gas, or by the temperature being maintained sufficiently

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low or sufficiently high to preclude the presence of water), need not have the insulation removed for the external inspection. However, the condition of the insulating system and/or the outer jacketing, such as the cold box shell, shall be observed periodically and repaired if necessary.

g) Interrupted Service

1) The periods for inspection referred to above assume that the pressure-retaining item is in continuous operation, interrupted only by normal shutdown intervals. If a pressure-retaining item is out of service for an extended interval, the effect of the environmental conditions during such an interval shall be considered.

2) If the pressure-retaining item was improperly stored, exposed to a detrimental environment or the condition is suspect, it shall be given an inspection before being placed into service.

3) The date of next inspection, which was established at the previous inspection, shall be revised if damage occurred during the period of interrupted service.

h) Circumferential Stresses
For an area affected by a general corrosion in which the circumferential stresses govern the MAWP, the least thicknesses along the most critical plane of such area may be averaged over a length not exceeding:

1) The lesser of one-half the pressure vessel diameter, or 20 in. (500 mm) for vessels with inside diameters of 60 in. (1.5 m) or less, or

2) The lesser of one-third the pressure vessel diameter, or 40 in. (1 m), for vessels with inside diameters greater than 60 in. (1.5 m), except that if the area contains an opening, the distance within which thicknesses may be averaged on either side of such opening shall not extend beyond the limits of reinforcement as defined in the applicable Section of the ASME Code for ASME Stamped vessels and for other vessels in their applicable codes of construction.

i) Longitudinal Stresses
If because of wind loads or other factors the longitudinal stresses would be of importance, the least thicknesses in a length of arc in the most critical plane perpendicular to the axis of the pressure vessel may be averaged for computation of the longitudinal stresses. The thicknesses used for determining corrosion rates at the respective locations shall be the most critical value of average thickness. The potential for buckling shall also be considered.

Move text to follow 4.4.8.7 "e"

REVISE TEXT to "LOCAL METAL LOSS"

j) Local Metal Loss
Corrosion pitting shall be evaluated in accordance with NBIC Part 2, 4.4.8.7. Widely scattered corrosion pits may be left in the pressure-retaining item in accordance with the following requirements:

1) Their depth is not more than one-half the required thickness of the pressure-retaining item wall (exclusive of corrosion allowance);

2) the total area of the pits does not exceed 7 sq. in. (4500 sq mm) within any 50 sq. inches (32000 sq. mm); and

3) the sum of their dimensions (depth and width) along any straight line within this area does not exceed 2 in. (50 mm).

k) Weld Joint Efficiency Factor
When the surface at a weld having a joint efficiency factor of other than one is corroded as well as surfaces remote from the weld, an independent calculation using the appropriate weld joint efficiency factor

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7) Dimensional verification checks;

d) If visual distortion or changes in the microstructure or mechanical properties are noted, consider replacing the component or a detailed engineering analysis shall be performed to verify continued safe operation.

e) Techniques for evaluating fire damage are referenced in applicable standards. See NBIC Part 2, 1.3. A1

4.4.8.6 EVALUATING EXPOSURE OF PRESSURE-RETAINING ITEMS TO CYCLIC FATIGUE

a) A fatigue evaluation should be performed if a component is subject to cyclic operation. The allowable number of cycles (mechanical or thermal) at a given level of stress should be adequate for the specified duration of service to determine suitability for continued operation.

b) Data requirements and history information should be obtained as identified in NBIC Part 2, 4.4.5.

c) Techniques for evaluating fatigue are referenced in applicable standards. See NBIC Part 2, 1.3.

4.4.8.7 EVALUATING PRESSURE-RETAINING ITEMS CONTAINING LOCAL THIN AREAS

a) Local thin areas can result from corrosion/erosion, mechanical damage, or blend/grind techniques during fabrication or repair, and may occur internally or externally. Types of local thin areas are grooves, gouges, and pitting. When evaluating these types of flaws, the following should be considered:

1) Original design and current operating conditions;

2) Component is not operating in the creep range;

3) Material has sufficient toughness;

4) Not operating in cyclic service;

5) Does not contain crack-like indications;

6) Flaws are not located in knuckle regions of heads or conical transitions;

7) Applied loads;

8) The range of temperature or pressure fluctuation.

b) Where appropriate, crack-like indications should be removed by blend/grinding, and evaluated as a local thin area.

c) Data requirements and history information should be obtained as identified in NBIC Part 2, 4.4.5.

d) Required measurements for evaluation of local thin areas shall include:

1) Thickness profiles within the local region;

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2) Flaw dimensions;

3) Flaw to major structural discontinuity spacing;

4) Vessel geometry;

5) Material properties.

e) Required measurements for evaluation of pitting corrosion shall include:

1) Depth of the pit;

2) Diameter of the pit;

3) Shape of the pit;

4) Uniformity.

reletter to "g"

f) Widely scattered corrosion pits may be left in the pressure-retaining item in accordance with the following requirements:
1) Their depth is not more than one-half the required thickness of the pressure-retaining item wall (exclusive of corrosion allowance);
2) the total area of the pits does not exceed 7 sq. in. (4500 sq mm) within any 50 sq. inches (32000 sq. mm); and
3) the sum of their dimensions (depth and width) along any straight line within this area does not exceed 2 in. (50 mm).

f) If metal loss is less than specified corrosion/erosion allowance and adequate thickness is available for future corrosion, then monitoring techniques should be established. If metal loss is greater than specified corrosion/erosion allowance and repairs are not performed, a detailed engineering evaluation shall be performed to ensure continued safe operation.

reletter to "h"

g) Techniques for evaluating local thin areas and pitting are referenced in applicable standards. See NBIC Part 2, 1.3.

4.5 RISK-BASED INSPECTION ASSESSMENT PROGRAMS

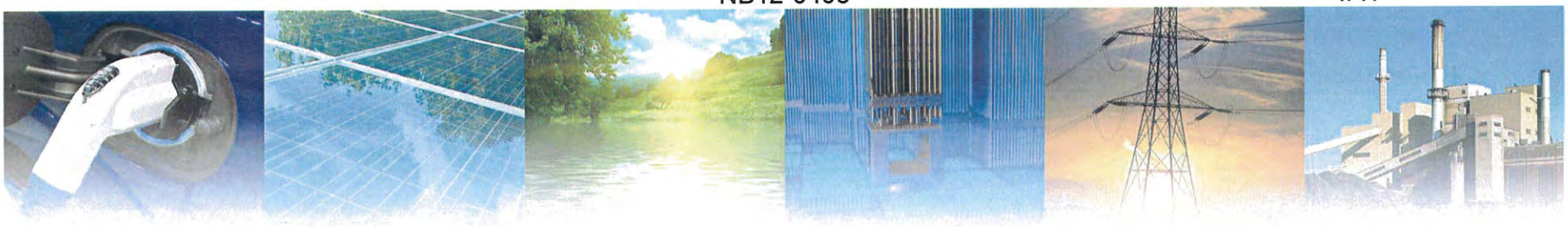
4.5.1 SCOPE

a) This Section describes the basic elements, principles, and guidelines of a risk-based inspection (RBI) program. This Section does not address any one method but is intended to clarify the elements associated with a RBI program. Risk assessment is a process to evaluate continued safe operation of a pressure-containing component. This process is based on sound engineering practices, proven risk assessment experience, and management principles. There are numerous risk-based assessment methods being applied throughout many industries. Details for developing and implementing risk-based inspection programs are defined in other referenced standards.

Implementation of a risk-based inspection (RBI) assessment program allows an owner-user to plan inspection frequencies based on assessing probability of failure (POF) and consequence of failure (COF) (risk = POF x COF). Risk assessment programs involve a team concept based on knowledge, training and experience between engineers, inspectors, operators, analysts, financial, maintenance, and management personnel. Appropriate and responsible decisions must be made from input by all team members to ensure safe operation of systems and their components. Organizational commitment and cooperation is required to successfully implement and maintain a RBI program.

4.5.2 DEFINITIONS

COF — Consequence of Failure. Outcome from a failure. There may be one or more outcomes from a single failure.



EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Update of EPRI Project on Weld Repair of Grade 91 Piping and Components

George Galanes, Jonathan Parker, John Siefert

NBIC Meeting, Mobile, Alabama
January 14th -17th

Project Objectives

- Ensure that the repair methods used are selected based on accurate technical understanding. Specific aims are to:
  - Understand how to remove damaged material efficiently and without introducing additional problems which could influence future performance
  - Develop the ability to make repairs in Grade 91 steel, which will provide the required service life
  - Develop follow-up inspection and assessment requirements consistent with safe and reliable operation
- **It is absolutely critical to provide a well-engineered solution**

Phase 1 – Rank Repair Performance

- Discussion of Methods and Extent of Excavation,
- Weld Procedure Considerations (including consumables) and Heat Treatment
- Post Repair evaluation of microstructure, damage etc
- Specimen Geometry and Testing Conditions
- Development of Test Matrix, cross weld creep, others?
- Analysis to identify **best option repairs** – 'best option' to be based on factors such as speed of welding, initial quality, creep life

20 weldments were made and tested to fulfill outlined objectives above

Phase 1 Completed

- 20 weldments completed and analyzed
  - Microstructure
  - Hardness
  - Creep tests (1157°F, 625°C and 11.6ksi, 80MPa)
- Phase 1 results enabled a down selection of consumables for a wide variety of engineering considerations

Phase 2 – Application of Best Option Methods to Ex-service Header

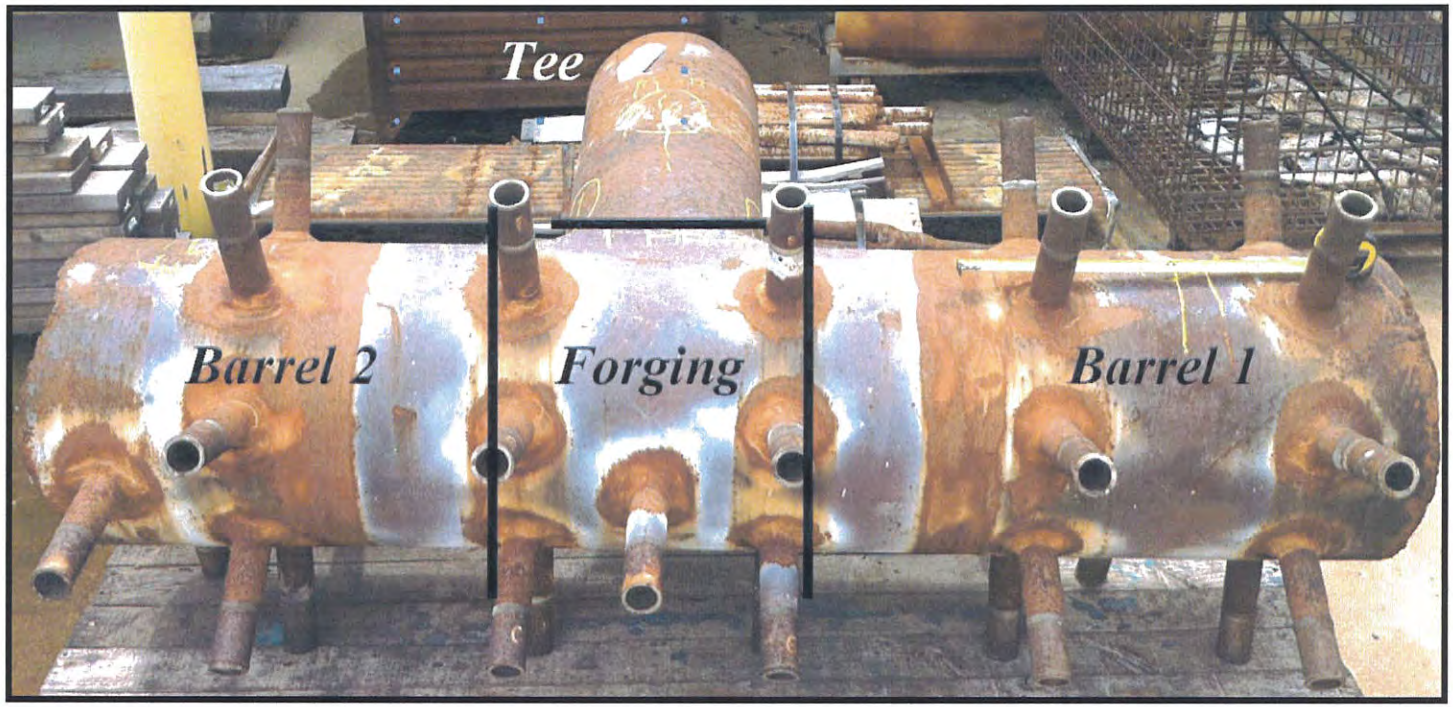
- Discussion of Methods and Extent of Excavation,
- Weld Procedure Considerations (including consumables) and Heat Treatment
- Post Repair evaluation of microstructure, damage etc
- Specimen Geometry and Testing Conditions
- Development of Test Matrix, cross weld creep, others?
- Data Analysis and Report Preparation

Welding Procedures for Phase 2

12 Total Simulations in Ex-service Header

- Three filler metals
  - Single Layer Temperbead + Ni-base Filler Metal (EPRI P87)
  - Single Layer Temperbead + Fe-base Filler Metal (E8015-B8)
  - Normal Welding Procedure + Matching Filler Metal (E9015-B9) + Low PWHT (1250°F, 676°C/2h)
- Four repair scenarios
  - Minor
  - Partial
  - Full (reinforcement left in root)
  - Full (no reinforcement left in root, backing bar utilized)

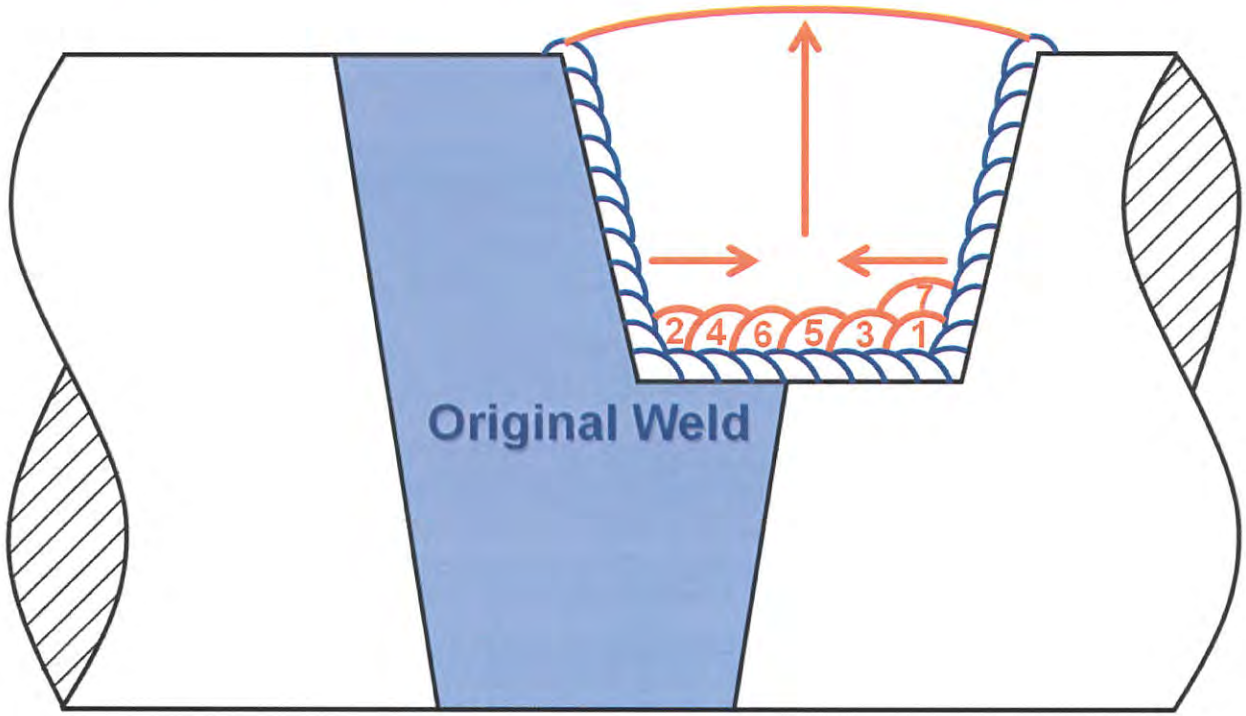
Repairs Conducted in Ex-service Gr. 91 Header



- Minor repair – conducted in barrel 1
- Partial repair – conducted in barrel 2
- Full repair (reinforcement left in root) – conducted in forging
- Full repair (no reinforcement, with backing bar) – conducted between ends cut from barrel 1 and barrel 2

Schematic of Welding Approach – Minor Repair

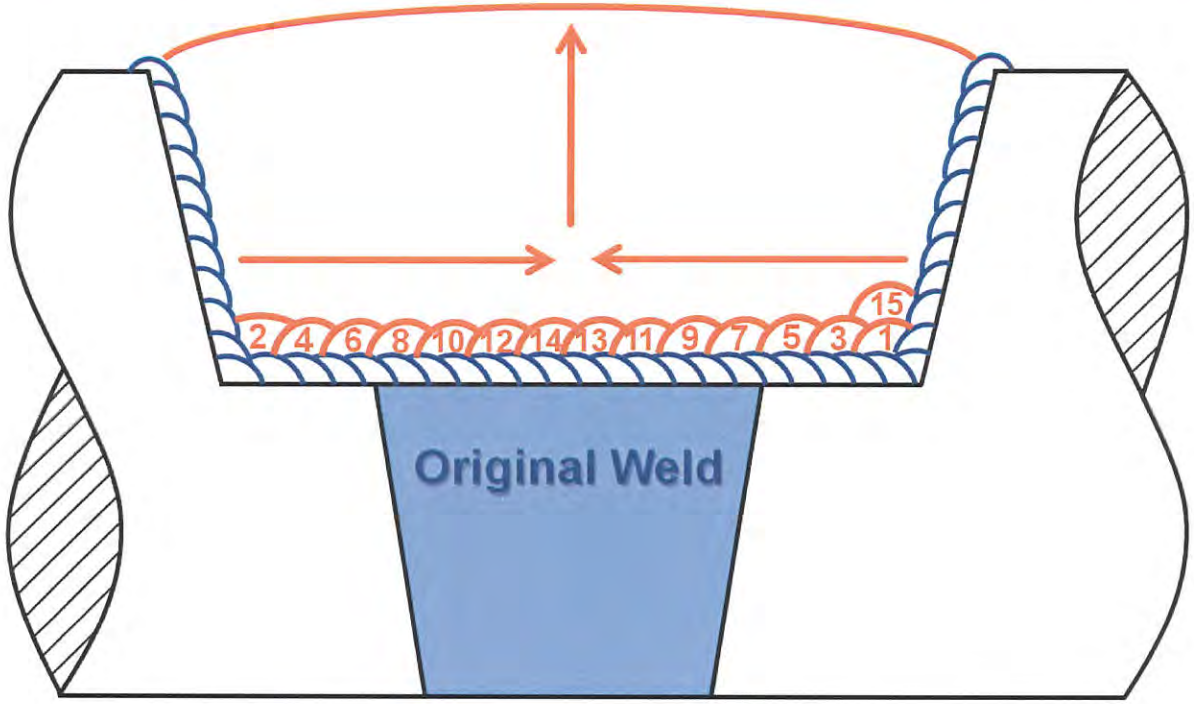
Methodology Specific to E8015-B8 and EPRI P87 Filler Metal



- Blue = 1 single layer of 3/32" (2.5mm) + >50% overlap bead to bead within a layer
  - *Light grind of single layer to remove all slag prior to fill (but NOT half-bead)*
- Red = fill passes of 1/8" (3.2mm) using typical stringer bead procedure
- Note: for E9015-B9, 1/8" (3.2mm) for all fill passes (no single layer temperbead)

Schematic of Welding Approach – Partial Repair

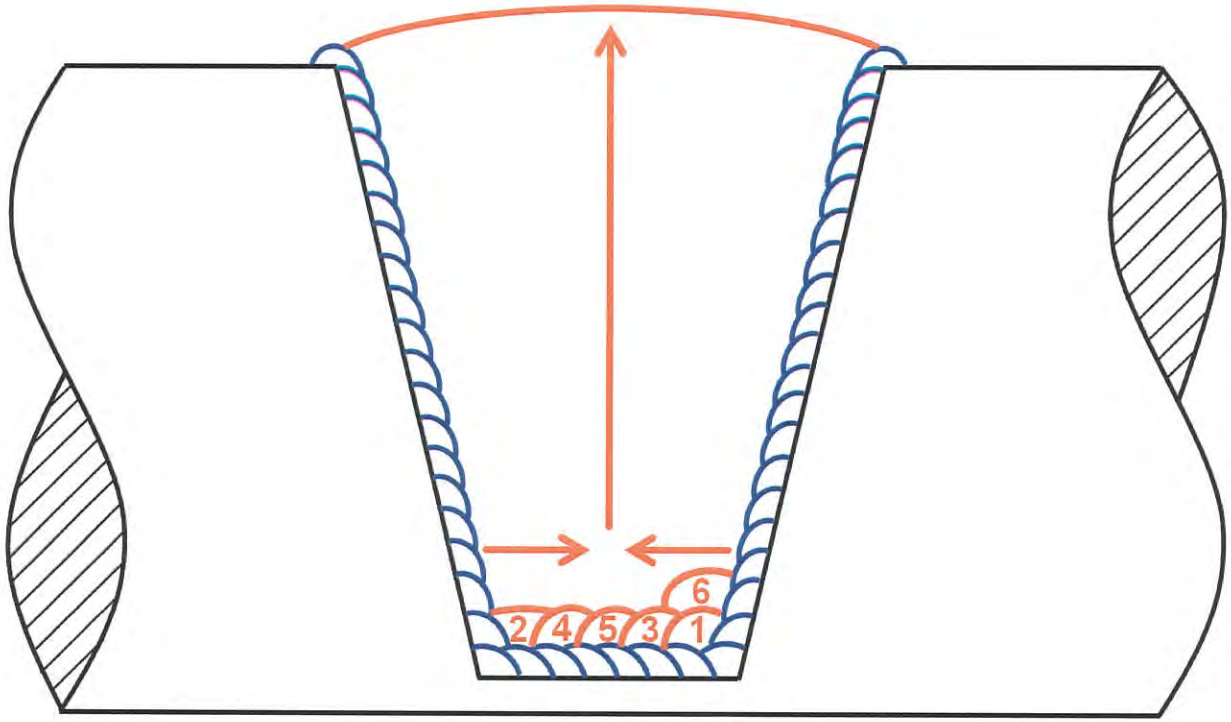
Methodology Specific to E8015-B8 and EPRI P87 Filler Metal



- Blue = 1 single layer of 3/32" (2.5mm) + >50% overlap bead to bead within a layer
  - *Light grind of single layer to remove all slag prior to fill (but NOT half-bead)*
- Red = fill passes of 1/8" (3.2mm) using typical stringer bead procedure
- Note: for E9015-B9, 1/8" (3.2mm) for all fill passes (no single layer temperbead)

Schematic of Welding Approach – Full Repair

Methodology Specific to E8015-B8 and EPRI P87 Filler Metal



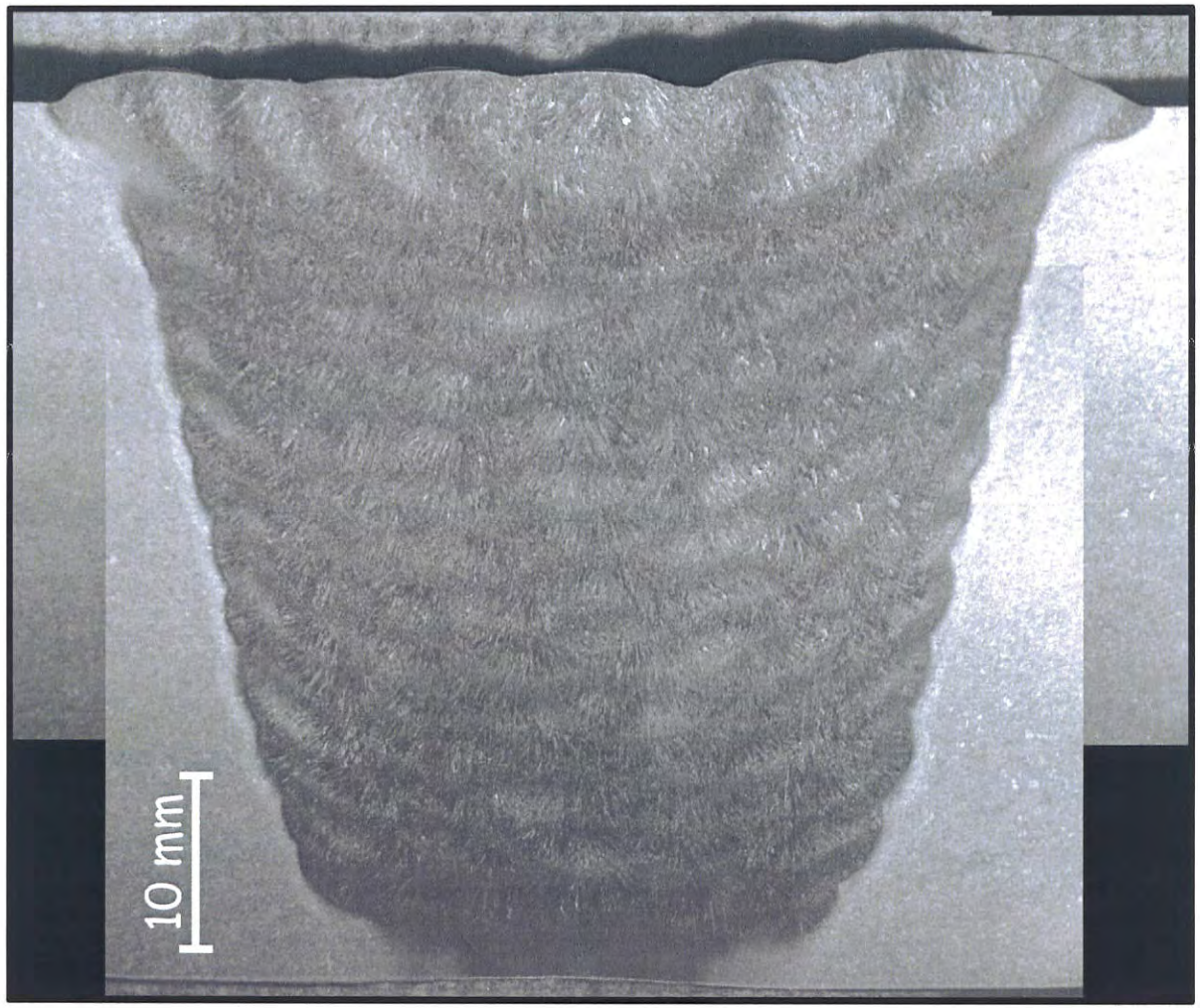
- Blue = 1 single layer of 3/32" (2.5mm) + >50% overlap bead to bead within a layer
  - *Light grind of single layer to remove all slag prior to fill (but NOT half-bead)*
- Red = fill passes of 1/8" (3.2mm) using typical stringer bead procedure
- Note: for E9015-B9, 1/8" (3.2mm) for all fill passes (no single layer temperbead)

Table of Welds and Details for Phase 2

TBW = Temperbead, N+PWHT = Normal+1250°F (676°C)/2h

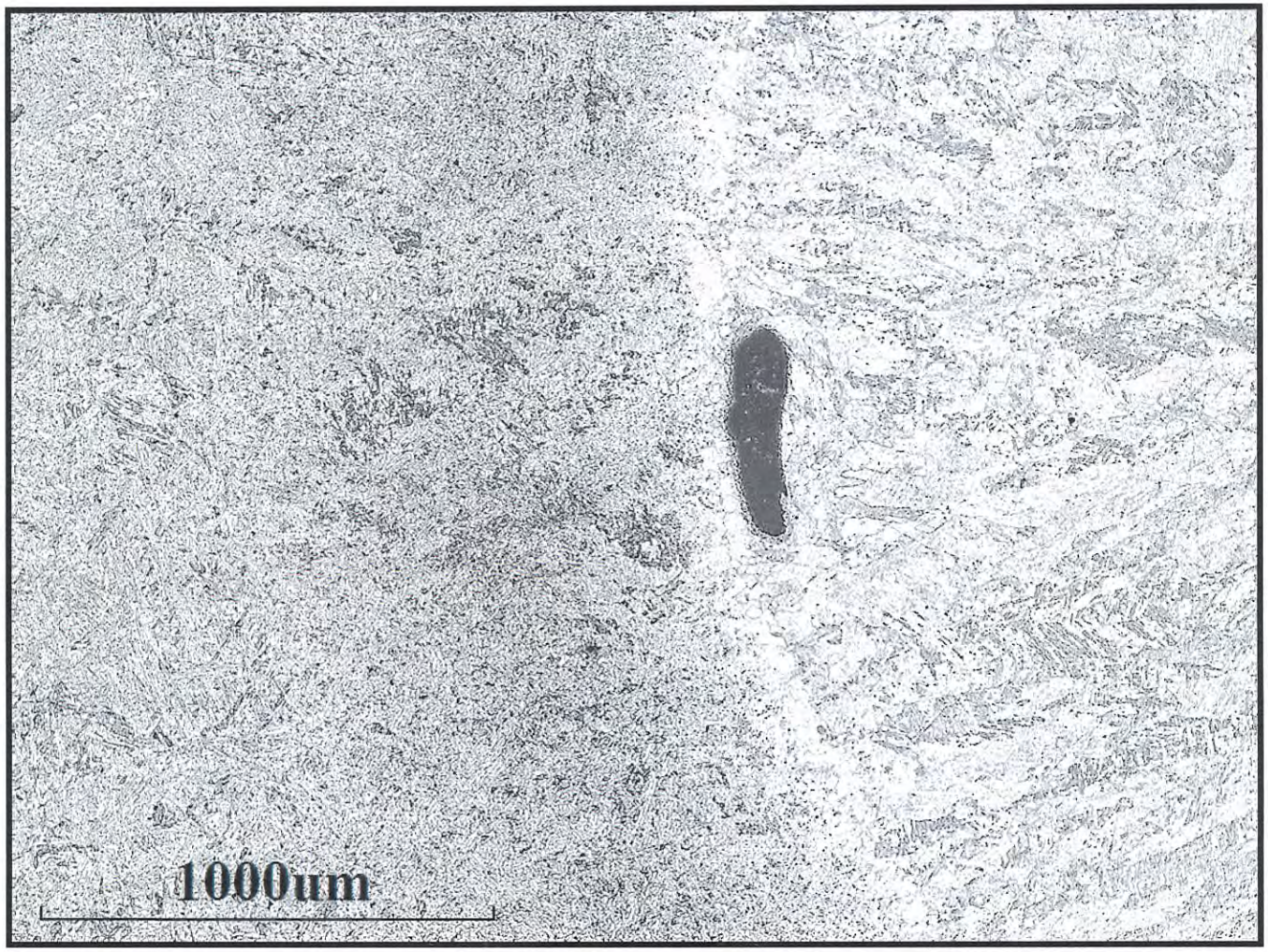
Weld	Procedure	Repair	Weld Metal	
1C	TBW	Minor	3/32" (2.5mm) Butter 1/8" (3.2mm) Fill	E8015-B8
2C	TBW			EPRI P87
3C	N+PWHT		1/8" (3.2mm) Fill	E9015-B9
4C	TBW	Partial	3/32" (2.5mm) Butter 1/8" (3.2mm) Fill	E8015-B8
5C	TBW			EPRI P87
6C	N+PWHT		1/8" (3.2mm) Fill	E9015-B9
7C	TBW	Full *(root reinforcement)*	3/32" (2.5mm) Butter 1/8" (3.2mm) Fill	E8015-B8
8C	TBW			EPRI P87
9C	N+PWHT		1/8" (3.2mm) Fill	E9015-B9
10C	TBW	Full *(backing bar)*	3/32" (2.5mm) Butter 1/8" (3.2mm) Fill	E8015-B8
11C	TBW			EPRI P87
12C	N+PWHT		1/8" (3.2mm) Fill	E9015-B9

Completed Weldment 8C [E8015-B8, TBW, Full]



Completed Weldment 8C [E8015-B8, TBW, Full]

Only one minor defect noted (slag inclusion in butter layer)



EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Update of EPRI Project on T91 Temperbead Approach Using EPRI P87 Filler Metal

George Galanes, John Shingledecker, John Siefert

NBIC Meeting, Mobile, Alabama
January 14th -17th

Scope Planned for 2013 – Destructive Evaluation

- Perform tube-tube weldments (6G position) for two processes:
  - Manual GTAW root + SMAW fill (1/16" diameter electrode preferably)
  - Automated GTAW
- Destructive evaluation should include:
  - ASME Sec. IX + comparison of side and face/root bends
  - Sectioning at 90° intervals to examine the consistency of the procedure
  - *Note – may need multiple weldments to complete scope*

Scope Planned for 2013 – Residual Stresses

- Service exposure (at 1080°F) of tube-tube coupons for each of the procedures
  - Expose for 0.1hr, 1hr, 10hr, 300hr (necessary to determine how fast residual stresses relax)
  - Perform residual stress measurements (method/scope TBD)
    - X-ray diffraction on surface (cap) of coupons (conduct at root if possible – depends on tube ID)
    - Deep-hole drilling to establish stress state through thickness

- ***Anything else NBIC would like to see?***

Together…Shaping the Future of Electricity

NBIC Item 12-0501

Background information in NBIC Part 3, 2011 Edition, 3.2.2

c) When ASME is the original code of construction, replacement parts subject to internal or external pressure fabricated by welding, which require inspection by an Authorized Inspector shall be fabricated by an organization having an appropriate ASME *Certificate of Authorization*. The item shall be inspected and stamped as required by the applicable section of the ASME Code. A completed ASME *Manufacturer's Partial Data Report* shall be supplied by the manufacturer;

The "R" Certificate Holder, using replacement parts fabricated and certified to an ASME Code edition and addenda different from that used for the original construction, shall consider and seek technical advice, where appropriate, for change or conflicts in design, materials, welding, heat treatment, examinations and tests to ensure a safe repair/alteration is performed. Note that work once classified as a repair could now be considered an alteration;

d) When the original code of construction is other than ASME, replacement parts subject to internal or external pressure, fabricated by welding, shall be manufactured by an organization certified as required by the original code of construction. The item shall be inspected and stamped as required by the original code of construction. Certification to the original code of construction, as required by the original code of construction or equivalent, shall be supplied with the item. When this is not possible or practicable, the organization fabricating the part shall have a National Board "R" *Certificate of Authorization*; replacement parts shall be documented on Form R-3 and the "R" Symbol Stamp applied as described in NBIC Part 3, Section 5.

Add new paragraph as follows; New paragraph shown is double underlined.

3.2.2 e)

"Replacement parts addressed by 3.2.2 c) or d) above shall receive a pressure test as required by the original code of construction. If replacement parts have not been pressure tested as required by the original code of construction prior to installation they may be installed without performing the original code of construction pressure test provided the owner, the Inspector and, when required, the Jurisdiction accept the use of one or a combination of the examination and test methods shown in Part 3, Section 4, paragraph 4.4.1 (for repairs) or 4.4.2 (for alterations). The R Certificate Holder responsible for completing the R Form shall note in the Remarks section of the R Form the examination(s) and test(s) performed, and the reason the replacement part was not tested in accordance with the original code of construction.

Part 1, Section 6
Supplement 4

Installation of Biomass (Wood/Solid Fuel) Fired Boilers

(Draft for Review and Comment January 2013)

S4.1 – Scope

NBIC Part 1, Section 6, Supplement 4 provides requirements for the installation of Biomass (Wood/Solid Fuel) Fired Boilers as defined in NBIC Part 1, Glossary.

S4.2 PURPOSE

a) The purpose of these rules is to establish minimum requirements, for the installation of Biomass Boilers.

b) It should be recognized that many of the requirements included in these rules must be considered in the design of the boiler by the manufacturer. However, the owner-user is responsible for ensuring that the installation complies with all the applicable requirements contained herein. Further the installer is responsible for complying with the applicable sections when performing work on the behalf of the owner user.

c) This supplement provides requirements for the installation and control of boilers which use biomass as a major fuel component and will address the differences that occur when solid fuels, such as Biomass, are being used. Thus the primary thrust of this section ~~will be~~ is directed toward the control of the fuel handling and distribution systems.

d) Fuels ~~will~~ vary widely depending upon source, moisture content, particle size and distribution, however once the fuel has been established, the owner-user should adhered to as closely as possible in order to minimize handling, combustion and emissions problems.

e) Additionally the emissions control equipment is designed around the initial fuel specification. Any changes in fuel fired will impact on the performance of the various elements of the emissions control system.

f) Biomass boilers and boiler rooms require additional considerations than traditionally fueled boilers that may include

- Transportation of the fuel from a storage facility to a metering device within the boiler room
- Transportation of the metered fuel to the boiler, for distribution to a combustion system whether it be a grate upon which the combustion takes place, a bubbling fluidized bed, circulating fluidized bed or suspension burner.

- In grate based combustion systems combustion air is typically divided into an underfire air system and an overfire air system, each of which must be closely controlled in order to produce clean, efficient combustion.
- Induced draft fans to overcome the pressure drop of the emissions control equipment
- A fly ash or carbons recycle system, to return unburned carbon to the combustion zone.

S4.3 – Determination of Allowable Operating Parameters

The allowable operating parameters of the combustion side shall be installed in accordance with jurisdictional and environments requirements, manufacturer's recommendations, and/or industrial standards, as applicable.

S4.4 – General Requirements

a) Power Boilers utilizing biomass as the primary fuel source shall meet the requirements of NBIC Part 1, Section 2 and this supplement.

b) Steam Heating, Hot Water Heating, and Hot Water Supply Boilers utilizing biomass as the primary fuel source shall meet the requirements of NBIC Part 1, Section 3 and this Supplement.

S4.5 – Fuel System Requirements and Controls

a) Fuel Transport Systems shall address preserving fuel particle size distribution, fire prevention, and the suppression of fires or explosions.
In a single installation various types of fuel transportation systems may co-exist, the most common systems are

- Conveyor systems- In these systems fuel is dropped onto a moving belt, bucket elevator, drag link conveyor or a screw or auger mechanism. Speed of the conveyor may be varied to meet fuel demand.
- Lean phase pneumatic systems
  In these systems fuel is dropped into a moving airstream, mixes with the air, and travels through a pipe at a velocity of approximately 5000 ft/min. Air pressures are in the region of 25 inches water column.

b) Fuel Transport Solid Fuel Metering Systems vary depending upon the fuel used and the particle size distribution, these metering systems include but are not limited to:

- Variable speed augers
  Variable speed, helically flighted, augers can be located in the bottom of a fuel metering bin. Alternatively they could be a part of a retort type stoker. The auger dimensions, flighting, and speed range are selected on the basis of fuel being burned, its size range, heating value and required boiler turndown range. The metered fuel typically is then dropped into the throat of a venturi, (or in some cases a plain pipe) though which the fuel transport air flows to carry the fuel into the boiler combustion zone, for distribution on a grate, upon which the burning of the fuel takes place.
- Variable speed air-lock valves
  This valve is basically a rotating slotted cylinder, operating within an outer cylinder, suitably sealed to prevent leakage. Rotational speed and slot dimensions can be varied to accommodate changes in fuel flow rate. The fuel passing through the valve, typically, is deposited onto a moving grate type stoker.
- Variable stroke rams
  This is another device that can be located on the bottom of a metering bin, is typically used on smaller units and is essentially a batch feed mechanism. The stroke of the ram is adjusted to set fuel flow rate.

S4.6 – Combustion Requirements

a) Overfire Air/Underfire Air Distribution

When solid fuels are burned on a grate, rather than in fluidized bed units or in suspension, it is normal practice to introduce some of the combustion air under the grate, or bed, and the remainder over the bed. In many cases fuel transport air becomes a part of the over-the-bed combustion air. The proportioning of the overfire to underfire airflow rates is dependent upon several factors, such as fuel particle size, fuel density, burn rate and volatiles. In general the objective is to get as complete a burn on the grate as possible, without creating large quantities of particulate emissions, and then using the overfire air to complete burning of the volatile and small particulate matter, leaving the fuel bed.

Loss of combustion air from either the underfire or overfire source shall cause shutoff of the fuel supply and a lockout condition.

The control system shall be capable of maintaining the correct relationship between underfire air and overfire air, over the complete firing range of the boiler, while promoting complete burning with minimum particulate emissions.

b) Programming Controls

Programming controls may be relay based, or on more current units, PLC based. Interactive graphics displays may also be incorporated into the system.

Access to PLC based controls and interactive graphic displays shall be limited to qualified individuals and password protected. PLC functions shall be confined to the normal boiler operating logic, covering startup, interlocks, and normal shutdown sequences.

Safety controls, which cause boiler safety shutdown when activated, shall not be interfered with by the PLC logic. shall not intefere with Consideration should be given to having the PLC logic comply with the requirements of NFPA-85.

c) Pre-firing Checks/interlocks

In addition to the Safety Controls defined in Section 4.5 and 4.6 proof of air handling fans or blowers are operating properly shall be required. This includes:

- Induced draft fans
- Fuel transport fans
- Underfire air and Overfire air fans, and
- Carbon, or flyash, re-injection fans.

In cases where variable speed drives are used on fans, the combustion system manufacturer's instructions shall be followed in terms of the allowable upper and lower limits of the power supply frequency (Hz).

d) Pre-purging

Pre-purging the boiler and its venting system shall be required. Unless defined otherwise by the manufacturer of the fuel burning equipment, the pre-purge may be achieved by operating the induced draft fan prior to starting the remaining fans in the installation.

Purge air volume shall be set during commissioning by the combustion system manufacturer, or the manufacturer's representative, in accordance with applicable Codes or Standards and shall not be capable of being reset by operating personnel.

e) Ignition Systems

Solid fuel ignition systems and/or methods can vary from the placement of manually ignited, oil soaked rags on the fuel bed, to gas or oil fired pilot burners or lances but in all cases shall be in accordance the manufactures recommendations.

f) Firing Rate Control and Fuel/Air Ratio Control

The control system shall be capable of maintaining the desired air to fuel ratio over the entire firing range of the boiler, while promoting clean, stable combustion.

g) Re-injection Systems

In installations where fly ash is re-injected from a multi-cyclone collector into the combustion zone for carbon re-burn; precautions should be taken to ensure that plugging of the reinjection pipe work does not occur. Consideration should be given to installing cleanouts in the pipe work.

h) Shutdown and Post Purge

added i)

Unless the boiler manufacturer's instructions state otherwise, the fuel supply shall be terminated at shutdown, and the overfire air should remain on until the fuel bed is burned out, and the residue cooled.

New definitions

Conveyor system(s)- A fuel transport system utilized on biomass boilers that drops fuel onto a moving belt, bucket elevator, drag link conveyor or a screw or auger mechanism. (The Speed of the conveyor may be varied to meet fuel demand.)

Lean phase pneumatic system(s)- A fuel transport system utilized on biomass boilers that drops fuel into a moving airstream, mixes with the air, and travels through a pipe at a velocity of approximately 5000 ft/min. Air pressures are in the region of 25 inches water column.

Suggested Additions to NBIC, Part 2 – Inspection, to Cover Biomass Fired Boiler Installations (Section 6, Supplement X)

(Draft for Review and Comment 10/31/12)

SX.1 - Scope

a) This supplement is intended to provide additional inspection requirements to cover Biomass fired boilers and the additional equipment utilized in these installations. In this context Biomass is intended to mean various types of wood wastes, or wood byproducts.

b) Many of the requirements of the earlier Sections of Part 2 are common to all boiler installations irrespective of the fuel being fired; therefore this supplement will address the differences that occur when solid fuels, such as Biomass, are being used. Thus the primary thrust of this section will be directed toward the inspection of the fuel handling and distribution systems, and the impact these systems may have on the pressure vessel itself.

SX.2 – Assessment of Installation

a) A general assessment of the complete installation shall be undertaken, in terms of observable results of operating and maintenance practices. Indicators include the general boiler room cleanliness, for example significant quantities of fuel particles (dust) should not be apparent in the boiler room.

b) The combustion air inlet shall be free of any debris or dust particle build up, and where moveable louvered intakes exist, the actuating mechanisms shall be clean and operate freely. Corrective action is required when non-compliance is noted.

c) The flue gas venting system shall be checked for tightness, with no observable signs of leakage. Corrective action is required if leakage is noted.

d) The intakes of the various fans or blowers shall be free of fuel particle build up or signs of other debris. Corrective action in terms of cleaning is required when discrepancies are noted.

e) The fuel metering equipment and the fuel transportation system shall be free from signs of particulate or dust leakage. Corrective action in terms of cleaning and repair work is required as necessary.

f) Electrical equipment and controls shall be properly protected from the ingress of dust, by ensuring that all cover plates are properly installed and all panel doors are intact, operable and closed.

g) Verify that all guards for rotating equipment (shafts, bearings, drives) are correctly installed and fan inlet screens are in place.

h) On the boiler, generally check for signs of potential problems, including;

- Water leaks
- Missing or misaligned pieces or parts
- Condition of support systems
- Provision of "Danger" or "Caution" signs
- Excess vibration
- Excess noise.

i) Verify that the Owner/User has established function test, inspection, requirements, maintenance and testing of all controls and safety devices in accordance with the manufacturer's recommendations. Verify that these activities are conducted at assigned intervals in accordance with written procedures, non-conformances which impact continued safe operation of the boiler are corrected and the results are properly documented. These activities shall be at a frequency recommended by the manufacturer, or frequency required by the jurisdiction. Where no frequencies are recommended, or prescribed, the activity should be conducted at least annually

SX.3 – Boiler Room Cleanliness

a) While boiler room cleanliness is of primary importance in all boiler rooms it is of particular importance in biomass fired boiler rooms. Biomass can contain fine particulate, which if allowed to leak from the transportation system into the surrounding boiler room, will eventually be drawn into fans, resulting in the possibility of combustion air systems becoming plugged.

b) Boiler rooms containing quantities of fine dusts are susceptible to fire or explosion, again emphasizing the need for high standards of cleanliness.

SX.4 – Emission Control Requirements

a) Emission control is dependent upon the fuel being fired and the emission requirements prevailing at the location of the boiler installation. As such they are a part of the initial design and installation process, and apart from ensuring that they are

kept in top working condition, so that emission requirements are not violated; there is little that can be done from the inspector's point of view.

b) When Continuous Emissions Monitors (CEM's) are in use, they should be demonstrated to be functioning properly and have a current calibration sticker.

c) Delta-P pressure gauges which measure the pressure drop across the various elements of the emission control system should all be functioning correctly.

d) There should be no sign of erosion caused by entrained particulate matter, in any part of the breaching, ductwork, stack or the individual emission control elements.

e) On systems in which the emissions control system incorporates a baghouse, appropriate fire detection and suppression systems shall be incorporated and functioning properly.

ATTACHMENT 9

NBIC Meeting - Mobile, AL January 17, 2013 API Liaison Report

Document	Title of Current Edition	Rev. Due	Status	Start Work
API 510	Pressure Vessel Inspection Code—9th Edition,	2013	J Reynolds under contract. Third ballot completed F2012. Working final question s on extending 'due date' process/interval.	In Process; early next yr.
API 536	Heat Recovery Steam Generators -2nd Edition February 2007. Errata published March 2011		Revise the document once API RP 538 is published. Include SRU/WHB if work on Reaction Furnace RP moves forward.	
API 538	Industrial Fired Boilers for General Refinery and Petrochemical Service - NEW		Ian Fischer/Paul Eichamer – Chairs (email: Paul.d.eichamer@cebridge.net) Publish in early 2013	In Process
API 570	Piping Inspection Code—3rd Edition, 2009	2014	Initial Task group meeting S2012. Master editor	In Process
RP 571	Damage mechanisms		On-hold seeking previously done work.	On hold
RP 572	Inspection of Pressure Vessels—3rd Edition,	2014	New publication Nov 2009	Spring 2013
RP 573	Inspection of Fired Boilers and Heaters—2nd Edition, 2002. Reaffirmed 2010.	2016	In API publishing.	2014
RP 574	Inspection Practices for Piping System ents—3rd Edition, 2009	2014	New publication Nov 2009. Will revise document in conjunction with API 570.	In Process
RP 575	Inspection of Atmospheric and Low Pressure Tanks—2nd Edition, 2005	2012	In API publishing.	In Process
RP 576	Inspection of Pressure Relieving Devices—3rd Edition, 2009	2014	New publication Nov 2009. Initial task group meeting S2012. Master editor selected.	In Process
RP 577	Welding Inspection and Metallurgy—1st t 2004	2016	In API publishing.	2014
RP 578	Material Verification Program for New and Alloy Piping Systems—2nd Edition, 2009	2015	New publication April 2010.	Spring 2014
RP 579-1	Fitness for Service—2nd Edition, 2007	2012	Ongoing under Fitness for Service group	Ongoing
RP 580	Risk Based Inspection—2nd Edition, 2009	2014	Initial Task group meeting S2012. Master editor	In Process
RP 581	Risk Based Inspection Technology—2nd Edition, 2008	2013	Probability of failure validation funding requested	Ongoing
RP 582	Supplementary Welding Guidelines—2nd 2009	2014	Subcommittee on Corrosion and Materials	In Process
RP 583	Corrosion Under Insulation—NEW		Frank Furillo under contract. Third ballot completed	In Process
RP 584	Integrity Operating Windows—NEW		Third ballot completed S2012. To be submitted to Publication.	In Process
RP 585	Pressure Equipment Integrity Incident Investigation—NEW		Virginia Edley under contract. Third ballot completed F2012.	In Process
	QUTE/QUSE Program (API UT Shearwave)		Revitalize program funding requested for 2013.	On-going
	NDE Methods for Equipment Damage Mechanisms Document – NEW		Funding Requested for 2013.	
	Ultrasonic Examiner Qualification Document -		Funding Requested for 2013.	

Prepared by: Jim Riley source: http://mycommittees.api.org/standards/cre/sci/default.aspx

January 7, 2013

1/1

The NBIC is considering consolidating all of the pressure relief device requirements currently in Parts 1, 2, and 3 into a new Part 4. This action will provide a single point of access for all pressure relief device requirements. Specific references to these requirements will be included in Parts 1, 2, and 3. Also note that by adding a Part 4 there will not be an additional cost. The National Board is conducting a survey to gauge opinion on creating a Part 4. Your input is greatly appreciated.

1) Please define your category of NBIC user (Check all that apply).

   NB Commissioned Inspector

   NB Owner/User Commissioned Inspector

   Owner/User

   VR Certificate Holder

   R Certificate Holder

   Pressure Retaining Item Manufacturer

   Valve Manufacturer or Assembler

   Other (Specify)

2) What is your preferred format for using the NBIC?

   Hardcopy
   Electronic- Single File (All parts combined)
   Electronic- Multiple Files (One file per part)

3) How often do you refer to the NBIC?
   Daily
   Weekly
   Monthly
   Seldom

4) Which parts of the NBIC do you currently use?
   (Check all that apply)
   Part 1
   Part 2
   Part 3

5) Having all requirements for installation, inspection, and repair, of pressure relief devices in a single separate part of the NBIC make your job_____
   Easier
   More Difficult
   No Different
   (If more difficult, please explain)

6) Any additional comments regarding this survey

B31.1 RULES for OPERATION and MAINTENANCE of POWER PIPING

National Board of Boiler and Pressure Vessel Inspectors
January 17th, 2013 meeting Mobile Alabama

Joe Frey, PE, Stress Engineering Services, Inc.

Utility	Plant/Unit	Date	Structure	Time in Service	Type of Failure
Gulf States Utilities	Sabine Unit 1	1979	HRH bend	120,000 hrs	Catastrophic (creep)
So. Cal. Edison	Mohave Unit 2	1985	HRH horiz. spool	88,000 hrs	Catastrophic (creep)
Detroit Edison	Monroe Unit 1	1986	HRH horiz. spool	97,000 hrs	Catastrophic (creep)
Virginia Pwr	Surry Unit 2	1986	BF Elbow	13 years	Catastrophic (FAC)
Gulf States Utilities	Sabine Unit 2	1992	HRH bend	212,000 hrs	Through-wall leak (creep)
Alabama Pwr (Southern Co)	Gaston Unit 5	1992	SH Link	156,000 hrs	Through-wall leak (creep)
Tampa Electric	Gannon Unit 6	1993	CRH horz Bend	150,000 hrs	Catastrophic (fatigue)

Utility	Plant/Unit	Date	Structure	Time in Service	Type of Failure
Wisconsin Electric	Pleasant Prairie Unit 1	1995	BF tee branch	15 years	Catastrophic (FAC)
East Kentucky Power	Spurlock Unit 2	1996	SH Link	~125,000 hrs	Through-wall leak (creep)
Virginia Power	Mt. Storm Unit 1	1996	SH Link	~200,000 hrs	Catastrophic (creep)
Kansas City P & L	Hawthorne Unit 5	1998	SH Link	~225,000 hrs	Catastrophic (creep)
Texas Genco	W A Parish Unit 8	2003	CRH horiz spool	145,000 hrs	Catastrophic (fatigue)
Kansai Elec Pwr Co	Mihama Unit 3	2004	FW before D/a	185000 hrs	Catastrophic (FAC)
Kansas City P & L	Iatan	2007	Desuperheater piping	27 years	Catastrophic (FAC)

ASME B31.1 Code

- Design
- Materials
- Dimensional Requirements
- Fabrication, Assembly, and Erection
- Inspection, Examination, & Testing
- Operation and Maintenance (Dec 2007)

ASME B31.1 Power Piping Code
Chapter VII
Operation and Maintenance
vs
Post Construction

"Must stop at the fence"

Issues

- B31.1 Power Piping Code Chapter VII
- List of Significant Industry Piping Failures
- Creep
- Graphitization
- Flow Accelerated Corrosion (FAC)
- Thermal Quenching
- Fatigue
- Corrosion Under Insulation (CUI)
- Material Problems
- Pipe Supports
- Pipe Routings

Two Papers on the Subject

- EPRI 1018998 Guideline for Compliance to B31.1 Chapter VII, Operation and Maintenance

- ASME PVP-26069 High-Energy Piping Systems are Now Covered Piping Systems

APPENDIX V

- Added to B31.1 after Mohave 6/9/85
- Nonmandatory
- How to maintain critical piping
- Will be where details of condition assessment are introduced into the Code
- Details will be moved over into Chapter VII in time

The WAP 8 CR Seam Weld Failure Prompted Two Industry Reactions:

1. Seal welded cold reheat systems were added to the inspection programs – fatigue cracks
2. ASME B31.1 Code Committee renewed efforts on Appendix V and then began work on a new mandatory operation and maintenance chapter. Chapter VII was published in December of 2007.

ASME B31.1 CHAPTER VII O&M Contributing Factors

- Deregulation has reduced funds and added new players
- Plants are being bought and sold
- Common industry practice to neglect pipe supports
- Lots of stories about being “lucky”

Other Codes with O&M Requirements

- B31.4 – 2002 Pipeline Transportation Systems For Liquid Hydrocarbons and Other Liquids (Chapter VII)
- B31.8 – 2003 Gas Transmission And Distribution Systems (Chapter V)
- B31.11 – 2002 Slurry Transportation Piping Systems (Chapter VII)
- High Pressure System HPS 2003 (Section 5000)

Thou Shall

Know the Condition of Thy Condition

GENERAL

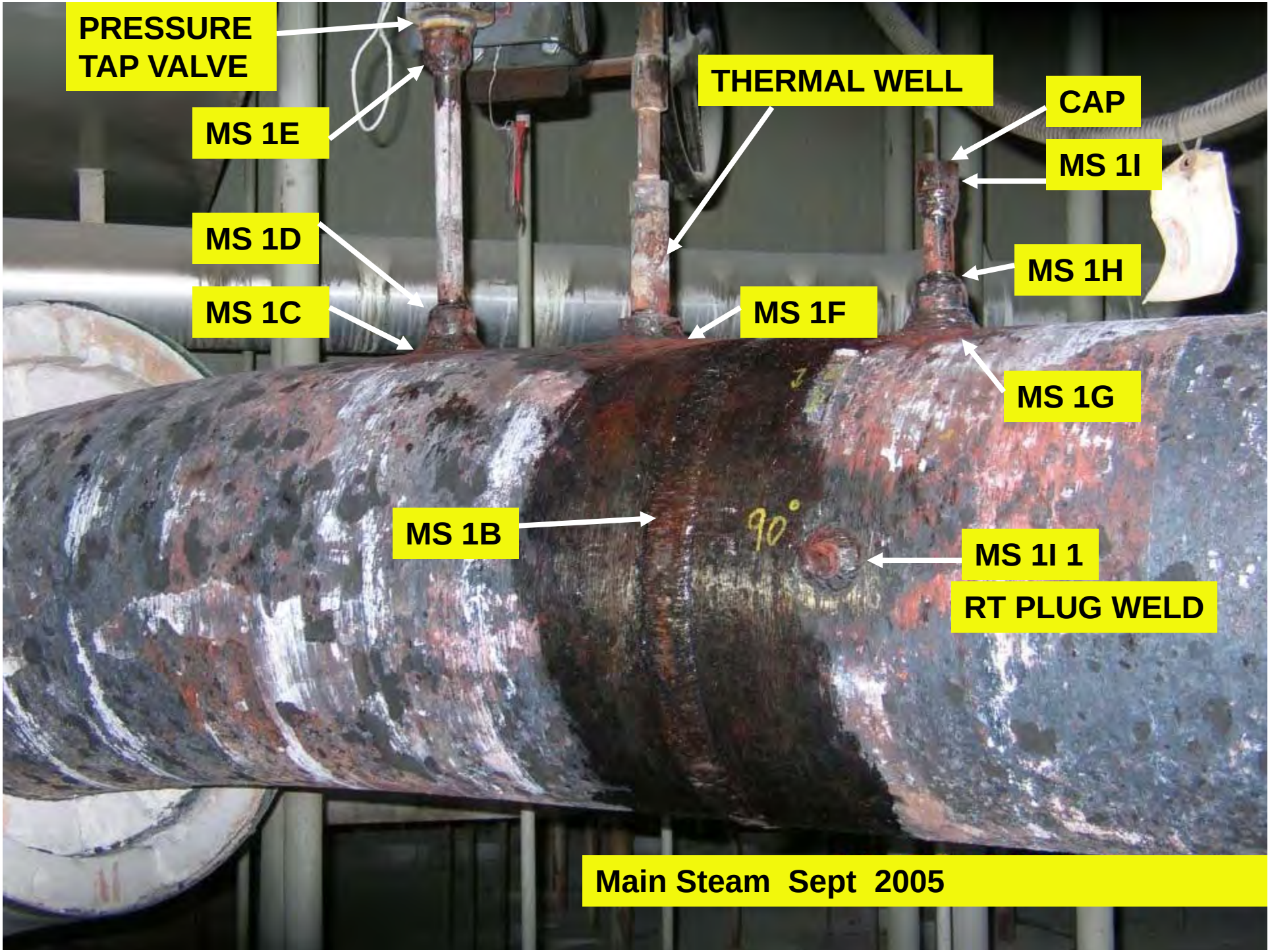
- Managing safe pipe service begins with the initial project concept and continues throughout the service life of the system.

OPERATION AND MAINTENANCE PROCEDURES

- The Operating Company shall be responsible for the safe operation and maintenance of their power piping.

Covered piping systems (CPS): Piping systems on which condition assessments are to be conducted.
As a minimum for electric power generating stations:

- NPS 4 and larger MS, HRH, CRH, & BF
- NPS 4 and larger in other systems that operate above 750F or above 1025 psi.
- The Operating Company may, in its judgment, include other piping systems determined to be hazardous by an engineering evaluation of probability and consequences of failure.


PRESSURE TAP VALVE
MS 1E
THERMAL WELL
CAP
MS 1I
MS 1D
MS 1H
MS 1C
MS 1F
MS 1G
MS 1B
90°
MS 1I 1
RT PLUG WELD
Main Steam Sept 2005

Creep

- Main Steam & Hot Reheat
- PMI
- Pipe Support walk downs
- As found stress analysis
- As found creep stress analysis remaining life
- AE / UT or rolling thirds (UT / MT)
- API 579-1 / ASME FFS-1 Part 10
- Inspection interval set by findings

FAC

- Boiler Feed, Heater drains, HRSG LP & IP
- Predictive Analysis
- Cycle Chemistry Control
- Indicator of Corrosion (iron corrosion products)
- Indicators in LP Heaters
- Indicators in Heater Drains
- API 579-1 / ASME FFS-1 Parts 4 and 5
- Inspection interval set by findings

Factors Impacting FAC

- Water chemistry
- Velocities of flow
- Temperature : 200-500F
- Geometries of piping :Elbows, Reducers, Valves, etc.
- Piping materials: <0.1% alloy content, <0.5% 2 phase flow

Fatigue

- Cold Reheat – seam welded
- Down stream of attemperator
- Near low points
- AE if loading can be achieved
- UT

Corrosion Under Insulation

- Walk downs
- Records

Graphitization

- Engineering Evaluation
- Plug Samples

P91

- Records review
- Hardness

W.A.Parish Unit 8 Cold Reheat Seam Weld Pipe Failure – July 15, 2003

- Approximate Operating Hours: **145,000**
- Starts: 180 hot and 55 cold
- Pipe Spec: 30” OD x 0.636” min. wall (0.750” actual)
- ASTM A155 carbon steel, KC70/Class 1
- Design: 675 F and 735 psig
- Operating: 620 F and 660 psig (first 136,431 hours)
- 675 F and 685 psig (next 7,791 hours)


JUN 4 200


JUL 15 2003


CHEVROLET
859-WTJ
JUL 15 2003


H
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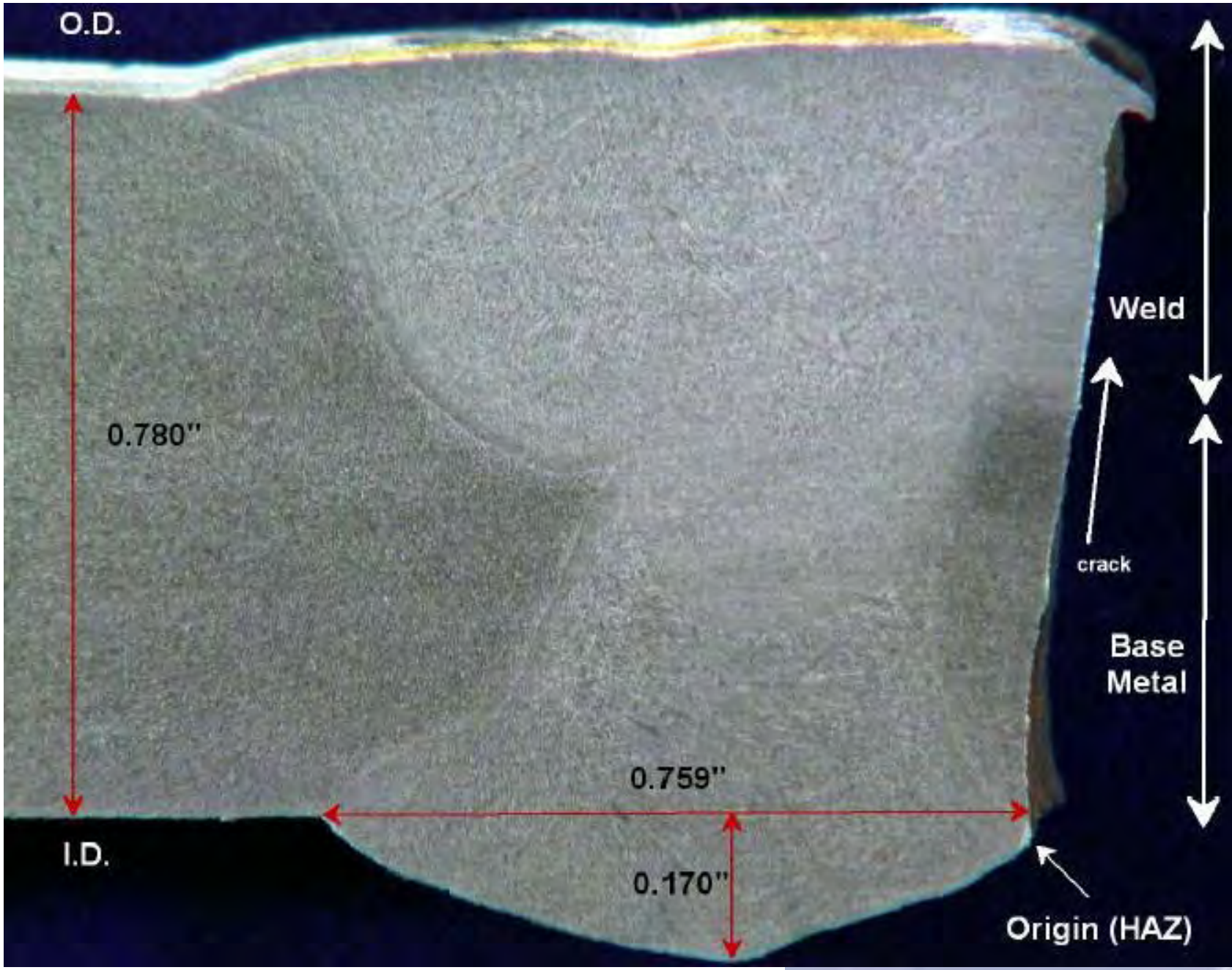
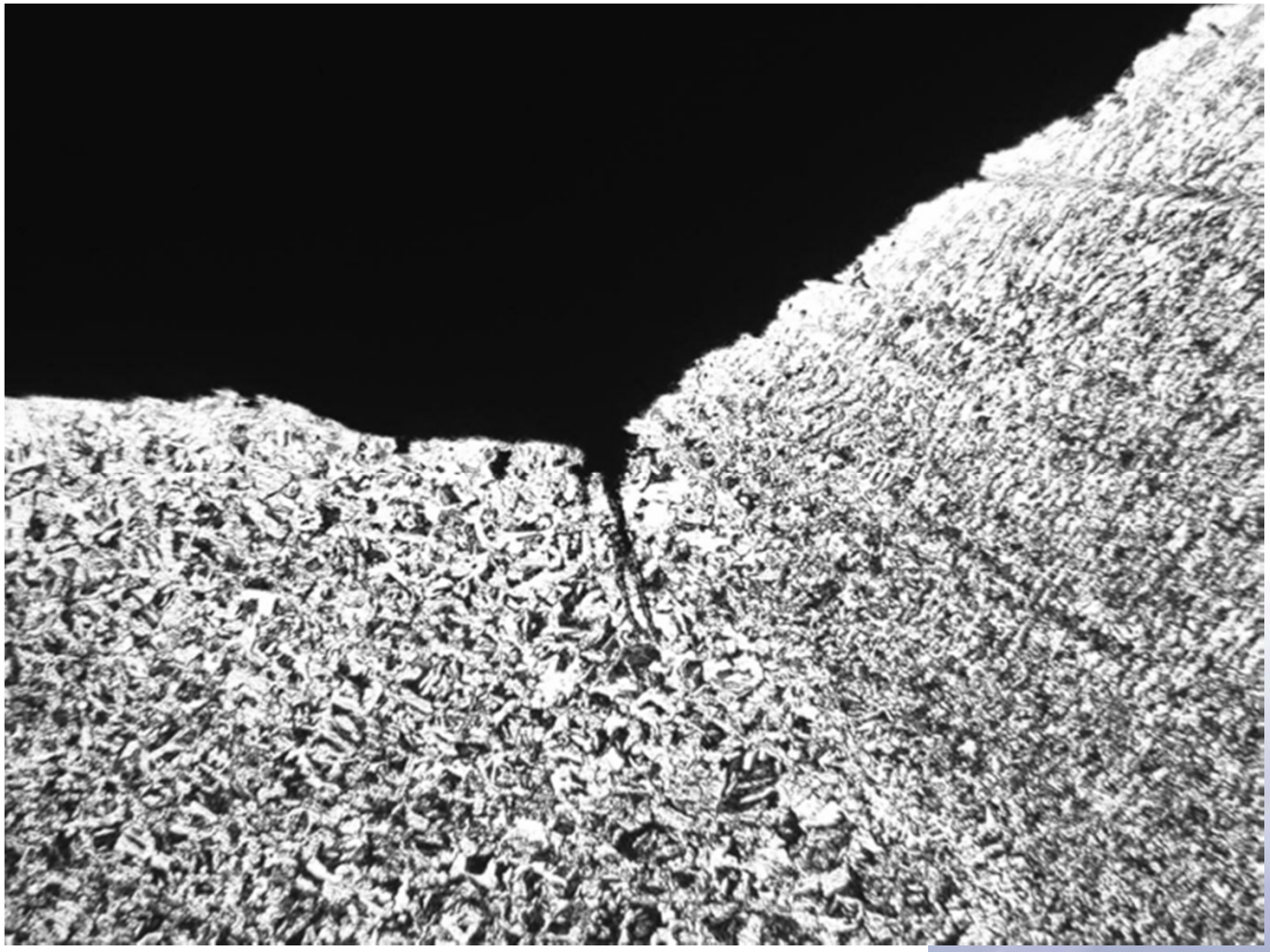
JUL 16 2003


E
N
JUL 16 2003


O.D.
0.780"
Weld
crack
Base
Metal
0.759"
I.D.
0.170"
Origin (HAZ)

WAP 8 CR
Long Seam Toe Crack



No Crack