Date Distributed: June 12, 2009

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD INSPECTION CODE COMMITTEE

AGENDA

Meeting of July 23, 2009
Columbus, Ohio

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614)888-8320
FAX: (614)847-1828

1. **Call to Order - 8:00 a.m.**

2. **Introduction of Members/Visitors**

3. **Announcements**

   a. Invitation to the Chief Inspector of Ohio

   b. Mr. David Douin, National Board Executive Director

   c. Mr. Joe Brzuszkiewicz will speak on the realigned BPV Code structure

   d. Others

4. **Adoption of the Agenda**

5. **Approval of the Minutes of January 2009 Meeting**

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

   a. Changes to rosters

   b. Resignations

   Mr. Robert Aben has resigned from all NBIC committees due to his election as the Chairman of the Board of Trustees.

   Mr. Bill Barbato and Mr. Ron Shapiro have resigned from their positions on the Subcommittee Inspection and its subgroups.

   c. Nominations and reappointments for subcommittees and NBIC Committee members

   1. Main Committee

      Mr. Jim Yagen, Mr. Stan Staniszewski and Mr. Paul Edwards are all eligible for reappointment to the NBIC Committee. A vote will be taken.

   2. Subcommittee on Installation

      Mr. Raymond Snyder, Mr. Neil Titer, Mr. Brian Moore, Mr. James Yagen, Mr. Ron Sulzer, Mr. Paul Bourgeois, Mr. Craig Hopkins, Mr. Geoff Halley and Mr. Michael Richards are all eligible for reappointment to this subcommittee. A vote will be taken

   3. Subcommittee on Inspection

      Mr. Mark Mooney and Mr. James Riley would like to join the Subcommittee on Inspection. Please view attached documents. A vote will be taken. (See Attachment 1, pgs. 2- 6)

      Mr. Steven Bacon, Mr. Domenic Canonico, Mr. Don Cook, Mr. Jim Getter, Mr. Phillip Martin, Mr. Greg McRae, Mr. David Parrish, Mr. John Richardson, Mr. Jim Riley, Mr. Michael Schwartzwalder, Mr. Stan Staniszewski and Mr. Randy Wacker are all eligible

for reappointment for membership on this subcommittee. A vote will be taken.

4. Subcommittee on Repairs and Alterations

   Mr. Palmer Dent would like to join the Subcommittee on Repairs and Alterations. A vote will be taken.

   Mr. Paul Edwards, Mr. Paul Edwards, Mr. Jack Given, Mr. James Larson, Mr. Frank Pavlovicz, Mr. Bryan Schulte, Mr. James Sekely and Mr. Michael Webb are all eligible for reappointment on this subcommittee. A vote will be taken.

5. Subcommittee on Pressure Relief Devices

   Ms. Marianne Brodeur, Mr. Sid Cammeresi, Mr. Denis DeMichael, Mr. Frank Hart and Mr. Robert Donalson are all eligible for reappointment on this subcommittee. A vote will be taken.

6. Subgroup on Fiber Reinforced Plastic Pressure Equipment

   Mr. Terry Cowley, Mr. Rick Crawford, Mr. Doug Eisberg, Mr. Timothy Fowler, Mr. David Hodgkinson, Mr. Dale Keeler, Mr. Richard Lewandowski, Mr. Henry Marsh, Mr. David Pinell, Mr. Jess Richter and Mr. Bernard Shelly are all eligible for reappointment on this subgroup. A vote will be taken.

7. Subgroup on Graphite

   Mr. Woody Banker, Mr. Gilles Braussen, Mr. Mark Johnson, Mr. Merle Minik, Mr. Ed Soltow and Mr. Andrew Stupica are eligible for reappointment to this subgroup. A vote will be taken.

8. Subgroup on Locomotive Boilers

   Mr. Clive Butler, Mr. Steve Butler, Mr. David Conrad, Mr. Robert Franzen, Mr. David Griner, Mr. Steve Jackson, Mr. Matthew Janssen, Mr. Stephen Lee, Mr. Doyle McCormack, Mr. Linn Moedinger, Mr. George Scerbo, Mr. Robert Schueler, Mr. Richard Stone, Mr. Bill Withuhn and Mr. Robert Yuill are all eligible for reappointment to this subgroup. A vote will be taken.

9. Subgroup on Historical Boilers

   The Subgroup on Historical Boilers has been re-established. Members of the subgroup are Mr. Tom Dillon, Mr. Don Cook, Mr. Robert Reetz, Mr. Steve Bacon, Mr. Dennis Rupert, Mr. Frank Johnson, Mr. Mike Wahl, Mr. Bruce Babcock, and Mr. James Larson.

7. Report of Subcommittees

a. SC on Repairs and Alterations (Attachment 2)

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), Paul Edwards, Jack Given, Frank Hart, Wayne Jones, Jim Larson, Frank Pavlovicz, Jim Pillow, Bryan Schulte, Jim Sekely, Mike Webb and John Hoh (Secretary).

G. Galanes is expected to report on the following:

1) Inquiries
There were no inquiries submitted for this subcommittee.

2) Public Review Comments for 2009 Addendum Cycle B

PR09-0501 Part 3 S4.6 The proposed change should be modified to include ASME RTP-1; Insert "or RTP-1" between Section X and criteria. Insert after Section X "or RTP-1" compliance" of the appropriate". It should read as follows: an Engineer meeting the ASME Section X of RTP-1 criteria for an Engineer certifying ASME Section X of RTP-1 compliance of the appropriate calculations contained in the Fabricator's Design Report.

PR09-0502 Part 3 S4.16.3 The proposed change should be modified to include ASME RTP-1; Insert "or RTP-1" between Section X and Criteria. Insert after Section X "or RTP-1" compliance "of the appropriate". It should read as follows: an Engineer meeting the ASME Section X or RTP-1 criteria for an Engineer certifying ASME Section X or RTP-1 compliance of the appropriate calculations contained in the Fabricator's Design Report. Note: The NBIC applies to ASME RTP-1 also. RTP-1 also requires a PE to certify the design calculations.

PR09-0503 S4.17.3 The proposed change should be modified to include ASME RTP-1; Insert "or RTP- 1" between Section X and criteria. Insert after Section X "or RTP-1" compliance "of the appropriate". It should read as follows: an Engineer meeting the ASME Section X or RTP-1 criteria for an Engineer certifying ASME Section X or RTP-1 compliance of the appropriate calculations contained in the Fabricator's Design Report. Note: The NBIC applies to ASME RTP-1 also requires a PE to certify the design calculations.

3) Action Items

NB08-0304 ***Part 3 Forms 5.13.1 SG on R and A Specific*** The instruction guide for "R" Forms needs to be improved. The form also needs to have the ability to expand to accommodate people filling it out completely. A task group of R. Pulliam (Chair), M. Webb and W. Jones has been assigned. (No Attachment)

January 2008
A progress report was given.

July 2008
A progress report was given

January 2009
A progress report was given.

July 2009
Mr. Pulliam is expected to report.

N**B08-0322** ***Part 3 3.2 SG on R and A General*** Add a new paragraph to 3.2 General Requirements for Repairs and Alterations to address change of service for a pressure vessel. These requirements should caution inspectors, owners, repair organizations and jurisdictional authorities of the inherent dangers involved when changing service. A new supplement should be added to address the specific requirements for repairs and alterations of pressure vessels that have been converted from one service to another. A task group of all three parts of the NBIC has been formed under the leadership of Bob Wielgoszinski. Task group members from R and A are P. Edwards and B. Schulte. (See Attachment 2, pgs. 4 – 6)

July 2008
A task group was assigned.

January 2009
Mr. Wielgoszinski gave a progress report.

July 2009
Mr. Wielgoszinski is expected to report on action items NB08-0320-NB08-0322 at this time.

NB08-1301 ***Part 3 4.4.1) e) & 4.4.2 c) SG on R and A General*** This action item is a result of PR08-0306. Prohibiting VT as the only means to evaluate repairs and alterations will now mandate some form of NDE or pressure test be performed on load bearing attachments of pressure test be performed on load bearing attachments and weld buildups and if a Jurisdiction does not reference or subscribe to routine repairs, an Inspector will now have to witness the pressure test for non-load bearing structural attachments in all cases. This will create a very costly repair in many cases for no apparent gain. A task group of M. Webb, J. Larson and R. Wielgoszinski has been assigned. (See Attachment 2, pgs. 7 – 8)

July 2008
A task group was assigned.

January 2009
Mr. Webb reported that the TG would like to letter ballot this issue before the July meeting.

July 2009
Mr. Webb is expected to report.

NB09-0901 ***Part 3 S3.3.6 SG on Graphite*** Connected repairs are not defined and the sentence is therefore confusing. The SG letter balloted this issue. The letter ballot passed unanimously. (See Attachment 2, pg. 9)

July 2009
Mr. Galanes is expected to report.

NB09-0902 ***Part 3 S3.5.2 SG on Graphite*** Replace the word “acetone” with “hydrophilic solution”. The subgroup letter balloted this issue. The letter ballot passed unanimously. (See Attachment 2, pgs. 10-13)

July 2009
Mr. Galanes is expected to report.

NB09-1002 ***Part 3 S1.2.9.81.2.9.8 SG on LB*** Insert wording in the flue section from BLW Standard Practice Sheet 1-14A : "All flues smaller than 3" OD shall be rolled and beaded or rolled and seal welded on the firebox end, and at least one in ten at the front flue sheet end. All flues 3" OD and larger shall be rolled and beaded or rolled and seal welded at both ends and all adjacent flues smaller than 3" OD that are within the large flue pack shall be rolled and beaded or rolled and seal welded at both ends. At least one in ten of the remaining flues smaller than 3" OD shall be beaded or seal welded on the front flue sheet, in addition to rolling. Where less than all flues are seal welded or beaded on the front flue sheet, those seal welded or beaded shall be distributed as evenly as practicable throughout the flue pack. This shall be considered a repair."(No Attachment)

July 2009
Mr. Reetz is expected to report.

NB09-1003 ***Part 3 S1.1.3 SG on LB*** Add SA-307 Grade A or Grade B to the materials list in a new row titled "Bolts and Studs" under the application column in the table. (See Attachment 2, pg. 14)

July 2009
Mr. Reetz is expected to report.

NB09-1004 ***Part 3 S1.2.11.2b) SG on LB*** Clarify Section S2.11 regarding whether RT and PWHT exemption applies to stayed shell as well as firebox , as intended in the 1952 Locomotive Code. Change the title of S1.2.11.2 to, "Stayed Area Patches", change wording in S1.2.11.2 b) to read, "Patches are to be flush type, using full penetration welds. If the load on the patch is carried by other forms of construction, such as braces, staybolts, rivets or flues, radiographic examination of the welds is not required." (See Attachment 2, pg. 15)

July 2009
Mr. Reetz is expected to report.

NB09-1005 ***Part 3 S1.2.11.6 SG on LB*** Insert new text: e) Maximum diameter of flue holes shall be ¼" greater than the diameter of the flue. Holes shall be made round if they equal or exceed 1/8" out of round. See Part 3 S1.2.9.7. (See Attachment 2, pg. 16)

July 2009
Mr. Reetz is expected to report.

b. Subcommittee on PRD (Attachment 3)

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 Donalson, Kevin Fitzsimmons, Glyn Humphrey, Thakor Patel, Raymond McCaffrey and Joe Ball (Secretary).

F. Hart is expected to report on the following:

1) Inquiries

IN9-0201 Part 3 4.5.2 Proposed Question ;Two different companies operating at the same site maintain a consistent technical and operational relationship. One of the companies has a certified VR valve shop and the other does not. Is it permissible to include the PRVs from the company that does not have the VR certified valve shop in the scope of the VR manual so that the owner-user exception in paragraph 4.5.2 may be applied to the PRVs from the company without the VR certified valve shop? **Proposed Reply**: Yes, provided the technical and operational relationship between the two companies is documented in the VR manual, and the monitoring and maintenance of the PRVs from both companies is consistent to the extent that the company with the VR valve shop has the same access to the PRVs from the company without the VR shop. Deviations from the relationship documented in the VR manual are not permitted and will invalidate extension of the owner-user exception granted in paragraph 4.5.2 to the company that does not have the VR certified valve shop

2) Public Review Comments for 2009 Addendum Cycle B

There were no public review comments for this subcommittee**.**

3) Action Items

NB06-0101 ***Part 3 S7.5 (b) SC on PRD*** This item concerns a proposed revision to paragraph Part 3 S7.5 b) of the NBIC to revise requirements relating to the source of specifications for replacement parts. A proposal was made to the SC on R and A and it failed. It was sent back to the task group for more work. A task group of M. Brodeur (Chair), A. Tannis, S. Cammerisi, B. Nutter, A. Syed, J. Richardson, T. Patel, K. Simmons and R. McCaffrey is assigned. (See Attachment 3, pgs. 4 - 6)

July 2006
A progress report was given.

January 2007
A progress report was given.

July 2007
A progress report was given.

January 2008
A progress report was given.

July 2008
A proposal was made to the SC on R and A and it failed. It was sent back to the task group for more work.

January 2009
It was decided to send a letter ballot out on this item. The letter ballot was sent to the subcommittee and the ballot failed.

July 2009
Mr. Hart is expected to report.

NB07-1206 ***Part 1 3.9.1.5, 5 SC on PRD*** Address valve loading. Add wording that states that discharge piping is not to apply loading to the pressure relief valve. The task group was also assigned to make sure the topic of loading of pressure relief devices was covered for boilers, heating boilers, pressure vessels, and piping as appropriate, although the initial request concerned heating boilers. A task group of R. Donalson (Chair), K. Simmons, G. Humphrey and J. Ball has been assigned. (See Attachment 3, pgs. 7- 10)

July 2007
A progress report was given.

January 2008
A progress report was given.

July 2008
A progress report was given.

January 2009
It was decided to letter ballot this item before the next meeting. The ballot passed but the chair would like to discuss the negative comments that were received.

July 2009
Mr. Hart is expected to report.

NB07-1301 ***Part 3 3.2.2 SC on PRD*** Quality control systems for replacement parts. This item addresses requirements for the manufacturing and quality control for replacement parts to be used for pressure relief valve. A task group of A. Cox (Chair), D. DeMichael, T. Patel, K. Simmons and K. Fitzsimmons has been assigned. (See Attachment 3, pgs. 11-12)

July 2007
A progress report was given.

January 2008
A progress report was given.

July 2008
A progress report was given.

January 2009
A progress report was given.

July 2009
Mr. Hart is expected to report.

c. Subcommittee on Installation (Attachment 4)

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, Allan Platt, Gary Scribner, Raymond Snyder, Ron Sulzer Neil Titer, Jim Yagen, James McGimpsey (Secretary).

M. Richards is expected to report on the following:

1) Inquiries

There were no inquiries submitted for this subcommittee.

2) Public Review Comments for 2009 Addendum Cycle B

PR09-0203 ***Part 1 3.7.5.1 b) 1)*** For readability I suggest revising the paragraph to read: 1) In a single hot water boiler installation stop valves shall be located at an accessible point in the supply and return pipe connections as near the boiler as is convenient and practicable, of a single hot water boiler installation to permit draining the boiler without emptying the system.

3) Action Items

NB06-0306 ***Part 1 3.8.3.1 SG on Boilers*** Address combustion controls for fired boilers. Reference action item NB02-2502. Brian Moore reported that CSD-1 and Section IV are working jointly on controls and safety devices. There were plans to publish in 2008. A task group of B. Moore has been assigned. (No Attachment)

January 2007
Brian Moore gave a progress report that the CSD-1 Committee will be meeting in May 2007 and he will have a report at the July NBIC meeting. A task group of B. Moore and P. Bourgeois was assigned.

July 2007
Mr. Moore reported that the CSD-1 Committee made a number of changes to the document and that they should be publishing in April 2008. It was decided that this action item should be expanded upon to fill in the blanks where CSD-1 is lacking. A task group of Brian Moore, Ron Sulzer, Ray Snyder and Geoff Halley was assigned to address solid fuel firing for a full range of boilers.

January 2008
Mr. Moore reported that the CSD-1 Committee still plans to publish in 2008. Mr. Halley also gave a brief report on solid fuels.

July 2008
Brian Moore reported the CSD-1 task group is working on new language for fuel trains with possible transfer of language to Part 2 of the NBIC.

January 2009
This action item was taken as a progress report. Mr. Moore reported that there are plans to publish at the end of April 2009.

July 2009
Mr. Moore is expected to report.

NB07-1208 ***Part 1 Glossary (SG Boilers and PVP)*** Expand on the glossary for Part 1

Installation. A task group of C. Hopkins (Chair), P. Bourgeois, B. Moore and R. Snyder has been assigned. (No Attachment)

July 2007
This will be an ongoing action item as the glossary will expand. Due to a public review comment it was decided to delete all terms that do not have a definition following them.

January 2008
A progress report was given.

July 2008
A progress report was given along with a handout of suggested wording additions.

January 2009
A progress report was given.

July 2009
Mr. Richards is expected to report.

NB08-2101 ***Part 1 Installation SG on Boilers*** CSD-1 does not address solid fuel firing and it would appropriate for the NBIC to look into it. A task group of G. Halley (Chair), M. Richards, D. Pranghoffer and B. Moore has been assigned. (No Attachment)

July 2008
A progress report was given. Mr. Geoff Halley presented a handout.

January 2009
A progress report was given.

July 2009
Mr. Halley is expected to report.

NB09-0501 ***Part 1*** Add the appropriate rules to Part 1 to ensure that Installation rules address the same requirements for pressure vessels and controls as will later be required for Inservice Inspection. (See Attachment 4, pg. 1)

January 2009
This item was taken as a progress report. A task group of G. Scribner (Chair), R. Snyder and J. Yagen was assigned.

July 2009
Mr. Richards is expected to report.

NB09-0601 ***Part 1 2.2 SG on Boilers*** This action item is a result of PR07-2102 which led to NB07-1212. Please reference these documents. Expand the definition of power boilers A task group of A. Platt (Chair), G. Scribner, P. Bourgeois and R. Sulzer has been assigned. (See Attachment 4, pgs. 2 - 3)

January 2009
A task group was assigned.

July 2009
Mr. Platt is expected to report.

NB09-0801 ***Part 1 2.8.1) SG on Boilers*** This paragraph conflicts with PFT-47.1. The commenter suggests we revise it to agree with Section I. (See Attachment 4, pgs. 4 - 5)

January 2009
This item was taken as a progress report. A task group of P. Bourgeois and B. Ferrell was assigned.

July 2009
Mr. Bourgeois is expected to report.

d. SC on Inspection (Attachment 5)

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: Don Cook (Chair), Steve Bacon, Domenic Canonico, Jim Getter, Phillip Martin, Greg McRae, David Parrish, Bob Reetz , John Richardson, Jim Riley, Mike Schwartzwalder, Ron Shapiro, Stan Staniszewski, Randy Wacker and Bill Smith (Secretary).

D. Cook is expected to report on the following:

1) Inquiries

There were no inquiries submitted for this subcommittee.

2) Public Review Comments for 2009 Addendum Cycle A

PR09-0401 ***Part 2 S1.4.2.1*** Table of contents add new item S1.4.2.1 a).

3) Action Items

NB07-0905 ***Part 2 4.3.1-4.3.3 SC Inspection*** Review these sections for completeness and consistency in pressure testing. Mr. Cook suggested forming a task group from all three parts. A task group of B. Barbato (Chair), R. Shapiro, D. Parrish, R. Aben and J. Yagen has been assigned. Included in the attachment is an email from Mr. Galanes requesting that his concern be addressed in this action item. (See Attachment 5, pgs. 2 - 4)

July 2007
A progress report was given.

January 2008
A progress report was given.

July 2008
A progress report was given.

January 2009
A progress report was given.

July 2009
Mr. Cook is expected to report.

NB07-0909 ***Part 2 2.3.6.4 SG Inspection General*** Review section Liquid Ammonia Vessels. A task group of R. Reetz (Chair), S. Staniszewski, G. McRae, V. Newton and M. Schwartzwalder has been assigned. (See Attachment 5, pgs. 5 - 6)

July 2007
A progress report was given.

January 2008
A progress report was given.

July 2008
A progress report was given.

January 2009
A progress report was given.

July 2009
Mr. Reetz is expected to report.

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. (No Attachment)

July 2007
A progress report was given. Changes to the DOT Glossary were approved previously due to approved public review comments.

January 2008
A progress report was given. The task group has met twice to discuss the public review comments received from the 2007 edition and in the process 11 more issues were identified.

July 2008
A progress report was given.

January 2009
This item was taken as a progress report. Mr. Staniszewski reported that the Federal Government is planning to release a standard on rule making under docket # PHMSA 2005-21351 in June of 2009.

July 2009
Mr. Staniszewski is expected to report.

NB07-0912 ***Part 2 SG Inspection Specific Inspection Guides Section 5*** Review the National Board Inspection guides for Cast Iron Boilers, Pressure Relief Devices, Water Level Controls & Devices and Operating Controls. (No Attachment)

July 2007
A progress report was given.

January 2008
Task groups were assigned to address the four inspection guides.

July 2008

- Guide for Cast Iron Boilers – Task group of W. Barbato, R. Dobbins, and D. Canonico. A motion made to accept the review and updates of the task group. The motion was unanimously approved.

- Guide for PRD – Task group of J. Richardson and R. Wacker. A progress report was given by Mr. Wacker.

- Guide for Water Level Controls & Devices – Task group of S. Bacon and V. Newton. A motion made to accept the review and updates of the task group. The motion was unanimously approved.

- Guide for Operating Controls – Task group of S. Bacon and V. Newton. A progress report was given by Mr. Bacon.

January 2009
A progress report was given. Three out of the four components have been approved by the Subcommittee. The guide for Pressure Relief Devices has not yet been reviewed.

July 2009
Mr. Cook is expected to report.

NB07-1013 ***Part 2 SG on LB*** All the figures (Part 3 S1) from Part 3 should be included in part 2 as well as in part 3. (See Attachment 5, pgs. 7 - 9)

July 2007
The SC has decided to send this action item back to the SG on Locomotives for more direction and placement of photos. No action was taken.

January 2008
A progress report was given. The action was sent back to the SG on Locomotive Boilers for more direction.

July 2008
A progress report was given.

January 2009

A progress report was given.

July 2009
Mr. Reetz is expected to report.

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 G. McRae (Chair), G. Galanes, J. Getter, M. Huffman, V. Mullins, J. Reed, D. Cook, J. Richardson and V. Newton has been assigned. (No Attachment)

January 2008
A progress report was given and a task group was assigned.

July 2008
A progress report was given.

January 2009
A progress report was given. This item will be discussed in conjunction with NB08-0321.

July 2009
Mr. McRae is expected to report.

NB08-0702 ***Part 2 S7 SG on Inspection Specific*** The maximum corrosion allowance for a LPG tank should be 10% of the minimum thickness required. A task group of G. McRae (Chair), G. Galanes, J. Getter, M. Huffman, V. Mullins, J. Reed, D. Cook, J. Richardson and V. Newton has been assigned. (No Attachment)

January 2008
A progress report was given and a task group was assigned.

July 2008
A progress report was given.

January 2009
A progress report was given. There were plans to discuss this item at the April meeting of PVMA.

July 2009
Mr. McRae is expected to report.

NB08-0703 ***Part 2 S7SG on Inspection Specific*** Investigate the feasibility of marking or stamping a re-rated name plate on a LPG tank that is being altered from an above ground tank to a below ground tank. A task group of G. McRae(Chair), G. Galanes, J. Getter, M. Huffman, V. Mullins, J. Reed, D. Cook, J. Richardson, and V. Newton has been assigned. (No Attachment)

July 2008
A progress report was given and a task group was assigned.

January 2009
A progress report was given. This item will be discussed in conjunction with NB08-0321.

July 2009
Mr. McRae is expected to report.

NB08-1904 ***Part 2 S6 SG on Insp. Spec.*** Condition of internal structures (pipes, baffles) is an important inspection problem. Loose structures inside tanks destroy internal PRDs. A task group of S. Staniszewski, G. McRae and J. Riley has been assigned. (See Attachment 5, pg.10)

January 2009
A progress report was given.

July 2009
Mr. Staniszewski is expected to report.

NB09-0303 ***Part 2 2.2.12.8 SG on Insp. Gen***. This action item is a result of PR09-0201. The commenter suggested changing BTUs to the units of measure independent term "thermal energy". This would make the statement independent of the U.S. Customary or metric units. A TG of V. Newton, M. Schwartzwalder and B. Moore has been assigned. (See Attachment 5, pg. 11)

July 2009
Mr. Cook is expected to report.

NB09-0304 ***Part 2 2.2.12.3SG on Insp. Gen.*** This action item is a result of PR09-0202. The commenter suggested adding new wording regarding solid fuel into the referenced paragraph. A task group of M. Schwartzwalder (Lead), V. Newton, M. Clark and B. Moore has been assigned. (See Attachment 5, pgs. 12-13)

July 2009
Mr. Schwartzwalder is expected to report.

NB09-1001 ***Part 2 S1.6 SG on LB*** Add a new table that shows evaporation rates for steam locomotive boilers. (No Attachment)

July 2009
Mr. Reetz is expected to report.

9. Liaison Activities

- **a.** ASME
- **b.** AWS
- **c.** API
- **d.** PVRC
- **e.** PCC
- **f.** Others

10. Approval of 2009 Addendum (Attachment 6)

11. New Business

12. Future Meetings

The following meetings have been scheduled:

January 2010, Austin, Texas
July 2010, Columbus, Ohio

13. Adjournment

Respectfully submitted,

Robin Hough
Secretary, NBIC Committee
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ATTACHMENT 1

Committee on National Board Inspection Code

Member	Title	Expiration Date	Interest Category
Hough, Robin	Secretary		
Parks, Terry	Chair		General Interest
Yagen, James M.		07/20/2009	Users
Staniszewski, Jr., Stanley		08/01/2009	Regulatory Authorities
Edwards, Paul D.		08/01/2009	NB Certificate Holders
Titer, H. Neal		01/31/2010	Users
Bacon, Steven E.		01/31/2010	Users
Richards, H. Michael		01/31/2010	Users
Pillow, James T.		07/19/2010	General Interest
Cook, Don		07/19/2010	Jurisdictional Authorities
Snyder, Raymond		07/19/2010	Auth Inpection Agencies
Sulzer, R. C.		07/19/2010	Manufacturer
Hopkins, Craig		07/19/2010	NB Certificate Holders
Richardson, John		07/19/2010	Manufacturer
Galanes, PE, George W.		07/19/2010	Users
Reetz, Robert		07/19/2010	Jurisdictional Authorities
Hart, Frank		07/19/2010	Manufacturer
Canonico, Dr. Domenic A.		07/19/2010	General Interest
Platt, Allan		07/19/2010	Jurisdictional Authorities
Wielgoszinski, Robert V.	Vice Chair	10/31/2010	Auth Inpection Agencies
Bourgeois, Paul		07/24/2011	Auth Inpection Agencies
Scribner, Gary		07/24/2011	Jurisdictional Authorities
Parrish, Dave		07/24/2011	Auth Inpection Agencies
Sekely, James		09/30/2011	General Interest
Given, Jack		01/26/2012	Jurisdictional Authorities

Total Members: 24

Liberty Mutual Property

Equipment Breakdown
Mail Stop: 02AN
20 Riverside Road
Weston, MA 02493-2231
www.libertymutualproperty.com

May 28, 2009

Mr. Terry Parks
Chairman, NBIC
1055 Crupper Avenue
Columbus, OH 43229-1183

RE: Letter of Interest to Serve

Dear Mr. Parks:

I would like to express my interest in serving on the National Board Inspection Code, Subcommittee for Inspection (Part 2). I am currently employed as the Senior Engineering Specialist for Liberty Mutual Insurance Company and have their full support as it relates to serving in this capacity.

As you know, I was the Jurisdictional Chief for the Commonwealth of Massachusetts from 1997 to 2009, and as a former National Board member I served on the Board of Trustees for 8 years. I currently hold inspector commissions in Massachusetts, Maine, New Hampshire, Vermont, Rhode Island, Connecticut, New York, Pennsylvania, Delaware, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Alabama, and Florida. I have attached my resume for your review.

With my past experience and current support from my employer, I believe I could be an asset to this committee.

I appreciate your consideration in this matter.

Sincerely,

Mark F. Mooney
Senior Engineering Specialist
Liberty Mutual Insurance Company

Cc: Don Cook, Chair – Subcommittee for Inspection
David Douin, National Board Executive Director

Attached: Resume

MARK F. MOONEY
22 CRYSTAL SPRING ROAD
MATTAPOISETT, MA 02739
(508) 758-2159

PROFESSIONAL EXPERIENCE

February 2009 – Present **Liberty Mutual Insurance Company,** Weston, MA

SENIOR ENGINEERING SPECIALIST (February 2009 - present)

Provides highly sophisticated consultative services to an assigned group of customers within a loss prevention specialty area or territory. Conducts on-site evaluations, evaluates data, and creates/implements service plans to control customer's source of risk, losses and costs. Provides risk assessment services and information to track progress and demonstrate the value of doing business with Liberty Mutual. Serves as a trainer/mentor to less experienced consultants in their specialty area at the discretion of their manager. Enhances the Company's leadership position in the safety field through speaking engagements at conferences, developing key relationships, and publishing safety related articles in professional publications.

1996 – February 2009 **Massachusetts Department of Public Safety,** Boston, MA

CHIEF OF INSPECTIONS - MECHANICAL (September 2006 – February 2009)

Responsible for the day to day operation of the mechanical inspectional divisions, in areas such as scheduling, communication, establishing direction and providing technical assistance to inspectional personnel. Oversee 42 State Elevator Inspectors, and 11 District Engineering Inspectors, 2 Administrative staff.

Major achievements include:

- Increased elevators in compliance from 35% to 66% with limited manpower
- Appointed Chairman, Bureau of Pipefitters, Refrigeration Technicians and Sprinklerfitters
- Appointed to the Board of State Examiners of Plumbers and Gas Fitters

ACTING CHIEF OF INSPECTIONS (October 2004 - September 2006)

Responsible for the day to day operation of the department inspectional divisions, in areas such as scheduling, communication, establishing direction and providing technical assistance to inspectional personnel. Oversee 42 State Elevator Inspectors, and 11 District Engineering Inspectors, 15 State Building Inspectors and 2 Administrative staff.

Major achievements include:

- Authored initial Trench legislation / regulations
- Implemented Global Positioning System (GPS) for DPS Inspectors.
- Initiated a Department continuing education program for the State Elevator Inspectors.
- Initiated a Department continuing education program for the District Engineering Inspectors.
- Completely revised Commonwealth Amusement Regulations
- Worked to bring Massachusetts as the #1 ranked state in Amusement safety (ranked by Saferparks.org)

ASSISTANT CHIEF OF INSPECTIONS (January 1997 – October 2004)

Responsible for the day to day operation of the Inspectional Division, primarily assisting the Chief of Inspections in areas such as scheduling, communication, establishing direction and providing technical assistance to inspectional personnel. Oversee 42 State Elevator Inspectors, and 11 District Engineering Inspectors, 15 State Building Inspectors.

Major achievements include:

- Completely reviewed and overhauled, and standardized the Department examination process for all licenses issued by inspectors of the Department, including formation of industry "Task Groups"
- Returned Massachusetts as a National Board Member State
- Elected as 2nd Vice Chairman to the Board of Trustees for the National Board
- Elected as President of the National Counsel of Amusement and Recreational Equipment Safety (CARES)
- Centralized elevator scheduling and inspector tracking system for entire state
- Updated all state boiler and pressure codes to reflect national standards
- Organized and put together Department Annual Boiler and Pressure Vessel Safety Seminar AND Annual Amusement Safety Seminar Series since 1999.
- First to obtain the advanced NAARSO Level II Inspector of Amusement Rides, and initiated a means to enable other inspectors of the Department to obtain their NAARSO Level I certifications and NAARSO Level II certification.

DISTRICT ENGINEERING INSPECTOR (June 1996 - January 1997)
Inspect boilers, pressure vessels, amusement devices and other equipment or devices for conformance to safety laws, standards, rules and regulations, approve plans for the construction or alteration of boilers, pressure vessels, and accessories; examine applicants for licenses; determine causes of accidents and perform related work as required.

1988 - 1996 **Bechtel - SEMASS OPERATIONS**, Rochester, MA
OPERATIONS SUPERVISOR/CHIEF ENGINEER (1994 - 1996)
Supervise the operation of a 3,000 ton/day Waste-to-Energy Facility, responsible for over 103 employees ranging from Shift Supervisor to Laborers.

SHIFT SUPERVISOR (1991 - 1994)
Supervise the operation and maintenance of power plant, on the night shift with a crew of 16 employees, including 2 Control Room Operators, 1 Assistant Control Room Operator, 4 Power Attendants, 5 Utility Operators/laborers, 3 Equipment Operators, and 2 Mechanics. Scheduling vacations and coverage for power block hourly personnel.
Major achievements include:
- Wrote Company Operating Procedures Manual (3 volumes)
- Create a data base of state license exams, tutoring individuals seeking engineering license upgrade, as well as developed and instructed training courses for shift personnel.
- Co-author of a Second Engineer Correspondence Course
- Assisted Bechtel Engineers in design of keyboard pattern and paging scheme for Westinghouse WDPD DCS system

CONTROL ROOM OPERATOR (1990 - 1991)
Operated and maintained continuous watch of control systems. Supervised and directed Power Attendants, Utility Operator, and Laborers. Maintained operating logs and records.
Major achievements include:
- As a Shop Steward, involved in successful contract negotiations.

POWER ATTENDANT (1988 - 1990)
Operated and maintained continuous watch of plant systems under the direction of the Control Room Operation. Assisted in the startup of a new Waste-to-energy Facility.

1991 - 1995 **L J Technical Group**, Mansfield, MA
INSTRUCTOR / CO-AUTHOR
Instructor for a Massachusetts engineering license preparation program for individuals seeking power plant operators licenses from entry level operator (Fireman) to Chief Engineer.
Major achievements include:
- Co-authored a Power Plant Engineer Reference Manual.

1986 - 1988 **Mooney Engineering, Inc.**, Canton, MA
VICE PRESIDENT
Involved in the startup and expansion of an industrial heating company. Design and supervised installation of new industrial, commercial, and residential heating systems, and maintained existing heating systems. Performed billing tasks.

EDUCATION
1986 **MASSACHUSETTS MARITIME ACADEMY**, Buzzards Bay, MA
Bachelor of Science in Marine Engineering

LICENSES / CERTIFICATIONS

National Board of Boiler and Pressure Vessel Inspector - Commission #12062

Commissioned Boiler Inspector in the following states:

- Massachusetts – Certificate of Competency #1868
- New York – Certificate of Competency #5247
- Connecticut – Certificate of Competency #1529
- New Hampshire – Boiler Inspector #777
- Rhode Island – Boiler Inspector #069
- Maine – Boiler Inspector #BIC833
- South Carolina – Boiler Inspector #234
- West Virginia – Certificate of Competency #3079
- North Carolina – Certificate of Competency #1582
- Virginia – Certificate of Competency #1091
- Alabama – Certificate of Competency #AL1047BL
- Georgia – Certificate of Competency #875
- Vermont – Certificate of Competency #1003
- Pennsylvania – Certificate of Comptency #3004
- Delaware – Certificate of Competency #8113
- Florida – Certificate of Competency #559

Commonwealth of Massachusetts - 1st Class Engineer License #1386

Commonwealth of Massachusetts - Oil Burner Technician License #025093

Commonwealth of Massachusetts – Journeyman Pipefitter #39868

Commonwealth of Massachusetts – Amusement Inspector Certificate of Competency #1868

National Institute for the Uniform Licensing of Power Engineers - 1st Class Engineer #E-41 *(expired)*

NAARSO – Advanced Level II - Certified Inspector of Amusement Devices - #CN 913
Instructor and Supervisor Endorsements

PROFESSIONAL ORGANIZATIONS

Massachusetts Board of Boiler Rules – Chairman (1997 – 2008)

Massachusetts Board of State Examiners of Plumbers and Gas Fitters (2007 – 2009)

Massachusetts Bureau of Pipefitter, Refrigeration Technicians and Sprinklerfitters – Chair (2007 – 2008)

National Board Member representing the Commonwealth of Massachusetts (1998 – 2008)

National Board – Board of Trustees 1st Vice Chairman (2008 – 2009)

National Board – Board of Trustees 2nd Vice Chairman (2001 – 2008)

C.A.R.E.S Member representing Massachusetts (2001 – 2009)

Council of Amusement and Recreational Equipment Safety (C.A.R.E.S.) – President (2006-08)

Massachusetts Amusement Advisory Board – Chairman (2001 – 2003)

American Society of Mechanical Engineers (ASME) – member #3538717

- Member of the Boiler & Pressure Vessel Conference Committee (1998 – 2009)
- Member of ASME CSD-1 Committee (National Boiler Controls Committee) (2006 – 2009)

American Society for Testing and Materials (ASTM) – member # 000230602

- Member of the F-24 Committee Amusement Devices
- Member of the C-26 Committee on Nuclear Fuel Cycle
- Member of the E-07 Committee on Non-Destructive Testing

VOLUNTEER WORK

1988 – 1991 St. Joseph's Church, Fairhaven – Youth Minister
1993 – 1998 Jericho Christian Fellowship – Youth Leader
1998 – 2000 Mentored a homeless youth
2005 – 2006 Soccer Coach for the local Mariner Soccer League
2006 – present Treasurer for the Mattapoisett Youth Baseball Association
2007 – 2008 Baseball coach for Mattapoisett Youth Baseball Association

ConocoPhillips

From: **Mr. Lou Mclean**
Technical Services Manager
ConocoPhillips San Francisco Refinery
1380 San Pablo Avenue,
Rodeo, CA 94572-1354

January 16, 2009

To: **Mr. David Douin**
National Board Executive Director
1055 Crupper Avenue
Columbus, OH 43229

RE: Continuance of Mr. James Riley on the NBIC Subcommittee Inspection

Mr. David Douin,

We request your consideration of the continued association of Mr. James (Jim) Riley with the National Board Inspection Committee. He was approved in late 2006 by Mr. Donald Tanner to be on the NBIC Subcommittee Inspection. At that time, he was employed by Chevron. He became employed by ConocoPhillips in June, 2008. He is a regular employee under the ConocoPhillips Accredited Owner-User Organization at Rodeo Refinery (OU Comm. No. 393 – expires 12/31/2009).

Mr. Donald Cook discussed this with Mr. George Bynog during the NBIC week last July and contacted Mr. Riley suggesting that he send a letter recognizing the support of his new employer to the National Board for this continuance. Mr. Riley has the full support of the ConocoPhillips San Francisco Refinery Management for this committee participation.

If there are any questions, please contact us. Mr. Riley's new contact information is as follows:

James Riley, Superintendent, Metallurgical Engineering and Inspection
ConocoPhillips Rodeo Refinery
1380 San Pablo Avenue,
Rodeo, CA 94572-1354
phone: 510-245-5895
email: jim.riley@conocophillips.com

Regards,

Lou Mclean

Cc. Mr. Donald Cook

1/1

(6)

OneBeacon America Insurance Company

February 3, 2009

Mr. David Douin
Executive Director
The National Board of Boiler
and Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183

Subject: Palmer Dent's NBIC Committee Participation

Dear Mr. Douin:

I am respectfully requesting consideration by the National Board of Boiler and Pressure Vessel Inspectors for a possible appointment to the Repair and Alteration, General and Specific Subgroups, as well as the Subcommittee on Repairs and Alterations. I bring to the Committees over 16 years of experience in the area of Repairs and Alterations as both an Inspector and Inspector Supervisor. I have the full support of my company to attend and participate in committee meetings and task groups. I am excited to have this opportunity, and I look forward to your decision. My resume is on file with the National Board but I can provide another one if requested.

Sincerely,

Palmer B. Dent III
Technical Supervisor / Authorized Inspector Supervisor

cc: Janice Mondello
Terry Parks
Keith Gilmore

330 Lynnway, Suite 403, Lynn, MA 01901
t 800.579.3444 f 781.584.1119

OneBeacon America Insurance Company

February 3, 2009

Mr. David Douin
Executive Director
The National Board of Boiler
and Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183

Subject: Support of Palmer Dent's NBIC Committee Participation

Dear Mr. Douin:

Please accept this letter as OneBeacon America Insurance Company's commitment to providing the support necessary for Palmer Dent to participate in the activities of the National Board Inspection Code Committee. This support includes the time and financial resources needed for Palmer to fulfill his obligations to the Committee should he be selected as a member. We have had a long term, mutually beneficial relationship with the National Board and look forward to assisting in the continued maintenance of the National Board Inspection Code.

Sincerely,

Janice Mondello
Vice President

JM/
cc: Palmer B. Dent
Terry Parks
Keith Gilmore

330 Lynnway, Suite 403, Lynn, MA 01901
t 800.579.3444 f 781.584.1119

2/5

(8)

Palmer B. Dent, III (Trey)
Technical (Inspector) Supervisor
OneCIS Insurance Company a Bureau Veritas Company
18410 Water Mill Dr. Cypress, TX. 77429
(281) 256-8088

TECHNICAL RESUME

EXPERIENCE:

OneCIS Insurance Company a Bureau Veritas Company

2004 – Present: Area Technical Supervisor, duties include but are not limited to:

- Maintaining the competency of the Authorized Inspector at an acceptable level through various methods such as discussions of work related topics; unique problems and their solutions; informal question and answer discussion sessions; and written examination.
- Auditing of the Authorized Inspector at assigned shop and field sites for Code compliance.
- Ensure Code compliance at all assigned shops through annual audits and reviews.

1993 – 2004: Codes and Standards Inspector (Authorized Inspector)

Responsible for 25 shop and field sight locations throughout the states of Alabama and Mississippi. Eleven years of inspection experience that includes but is not limited to the following:

- Performing ASME Code shop and field fabrication inspection of boilers, pressure vessels, piping, valves and other components; verifying and certifying compliance to the ASME Code and other applicable codes, quality standards and specifications.
- Preparing and implementing Quality Control and Quality Assurance Systems and procedures for fabrication of ASME Code products and repairs and alterations in accordance with the National Board Inspection Code.
- Reviewing and verifying compliance of welding procedure specifications, welding procedure qualifications, welder performance qualifications to ASME, AWS and other applicable Codes, quality standards and specifications.
- Monitor Quality Control Programs for compliance to the ASME Codes, the National Board Inspection Code, and other quality standards.
- Witnessing destructive and nondestructive testing and verifying compliance to ASME, ASTM, and other applicable Codes, quality standards and specifications.

U.S. Navy

1984 – 1993:

Nine years of engine room maintenance, repair, and operation. Experience in high pressure boiler repair, maintenance, operation, and inspection. **Billets include**: Work Center Supervisor, Training Petty Officer, and Gauge Calibration Petty Officer. Copies of Evaluations available upon request.

Shore Duty Billet: Brunswick Naval Air Station, Naval Security Force; Brunswick, Maine.

EDUCATION:

High School Graduate

Additional Training:

- Training Course on Fabrication, Nondestructive Examination and Inspection of Welded Pressure Vessels, ASME Section VIII and Section I.
- Authorized Inspector and Authorized Nuclear Inspector Supervisor Training Course (B, NS Endorsement)
- Training Course on Fabrication, Nondestructive Examination and Inspection of Welded Pressure Vessels, ASME Section III (Nuclear).
- Machinist Mate (Class A Engineering) School, NTC Great Lakes, IL (USN)
- Shipboard Pressure and Temperature Device Calibration School, Charleston, SC (USN)
- Quality Assurance Course, Charleston, SC (USN)

COMMISSIONS:

National Board Commission Number 11599 with endorsements A, B, N, NS
State of Georgia Commission Number 419
State of Florida Commission Number 338
State of Mississippi Commission Number 4057
State of Tennessee Commission Number 3372
State of Texas Commission Number 1745
State of Alabama Commission Number 106
State of Louisiana Commission Number 1498
State of Arizona Commission Number 444

SPECIALTY PROJECTS:

GeoNET Ethanol Boiler Rebuild and Recommissioning / Christiansted, ST. Croix, USVI

March 2007 thru August 2007:

- Performed and coordinated a detailed internal and external inspection on 1 of 3 idle (10 Years) boilers and safety appurtances for a successful return to service in the dehydration of ethanol fuels. Provided guidance and direction to engineering personnel for the replacement of the 1st Intermediate Superheater Outlet Header and 2nd Intermediate Header as well as expedited the fabrication and replacement of both. Provided detailed written reports with photos both during and subsequent to the projects end. Provided a complete NB-5 National Board boiler inspection report for use in issuing the required operating certificates.

Compania de Electricidad de San Pedro de Macoris (CESPM) Electric Generation Plant / San Pedro de Macoris, Dominican Republic

May 2007:

- Coordinated the agreement intended for inspection of (3) three 1320 PSI HRSG boilers for use in electric generation process. Provided guidance and instruction to the assigned Boiler Inspector. CESPM was provided with a complete boiler internal inspection which included a detailed graphed illustration of all Ultrasonic Test readings taken. All boiler internal surfaces were meticulously inspected for defects, corrosion and erosion. A comprehensive NB-5 National Board internal inspection report with recommendations was provided.

PROFESSIONAL REFERENCES:

Mr. Barry Latham
QC/Project Manager
McAbee Construction, Inc.
(205) 349-2212

Mr. Mike Burk
Quality Assurance Manager
Schuff Steel – Gulf Coast, Inc.
(713) 884-2429

Mr. Michael Fabre
Project Superintendent / Coordinator
Tiger ST. Croix Construction, Inc.
(225) 505-5932

Mr. Gerald Hubbard
Corporate Quality Manager
Turner Industries Group LLC
(225) 490-7134

Mr. Bob Scribner
President/Owner
Rouly, Inc.
(432) 563-5700

Mr. Dan Noland
QA/QC Manager
Southern Heat Exchanger Corporation
(205) 345-5335

Mr. Scott Bryant
QA/QC Manager
Waddell Mechanical, Inc.
(256) 584-0004

Mr. Josiah B. Collier
Project Coordinator / QAQC
Tiger ST. Croix Construction, Inc.
(225) 241-9239

Mr. Harold Lauve
Quality Assurance Manager
W.W. Industries, Inc.
(713) 896-4391

ATTACHMENT 2

National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2009 Draft Addendum- Cycle B

PLEASE SUBMIT ONLY ONE COMMENT/RECOMMENDATION PER PAGE
Make additional copies as needed

Comments Must be Received No Later Than: June 1, 2009 NB08-0313

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: April 20, 2009

Commenter Name: Francis Brown

Commenter Address: 1075 Crupper Ave.

Columbus,OH

Commenter Phone: 614-888-8320

Commenter Fax: _____

Commenter Email: fbrown@nationalboard.org

Section/Subsection Referenced: Part 3; Sv.6

Comment/Recommendation: *Proposed Solution:* ☐ New Text X☐ Revise Text ☐ Delete Text

The proposed change should be modified to included ASME RTP-1; Insert "or RPT-1" between Section X and criteria. Insert after Section X "or RPT-1" compliance "of the appropriate"

It should read as follows: an Engineer meeting the ASME Section X or RTP-1 criteria for an Engineer certifying ASME Section X or RTP-1 compliance of the appropriate calculations contained in the Fabricator's Design Report.

Source: X☐ Own Experience/Idea ☐ Other Source/Article/Code/Standard

Submit Form To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhough@nationalboard.org

NB Use Only

Commenter No. Issued: PR09-05

Comment No. Issued: 01

Project Committee Referred To: SC on R+A

National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2009 Draft Addendum- Cycle B

PLEASE SUBMIT ONLY ONE COMMENT/RECOMMENDATION PER PAGE
Make additional copies as needed

Comments Must be Received No Later Than: June 1, 2009 NB08-0313

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: April 20, 2009

Commenter Name: Francis Brown

Commenter Address: 1075 Crupper Ave

Columbus, OH

Commenter Phone: 614-888-8320

Commenter Fax: _____

Commenter Email: fbrown@nationaboard.org

Section/Subsection Referenced: Part 3; S 4.16.3

Comment/Recommendation: *Proposed Solution:* ☐ New Text X☐ Revise Text ☐ Delete Text

The proposed change should be modified to included ASME RTP-1; Insert "or RPT-1" between Section X and criteria. Insert after Section X "or RPT-1" compliance "of the appropriate"

It should read as follows: an Engineer meeting the ASME Section X or RTP-1 criteria for an Engineer certifying ASME Section X or RTP-1 compliance of the appropriate calculations contained in the Fabricator's Design Report.

Note: The NBIC applies to ASME RTP-1 also. RTP-1 also requires a PE to certify the design calculations.

Source: X☐ Own Experience/Idea ☐ Other Source/Article/Code/Standard

Submit Form To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhough@nationalboard.org

NB Use Only

Commenter No. Issued: PR09-05

Comment No. Issued: 02

Project Committee Referred To: SC on R+A

(2)

National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2009 Draft Addendum- Cycle B

PLEASE SUBMIT ONLY ONE COMMENT/RECOMMENDATION PER PAGE
Make additional copies as needed

Comments Must be Received No Later Than: June 1, 2009

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: April 20, 2009

Commenter Name: Francis Brown

Commenter Address: 1075 Crupper Ave

Columbus, OH

Commenter Phone: 614-888-8320

Commenter Fax:

Commenter Email: fbrown@nationaboard.org

Section/Subsection Referenced: Part 3, S4.17.3

Comment/Recommendation: *Proposed Solution:* ☐ New Text X☐ Revise Text ☐ Delete Text

The proposed change should be modified to included ASME RTP-1; Insert "or RPT-1" between Section X and criteria. Insert after Section X "or RPT-1" compliance "of the appropriate"

It should read as follows: an Engineer meeting the ASME Section X or RTP-1 criteria for an Engineer certifying ASME Section X or RTP-1 compliance of the appropriate calculations contained in the Fabricator's Design Report.

Note: The NBIC applies to ASME RTP-1 also. RTP-1 also requires a PE to certify the design calculations.

Source: X☐ Own Experience/Idea ☐ Other Source/Article/Code/Standard

Submit Form To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhough@nationalboard.org

NB Use Only

Commenter No. Issued: PRV9-05

Comment No. Issued: 3

Project Committee Referred To: SC on R+A

(3)

NB08-0320

Secretary, NBIC Committee
The National Board of Boiler and
Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, OH 43229

The following addition to the NBIC is proposed;

Add requirements to change the service of pressure vessels in Part 1, Installation, Part 2, Inspection, and Part 3 Repairs and Alterations.

Statement of Need

The Federal Railroad Administration has a proposal out on railcars carrying Poison Inhalation Hazard (PIH) that will require a number of existing tank cars to be retired early. There is a potential that some of these tanks will be recycled into stationary tanks for service other then what they were design for.

Additionally, this practice already occurs in some industries without any consideration for any damage mechanisms that made have been present in the initial service. The NBIC does not currently address these types of events.

Background Information

Part 1 – 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.

NB08-0321

Secretary, NBIC Committee
The National Board of Boiler and
Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, OH 43229

The following addition to the NBIC is proposed;

Add requirements to change the service of pressure vessels in Part 1, Installation, Part 2, Inspection, and Part 3 Repairs and Alterations.

Statement of Need

The Federal Railroad Administration has a proposal out on railcars carrying Poison Inhalation Hazard (PIH) that will require a number of existing tank cars to be retired early. There is a potential that some of these tanks will be recycled into stationary tanks for service other then what they were design for.

Additionally, this practice already occurs in some industries without any consideration for any damage mechanisms that made have been present in the initial service. The NBIC does not currently address these types of events.

Background Information

Part 2 – Add in Paragraph 1.5 Inspection Activities verbiage to address change of service for a pressure vessel. These requirements should caution inspectors, owners, and jurisdictional authorities of the inherent dangers involved when changing service. A new supplement or new Subject under 2.3.6, Description and Concerns of Specific Types of Pressure Vessels, should be added to address the specific requirements for inspection of pressure vessels that have been converted from one service to another.

NB08-0322

Secretary, NBIC Committee
The National Board of Boiler and
Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, OH 43229

The following addition to the NBIC is proposed;

Add requirements to change the service of pressure vessels in Part 1, Installation, Part 2, Inspection, and Part 3 Repairs and Alterations.

Statement of Need

The Federal Railroad Administration has a proposal out on railcars carrying Poison Inhalation Hazard (PIH) that will require a number of existing tank cars to be retired early. There is a potential that some of these tanks will be recycled into stationary tanks for service other then what they were design for.

Additionally, this practice already occurs in some industries without any consideration for any damage mechanisms that made have been present in the initial service. The NBIC does not currently address these types of events.

Background Information

Part 3 - Add a new paragraph to 3.2 General Requirements for Repairs and Alterations to address change of service for a pressure vessel. These requirements should caution inspectors, owners, repair organizations and jurisdictional authorities of the inherent dangers involved when changing service. A new supplement should be added to address the specific requirements for repairs and alterations of pressure vessels that have been converted from one service to another.

NBIC Sub-Group Repairs & Alterations

Subject:	Exclusive use of VT is prohibited as an alternative to pressure testing
NB-Item number:	PR08-0306 ➡ NB item: ***NB08-1301***
Explanation of assignment needed:	See narrative originally provided by Darryl Peetz. Without some exclusive provisions for VT-examination, escalated repair costs and Inspector involvement may be required without any appreciable gain in safety realized. A VT-examination may provide more meaningful results than instituting an initial service leak test; not prohibited by some codes. A VT-examination during welding may be more meaningful than a surface NDE-examination method.
Assigned to:	Mike Webb, Jim Larson, Bob Wielgoszinski
Background:	The "Exclusive use of VT-examination" was not permitted after being brought before the Committee and passed as item NB04-0203. Through the public review process, PR08-0306 was initiated after several comments were received. After review in Sub-group RA, this new item was initiated to review the premise of accepting repairs and / or alterations using only a VT-examination method.

Existing Text in '08-addenda	*Proposed Revision*	Rationale	Notes during discussion
Part 3, **4.4.1 TEST OR EXAMINATION METHODS APPLICABLE TO REPAIRS** Section **4.4.1-e** e) Nondestructive Examination NDE may be conducted. Exclusive use of Visual Examination (VT) shall not be permitted. NDE methods used shall be suitable for providing meaningful results to verify the integrity of the repair.	**Part 3,** **4.4.1 TEST OR EXAMINATION METHODS APPLICABLE TO REPAIRS** Section **4.4.1-e** e) Nondestructive Examination NDE may be conducted when pressure testing is not practicable. NDE methods used shall be suitable for providing meaningful results to verify the integrity of the repair. Exclusive use of Visual Examination (VT) is only permitted with the following considerations: 1. When a pressure test or alternative NDE methods are not practicable, exclusive use of direct Visual Examination (VT) as an NDE method shall be limited to routine repairs, as identified in 3.3.2. 2. For each repair being considered, the exclusive use of direct VT as an NDE method shall be acceptable to the Inspector, and where required, the Jurisdiction. 3. As a minimum, VT-examination shall be performed after the root weld layer or first-pass is deposited, and	The proposed revision offers some guidance currently found in ASME B31.1. As proposed (e-3), VT-examination at the 1st layer & final weld surface represents 100% more examination than required by original Code in lieu of the pressure test. Some boiler designs do not lend themselves to pressure tests (e.g. Reheat Superheater). Availability of NDE-contractors enlisting alternative volumetric examination methods is at times uncertain leaving no alternative in complying with the NBIC. Other NDE methods recognized by the NBIC represent enhanced VT using dye penetrant or fluorescent magnetic particle and are surface or slightly subsurface NDE-methods. PT/MT NDE methods may not represent meaningful results due to limited access or other influences negating their use such as flammability of sprays and solvents in a confined space. (Example: Steam drum liner attachment weld to a Superheat outlet tube stub in a CE-designed Controlled Circulation boiler. Very limited room and can not verify tightness with a pressure test) VT-examination by a certified individual (e.g. QC-1-CWI) with established	Repairs in some areas of the country are greatly influenced by quick returns to service in order to protect equipment from freezing. This alternative to pressure testing better protects the owner, equipment, and reduces safety risk by mitigating freezing situations. 4.2 - a) identifies the acceptance criteria shall be in accordance with the original code of construction.

Also.... Part 3 **4.4.2 TEST OR EXAMINATION METHODS APPLICABLE TO ALTERATIONS** Section **4.4.2-c** c) Nondestructive Examination Nondestructive examination (NDE) may be conducted when contamination of the pressure retaining item by liquids is possible or when pressure testing is not practicable. Concurrence of the owner shall be obtained in addition to the Inspector and jurisdiction, where required. Exclusive use of Visual Examination (VT) shall not be permitted. In all cases NDE methods or combination of methods used shall be suitable for providing meaningful results to verify the integrity of the alteration.	the final weld surface. Other weld layers shall be examined as identified by the Inspector and, where required, the jurisdiction. 4. Personnel completing direct VT-examinations shall be qualified and certified in accordance with paragraph 4.2- b), AWS QC-1, or any nationally recognized standard. Visual acuity shall be demonstrated using as a minimum, standard J-2 letters on standard Jaeger test type charts for near vision. 5. VT-examination shall be performed in accordance with a written procedure meeting the procedure and reporting requirements listed in the original code of construction or ASME Section V, Article 9. Part 3 **4.4.2 TEST OR EXAMINATION METHODS APPLICABLE TO ALTERATIONS** Section **4.4.2-c** c) Nondestructive Examination Nondestructive examination (NDE) may be conducted when contamination of the pressure retaining item by liquids is possible or when pressure testing is not practicable. Concurrence of the owner shall be obtained in addition to the Inspector, and where required, the Jurisdiction. Exclusive use of Visual Examination (VT) shall not be permitted. In all cases NDE methods or combination of methods used shall be suitable for providing meaningful results to verify the integrity of the alteration.	acceptance criteria and a procedure w/reporting requirements represents in-process controls suggested by other NDE-methods while affording an alternative to high cost / limited availability NDE personnel. The QC-1 type person is certified by an in-house program & described in the quality manual. Qualification of NDE-personnel per 4.2 (b) in accordance with requirements of the original code of construction may follow ASME Section V, article 9 that in turn references article I & allows ASNT-TC-1A or ASNT CP-189. VT-examination per Section V @ Article 9 identifies near distance acuity to reading standard J-1 letters on standard Jaeger-test charts for near vision. This exceeds requirements of ASNT TC 1A, CP-189, and AWS QC-1 requirements that identify using J-2 letters on standard Jaeger-test charts for near vision. **Identifying "standard J-2 letters" within the paragraph, establishes uniformity between the referenced standards.** Reference to "direct" visual examination displaces the use of binoculars, etc. in completing the proposed examinations. Part 3 Section **4.4.2-c** "... and where required, the Jurisdiction." Is proposed only for consistency throughout Part 3 and the other Sections.	**@ Proposed 4-** The current reference to ASNT-TC-1A & ASNT CP-189 @ 4.2-b) for qualifying NDE-personnel, could be confusing when referenced to an "original code of construction" such as ASME Section V, Article 9 which identifies near distance acuity to standard J-1 letters on standard Jaeger test-type charts. Additionally, the reference @ 4.2-b) to "qualified and certified" personnel does not currently extend to AWS QC-1 or another nationally recognized standard. Therefore the "qualified & certified" -statement is added to 4.4.1 –e) 4. to clarify the requirement. By identifying the standard J-2 letters, the referenced Section V-Code and standards are aligned. **@ Proposed 5-** The proposed language is to say, the written procedure & reporting is to meet the listed requirements, "like" those identified in ASME Section V, Article 9. ASME Section V, Article 9 would serve as a framework to develop an NDT-procedure with reporting requirements. The reference to, "original code of construction" is already extended to represent as applicable, the construction standard used to fabricate the pressure retaining item @ 3.2.1. To add a reference to construction "standard" would be redundant to this noted understanding.

9 of 12

NB09-0901

March 26, 2009

LETTER BALLOT for Graphite Subgroup #2

Subj:Revision of S3.3.6

Explanation: "Connected repairs" are not defined and the sentence is therefore confusing.

PM: Ed Soltow

Background:

Existing Text:

6) Surface Repair — surface repair by installation of plugs or inlay material shall not exceed 1 cu. in. (16 cu. cm) of total volume. Connected repairs are not to be considered routine.

Proposed Revision:

6) Surface Repair — surface repair by installation of plugs or inlay material shall not exceed 1 cu. in. (16 cu. cm) of total volume. ~~Connected repairs are not to be considered routine.~~

Rationale: The revision is needed to clarify the meaning of the Code.

Notes during discussion: None

LETTER BALLOT #3

Subj: Replacing the word acetone in Supplement 3

Explanation: The proposal is to replace the requirement for cleaning parts with acetone, a toxic substance, to the generic "hydrophilic solvent".

PM: Ed Soltow

Background: There are several places in Supplement 3 where "acetone" is used to clean graphite parts or to locate cracks. Acetone is toxic. A hydrophilic solvent (acetone is one) is generic in nature but has the desired property of acetone.

Existing Text: See the attachments.

Proposed Revision: The revision is shown as a strikethrough with the replacement shown in a text box.

Rationale:

Notes during discussion:

dure, and the economics of repair versus replacement.

c) Impervious graphite is a machinable material. Parts can be modified or repaired in the field, or in a repair shop.

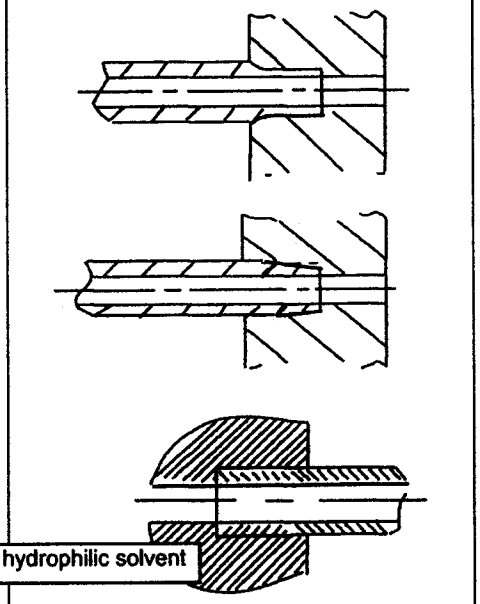
d) Machining operations may be handled with high-speed steel tools. Extensive machining requires tungsten carbide or diamond tooling. No cooling or flushing fluid is required, nor should either be used.

e) Cleanliness is important. Dusty, dirty, and chemically contaminated surfaces prevent proper cement adhesion. Poor cement adhesion will result in a low strength joint or a joint which leaks. All surfaces should be neutralized to a pH of 7. Graphite parts should be cleaned and washed with ~~acetone~~ a hydrophilic solvent to remove all moisture.

f) All damage should be examined and evaluated to determine the cause. Identification and elimination of the cause is essential in helping to prevent a recurrence.

g) ~~An acetone~~ A hydrophilic solvent wash on the surface of the damaged part is useful in identifying the full extent of the cracks. The ~~acetone~~ hydrophilic solvent will quickly evaporate from the surface, leaving the cracks damp and clearly visible.

FIGURE S3.5.1-a
Typical Tube-Tubesheet Joints



S3.5.2 TYPICAL GRAPHITE FRACTURES

S3.5.2.1 MAJOR FRACTURE

An extensive fracture, such as shown in Figure S3.5.2.1, is best repaired by completing the break and re-cementing the two pieces. Temporary steel banding around the circumference is a method of clamping the repair until the cement is cured.

S3.5.2.2 INTERMEDIATE FRACTURE

The break is too minor to warrant completing the fracture. A pie-shaped cut may be made and the segment re-cemented in place. (See Figure S3.5.2.2).

S3.5.2.3 MINOR FRACTURE

For minor fractures, such as those shown in Figure S3.5.2.3, plug stitching can be used. The crack is removed by drilling and plugging a continuous chain of overlapping holes along the length and depth of fracture.

2/4

(11)

S3.5.3 GRAPHITE REPAIR BY PLUG STITCHING (SEE FIGURE S3.5.3)

a) Plug stitching is a form of repair by material inlaying. In this case, the inlays are small cylindrical impervious graphite plugs. The crack or fracture is removed by drilling and plugging a continuous series of overlapping holes along its length and depth.

b) Most plug stitching is done with 7/8 in. (22 mm) diameter plugs. The plugs are laid out along the fracture line on a pitch of 5/8 in. (16 mm) centers. The overlap of plug material is 1/4 in. (6 mm) along the fracture line. A number of plug sizes are available and are used in repair, and the amount of overlapping is proportional to their diameters.

S3.5.3.1 PLUG STITCHING PROCEDURE (SEE FIGURE S3.5.3)

The following procedure is defined for 7/8 in. (22 mm) diameter plugs (an undersized plug will allow the use of common size tooling). Dimensions for other size plugs shall be adjusted proportionally to the diameter.

a) Trace the line of fracture with ~~acetone~~ a hydrophilic solvent and mark its length and direction.

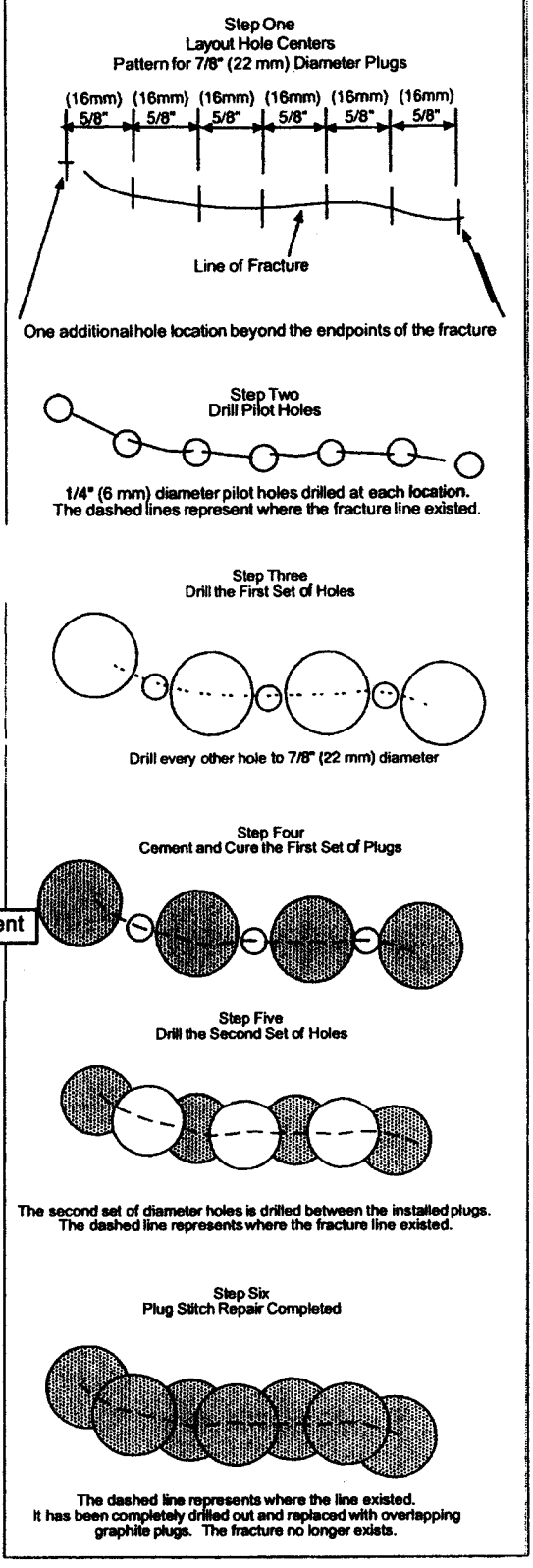
b) Beyond the end points of the fracture (crack), one additional plug shall be installed.

c) Starting 5/8 in. (16 mm) beyond the end point of the crack, mark drilling centers every 5/8 in. (16 mm) along its length. Make sure there is a plug to be installed outside both end points of the line of fracture.

d) Drill a 1/4 in. (6 mm) pilot hole at each location.

e) Redrill a 7/8 in. *(22 mm)* hole at every other pilot hole. Holes must be drilled the full depth of the crack. The depth and direction of the crack can be checked with ~~acetone~~. a hydrophilic solvent

FIGURE S3.5.3



3/4

(12)

f) A 7/8 in. (22 mm) diameter reamer may be used to true the drilled holes.

g) Dry fit a plug into the holes. There should be 0.005 in. to 0.010 in. (.13 mm to .25 mm) clearance for the cement joint. At no time should there be a force fit of plugs into any drilled hole. Provisions shall be provided for venting trapped air.

h) Sand the outside surface of the plugs. Thoroughly clean all the surfaces of the repair, plugs, and drilled holes with ~~acetone~~. a hydrophilic solvent

i) Apply graphite cement to both plugs and holes. All surfaces of plugs and holes to be joined are to be wetted with cement.

j) Insert the cemented plugs into the holes allowing 1/16 in. (1.5 mm) of the plug to extend beyond the surface of the graphite part.

k) Cure the graphite cement according to the cement Manufacturer's instruction.

l) At this point, half of the plug stitch repair is completed. A row of plugs has been installed with 1/4 in. (6 mm) pilot holes between them.

m) Redrill the remaining pilot holes to 718 in. (22 mm) diameter. The drill will remove part of the plugs that were installed. It is important to have the plugs replace all of the fracture. If the new holes do not cut into the installed plugs, it will be necessary to repeat the procedure between these holes and plug locations to ensure that all of the crack has been repaired. The line of fracture is completely removed by the overlapping effect of the graphite plugs.

n) After the second set of holes have been drilled, repeat the plug cementing procedures.

o) Contour the plugs to provide a smooth transition into the adjoining surface area. The finished repair may be coated with a wash coat for appearance.

S3.5.3.2 FIGURES TYPICAL PLUG STITCHING PROCEDURE SEE FIGURE S3.5.3

a) Step one: Layout hole centers.

b) Step two: Drilling pilot holes.

c) Step three: Drilling the first set of holes.

d) Step four: Cementing and curing the first set of plugs.

e) Step five: Drilling the second set of holes.

f) Step six: Plug stitching repair completed.

S3.5.4 RE-IMPREGNATION OF GRAPHITE PARTS (TUBESHEETS, HEADS, AND BLOCKS)

a) As a function of time, temperature, and chemical exposure, the resin used to impregnate graphite may shrink and/or degrade. As such, it is possible for voids to develop in impregnated graphite that has been in chemical service for a period of time. The resin loss can vary from slight to almost complete loss of impregnation. There is no practical way to determine the amount of resin remaining in the pores. However, a pressure test will determine if the graphite has continuous porosity. **A08**

b) Re-impregnation of a graphite component may be used to reduce porosity in an existing graphite component, which in turn will improve the performance and expected life of the existing graphite components. A written re-impregnation procedure acceptable to the Inspector is required. The re-impregnation procedure shall include as a minimum:

1) Decontamination and drying of the graphite component

2) Subjecting the component to a vacuum

4/4

(13)

b) If the line identifying Minimum Required Relieving Capacity is represented on the nameplate and the scope of work does not affect the Minimum Required Relieving Capacity, the line shall be "X'd" to represent "no change".

c) Minimum Required Relieving Capacity may be abbreviated to M.R.C.C.

NB08-1601
S1.1.3.1

Application	**Specification**
Boiler Tubes & Flues, Arch Tubes Superheater Units	SA-178 Grade A, SA-192, SA-210
Boiler & Firebox Plate, Pressure Retaining Plate	SA-285 Grade C, SA-515, SA-516, SA-203, SA-204
Welded Staybolts	SA-675, SA-36, ~~ASTM A-31~~ SA-31 Grade B
Threaded Staybolts	SA-31 Grade A SA-675 with a tensile strength of 47,000 psi to 65,000 psi inclusive
Staybolt Sleeves and Caps	SA-105 Forging, SA-675
Boiler Braces	SA-675, SA-36
Rivets	SA-675, SA-31
Forged Parts & Fittings	SA-105, SA-181
Pressure-Retaining Steel Castings	SA-216, A-217
Hollow Cylindrical Pressure-Retaining Parts	SA-105 Forgings, SA-675 Bar Stock
Superheater Unit Bolts & Nuts	Bolts - SA-193, Nuts - SA-194
Pipe Flanges	SA-181, SA-105
Pipe	SA-106, SA-53 Seamless
Bronze Castings & Washout Plugs	SB-61, SB-62, SB-148

d) When staybolt material tensile strength is stronger than that of the firebox sheets, the firebox sheets

1/1

g) The factor of safety of all riveted patches shall not be less than four for locomotives operating under Federal Railroad Administration regulations.

S1.2.11 REPAIRS AND ALTERATIONS TO BOILER BARREL STAYED AREA

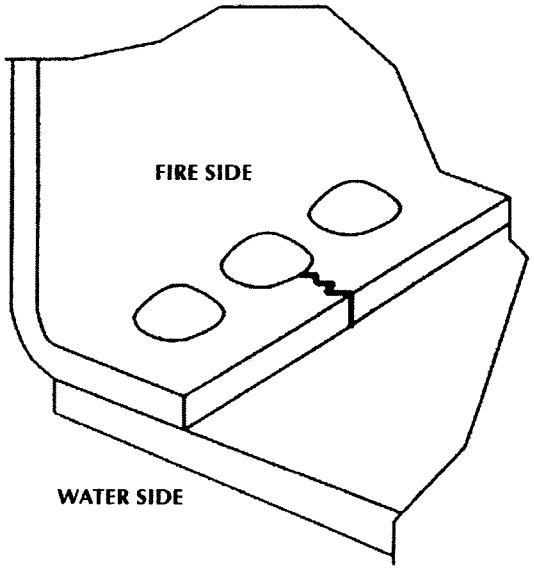
S1.2.11.1 FIREBOX SHEET REPAIR

a) Cracks in all stayed firebox sheets may be repaired by welding or the installation of a flush patch.

b) If the crack extends into a staybolt or rivet hole, the staybolt or rivet shall be removed prior to making the repair.

A07 c) Fire cracks or thermal fatigue cracks in riveted seams located in the firebox that run from the edge of the plate into the rivet holes may be left in place provided they do not leak and there is no indication that
A08 the seam or rivets are loose. (See Figure S1.2.11.1).

A08 **FIGURE S1.2.11.1**
Example of Thermal Fire Crack

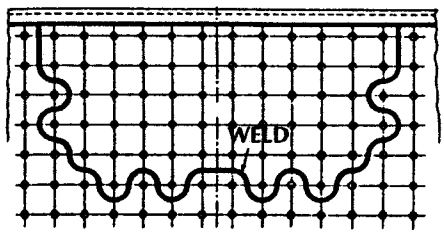


S1.2.11.2 FIREBOX PATCHES

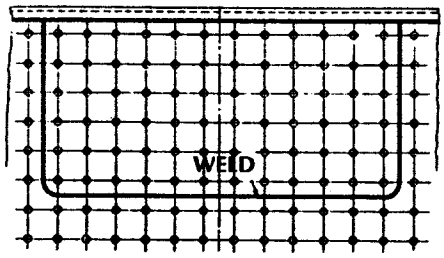
a) Patches may be any shape provided they are adequately supported by staybolts, rivets, tubes, or other forms of construction. Patches on stayed surfaces should be designed so weld seams pass between staybolt rows. (See Figure S1.2.11.2).

b) Patches are to be flush type, using full penetration welds. If the load on the patch is carried by

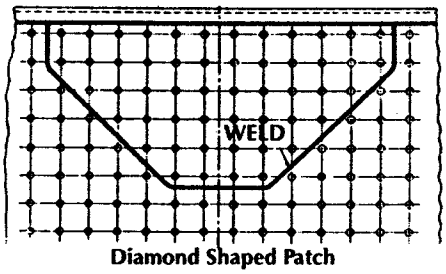
FIGURE S1.2.11.2
Typical Firebox Patches
This figure illustrates what would be considered a saw-tooth patch. Its advantage is that a maximum amount of welding is obtained for securing a given patch and by zig-zagging the weld, the weld is supported by three rows of staybolts instead of two. Its disadvantage is its irregular shape which causes greater difficulty in fitting and applying.



Saw-Tooth Patch



Rectangular Shaped Patch



Diamond Shaped Patch

b) Any patch not supported by means other than the weld, such as rivets, staybolts, tubes, or other forms of construction, shall have all weld seams radiographically examined.

c) Patches shall be formed to proper shape and curvature.

d) Wasted sections of knuckles that have not wasted below 60% of the minimum required thickness may be repaired by weld buildup provided the strength of the structure will not be impaired. Where weld buildup is employed, the Inspector may require an appropriate method of NDE for the repair.

e) Wasted sections of knuckles that have wasted below 60% of the minimum required thickness shall be replaced.

S1.2.11.6 TUBESHEET REPAIRS (SEE FIGURE S1.2.11.6)

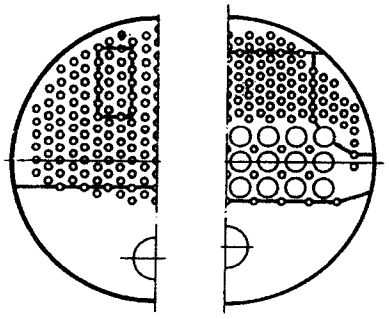
a) Cracked tubesheet ligaments may be repaired by welding using full penetration welds.

b) Damaged tubesheet holes may be repaired by welding.

c) Sections of tubesheets damaged or wasted to less than 60% minimum required thickness shall be repaired by installing a flush patch using full penetration welds.

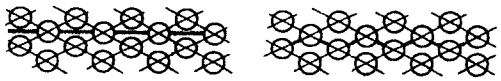
d) Sections of tubesheets that have not wasted below 60% minimum required thickness may be repaired by weld buildup provided the strength of the structure will not be impaired. Where weld buildup is employed, the Inspector may require an appropriate method of NDE for the repair.

FIGURE S1.2.11.6
Tubesheet Repairs



typical tubesheet flush patches

tubesheet welded around tube holes



tubesheet welded through ligaments and tube holes

S1.2.12 SEAMS AND JOINTS

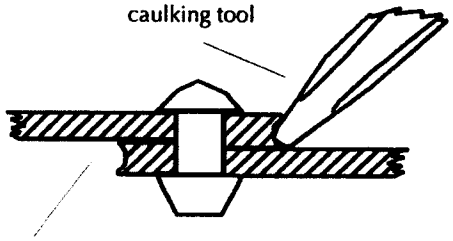
S1.2.12.1 CAULKING RIVETED SEAMS AND RIVET HEADS (SEE FIGURE S1.2.12.1)

a) Caulking refers to the sealing of plate seams and rivet heads by driving the edge of one surface onto the other by use of an impact tool.

b) Riveted seams and rivet heads may be caulked in accordance with ASME Code Section I, 1971.[14]

14 This Code is available from the National Board.

FIGURE S1.2.12.1



ATTACHMENT 3

IN9-0201

A Fluor Daniel Partnership

June 2, 2009

Secretary, NBIC Committee
National Board of Boiler and Pressure Vessel Inspectors
1055 Crupper Ave.
Columbus, Ohio 43229

SUBJECT: CODE INTERPRETATION Part 3, Section 4.5.2 – "Owner-User ASME Code Section VIII Steam Testing"

BACKGROUND INFORMATION:

The Savannah River Site (SRS) is a 310 square mile Department of Energy (DOE) site located in the south eastern coastal area of the United States in the state of South Carolina. The SRS consists of multiple facilities that have a combined total of approximately 2500 pressure vessels and 5000 pressure relief valves (PRVs). DOE recently awarded the operation of the SRS to two different contractors, Savannah River Nuclear Solutions (SRNS) and Savannah River Remediation (SRR).

SRNS and SSR are technically and operationally linked to ensure all aspects of design, fabrication, examination, testing, and maintenance are applied uniformly to the structures, systems, and components of both companies. SRNS and SSR share a joint standards board and joint technical committees that maintain a consistent operational relation between the two companies. In addition to the application of the same National Codes and Standards, the two companies also share the same company standards and guides that are developed and maintained by the joint committees. The company standards and guides impose additional requirements that further strengthen the technical and operational relationship between the two companies.

One of the joint committees requires that the PRVs for both SRNS and SRR are maintained, repaired, and tested in accordance with NB-23 by a certified valve shop. SRNS has a VR certified valve shop and SRR does not. The SRNS VR valve shop exclusively services SRS PRVs and no others.

QUESTION:

Two different companies operating at the same site maintain a consistent technical and operational relationship. One of the companies has a certified VR valve shop and the other does not. Is it permissible to include the PRVs from the company that does not have the VR certified valve shop in the scope of the VR Manual so that the owner-user exception in para. 4.5.2 may be applied to the PRVs from the company without the VR certified valve shop?

NB-23-2007 PART 3 – REPAIRS AND ALTERATIONS
Section 4.5.2 – "Owner-User ASME Code Section VIII Steam Testing"

When ASME Code Section VIII valves are repaired by the owner for the owner's own use, valves for steam service may be tested on air for set pressure and, if possible, blowdown adjustment provided the valve manufacturer's corrections for differential in set pressure between steam and air are applied to the set pressure.

PROPOSED REPLY:

Yes provided the technical and operational relationship between the two companies is documented in the VR Manual, and the monitoring and maintenance of the PRVs from both companies is consistent to the extent that the company with the VR valve shop has the same access to the PRVs from the company without the VR shop. Deviations from the relationship documented in the VR Manual are not permitted and will invalidate extension of the owner-user exception granted in para. 4.5.2 to the company that does not have the VR certified valve shop.

Thank you for your assistance.

S. Tyler French
Savannah River Nuclear Solutions
Principal Technical Advisor
Building 730-1B, Rm 2130
Aiken, SC 29808
803.952.9111

PROPOSED INTERPRETATION

Inquiry No.	IN9-0201				
Source	Tyler French				
Subject	Part 3, 4.5.2				
Edition	2007 Edition				
Question	Two different companies operating at the same site maintain a consistent technical and operational relationship. One of the companies has a certified VR valve shop and the other does not. Is it permissible to include the PRVs from the company that does not have the VR certified valve shop in the scope of the VR manual so that the owner-user exception in paragraph 4.5.2 may be applied to the PRVs from the company without the VR certified valve shop?				
Reply	Yes, provided the technical and operational relationship between the two companies is documented in the VR manual, and the monitoring and maintenance of the PRVs from both companies is consistent to the extent that the company with the VR valve shop has the same access to the PRVs from the company without the VR shop. Deviations from the relationship documented in the VR manual are not permitted and will invalidate extension of the owner-user exception granted in paragraph 4.5.2 to the company that does not have the VR certified valve shop.				
Committee's Question					
Committee's Reply					
Rationale					
SC Vote	Unanimous	No. Affirmative	No. Negative	No. Abstain	No. Not Voting
NBIC Vote	Unanimous	No. Affirmative	No. Negative	No. Abstain	No. Not Voting
Negative Vote Comments					

COMMITTEE: National Board Inspection Code
Subcommittee on Pressure Relief Devices

ADDRESS WRITER CARE OF:
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To: Marianne Brodeur (TG Chair)
Kevin Simmons
Thakor Patel
Brandon Nutter
Ray McCaffery
Alton Cox
Ali Syed
Joe Ball SC-PRD Secretary
Frank Hart, SC-PRD Chairman

January, ~~22~~ 21nd, 2009

Subject: NB06-0101, Source of Specification for replacement parts

EXISTING Part 3, S7.5 a)

(a) All Critical parts shall be fabricated by the Valve manufacturer or to the Manufacturer's specifications.

Critical parts are those that may affect the Valve flow passage, capacity function, or Pressure retaining integrity.

(b) All critical parts not fabricated by the valve Manufacturer shall be supplied with material test certification for the material used to fabricate the part.

(c) Replacement critical parts receiving records Shall be attached or be traceable to the valve Repair document.(See S7.3(a)). These records Shall conform to at least one of the following.

PROPOSED REVISION TO Part 3, S7.5, a)

All replacement critical parts shall be fabricated by the original valve manufacturer under its current ASME Quality System or to specifications provided by the original valve manufacturer. The specifications shall include all technical data required to produce the part.

The replacement critical part fabricator other than the original valve manufacturer shall have and provide evidence of:

a. An industry recognized Quality System equivalent to ASME
b. The applicable revision of the technical data from the original Valve Manufacturer to produce the specific part.

These requirements do not apply to parts and components that are normally purchased by the manufacturer from an outside vendor and are considered hardware items built to existing industry standards or specifications, Provided the parts comply with the original valve manufacturer's material and design requirements.

(4)

Archived Comments for Ballot: NB06-0101-SC PRD

DeMichael,Denis
3/8/2009 6:26:44 PM
I am withdrawing my negative. Although I believe there is a better descriptive term for "hardware," that change can be made at a later date if it proves to be probelmatic.

McCaffrey,Raymond
3/5/2009 4:07:51 PM
After further review, I would like to change my vote to diaapproved. I have to agree with Alton Cox that the existing code has been fine for many years. Since the fact of reverse engineering is no loner on the table, I feel to leave the present wording in place is satisfactory.

Hart,Frank
3/2/2009 4:28:12 PM
After considering the number of negatives, this item needs to come back to SC-PRD for additional work

Cox,Alton
3/2/2009 10:11:06 AM
Item 06-0101: Part 3, S7.5 (b), I voted negative because the current words have served the industry satisfactorily for many years and in my opinion are sufficient. The addition of the requirements proposed are unduly restrictive and serve no purpose in providing any benefit to public safety.

DeMichael,Denis
2/27/2009 8:29:30 PM
The last paragraph needs additional refinement. I believe the phrase "considered hardware items" is not sufficiently clear. It would seem the intent of the last paragraph is to allow the repair organization to obtain any commonly available industrial item that that the Manufacturer purchases and uses is provided the last sentence is complied with. I would think those items would include o-rings and non proprietary gaskets. It doesn't appear the term "hardware" describes those items.

Cammeresi,Sid
2/27/2009 12:01:40 PM
The existing Code has been sufficient for many, many years without any reported failures that have affected public safety. I agree with Frank Hart, the use of words "provided by" should be eliminated. They should be replaced by the word "of". A valid reason to restrict parts replacement options to repairers has not been demonstrated.

Cammeresi,Sid
2/27/2009 11:55:57 AM

The existing Code has been sufficient for many, many years without any reported failures that have affected public safety. Therefore, a need to restrict parts replacement options to repairers has not been demonstrated.

Patel,Thakor
2/5/2009 12:58:39 PM
This proposal adds the Quality Conrol requirements to make replacement parts by original valve manufacturer and others which was not there in NBIC.

Hart,Frank
1/30/2009 11:36:18 AM
I do not believe the word "provided" should be in the firt paragraph (Part3, S7.5a), It gives the appearance of requiring permission.

between a pressure relief valve and the pressure vessel, the reduction in capacity due to installation of the non-reclosing device shall be determined in accordance with the code of construction by use of a National Board certified Combination Capacity Factor (CCF). For rupture disks, if a certified combination capacity factor is not available, the capacity of the pressure relief valve shall be multiplied by 0.9 and this value used as the capacity of the combination installation.

f) The owner shall document the basis for selection of the pressure relief devices used, including capacity, and have such calculations available for review by the Jurisdiction.

4.5.5 SET PRESSURE

a) When a single pressure relief device is used, the set pressure marked on the device shall not exceed the maximum allowable working pressure.

b) When more than one pressure relief device is provided to obtain the required capacity, only one pressure relief device set pressure needs to be at the maximum allowable working pressure. The set pressures of the additional pressure relief devices shall be such that the pressure cannot exceed the overpressure permitted by the code of construction.

4.5.6 INSTALLATION AND DISCHARGE PIPING REQUIREMENTS

a) The opening through all pipe and fittings between a pressure vessel and its pressure relief device shall have at least the area of the pressure relief device inlet. The characteristics of this upstream system shall be such that the pressure drop will not reduce the relieving capacity below that required or adversely affect the proper operation of the pressure relief device.

b) A non-reclosing device installed between a pressure vessel and a pressure relief valve shall meet the requirements of 4.5.6(a).

c) The opening in the pressure vessel wall shall be designed to provide unobstructed flow between the vessel and its pressure relief device.

d) When two or more required pressure relief devices are placed on one connection, the inlet cross-sectional area of this connection shall be sized either to avoid restricting flow to the pressure relief devices or made at least equal to the combined inlet areas of the pressure relief devices connected to it. The flow characteristics of the upstream system shall satisfy the requirements of 4.5.6(a).

e) There shall be no intervening stop valves between the vessel and its pressure relief device(s), or between the pressure relief device(s) and the point of discharge except under the following conditions:

1) When these stop valves are so constructed or positively controlled that the closing of the maximum number of block valves at one time will not reduce the pressure relieving capacity below the required relieving capacity; or,

2) Upon specific acceptance of the Jurisdiction, when necessary for the continuous operation of processing equipment of such a complex nature that shutdown of any part is not feasible, a full area stop valve between a pressure vessel and its pressure relief device should be provided for inspection and repair purposes only. This stop valve shall be arranged so that it can

Add to 4.5.6 a)

When a discharge pipe is used, the size shall be such that any pressure that may exist or develop will not reduce the pressure relief device capacity, and it shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.

(7)

1/4

1) When these stop valves are so constructed or positively controlled that the closing of the maximum number of block valves at one time will not reduce the pressure relieving capacity below the required relieving capacity; or,

2) Upon specific acceptance of the Jurisdiction, when necessary for the continuous operation of processing equipment of such a complex nature that shutdown of any part is not feasible, a full area stop valve between a piping system and its pressure relief device should be provided for inspection and repair purposes only. This stop valve shall be arranged so that it can be locked or sealed open and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station.

3) A full area stop valve may be placed on the discharge side of a pressure relief device when its discharge is connected to a common header for pressure relief devices to prevent discharges from these other devices from flowing back to the first device during inspection and repair. This stop valve shall be arranged so that it can be locked or sealed open, and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station. This valve shall only be used when a stop valve on the inlet side of the pressure relief device is first closed.

4) A piping system where the pressure originates from an outside source should have a stop valve between the system and the pressure relief device, and this valve need not be sealed open, provided it also closes off that vessel from the source of pressure.

f) Pressure relief device discharges shall be arranged such that they are not a hazard to personnel or other equipment and when necessary, lead to a safe location for disposal of fluids being relieved.

g) Discharge lines from pressure relief devices shall be designed to facilitate drainage or be fitted with drains to prevent liquid from collecting in the discharge side of a pressure relief device. The size of discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the pressure relief device, or adversely affect the operation of the pressure relief device.

h) Pressure relief devices shall be installed so they are accessible for inspection, repair, or replacement.

5.4 EXAMINATION, INSPECTION, AND TESTING

The owner shall ensure that all examinations, inspections, and tests required by the code of construction have been performed prior to operation.

Add to 5.3.6 g)

It shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.

(8)

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INFORMATION ONLY

(6 mm). If safety or safety relief valves are attached to a separate steam drum or dome, the opening between the boiler proper and the steam drum or dome shall be not less than 10 times the total area of the safety valve inlet.

b) Every safety or safety relief valve shall be connected so as to stand in an upright position with spindle vertical.

c) The opening or connection between the boiler and the safety or safety relief valve shall have at least the area of the valve inlet. No valve of any description should be placed between the safety or safety relief valves and the boiler, nor on the discharge pipe between the safety or safety relief valves and the atmosphere. When a discharge pipe is used, the cross-sectional area shall not be less than the full area of the valve outlet or of the total of the areas of the valve outlets, discharging thereinto and shall be as short and straight as possible and arranged to avoid undue stresses on the valve or valves.

d) When two or more safety valves are used on a boiler, they should be mounted either separately or as twin valves made by placing individual valves on Y-bases, or duplex valves having two valves in the same body casing. Twin valves made by placing individual valves on Y-bases or duplex valves having two valves in the same body shall be of equal size.

e) When two valves of different sizes are mounted singly, the relieving capacity of the smaller valve shall not be less than 50% of that of the larger valve.

f) When a boiler is fitted with two or more safety relief valves on one connection, this connection to the boiler shall have a cross-sectional area not less than the combined areas of inlet connections of all the safety relief valves with which it connects.

g) All safety or safety relief valves shall be piped to a safe point of discharge so located or piped as to be carried clear from running boards or platforms. Ample provision for gravity drain shall be made in the discharge pipe at or near each safety or safety relief valve, and where water or condensation may collect. Each valve shall have an open gravity drain through the casing below the level of the valve seat. For iron- and steel-bodied valves exceeding NPS 2 (DN 50), the drain hole shall be tapped not less than NPS 3/8 (DN 10).

h) Discharge piping from safety relief valves on high temperature water boilers shall have adequate provisions for water drainage as well as steam venting.

i) If a muffler is used on a safety or safety relief valve, it shall have sufficient outlet area to prevent back pressure from interfering with the proper operation and discharge capacity of the valve. The muffler plates or other devices shall be so constructed as to avoid a possibility of restriction of the steam passages due to deposits. Mufflers shall not be used on high temperature water boiler safety relief valves.

2.10 TESTING AND ACCEPTANCE

2.10.1 GENERAL

a) Care shall be exercised during installation to prevent loose weld material, welding rods, small tools, and miscellaneous scrap metal from getting into the boiler. Where possible, an inspection of the interior of the boiler and its appurtenances shall be made for the presence of foreign debris prior to making the final closure.

b) Safe operation should be verified by a person familiar with boiler system operations for all boilers and connected appurtenances and all pressure piping connecting them to the appurtenances and all piping up to and A07

(9)

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Archived Comments for Ballot: NB07-1206-SC PRD

Cox,Alton
3/2/2009 10:15:38 AM
I agree with Mr. DeMichael's comments. I agree in principle with the revision, but there should be clarification as to the "flow rated capacity" versus the "required capacity".

DeMichael,Denis
2/27/2009 7:49:24 PM
One could interpret the phrase "device capacity" in 4.5.6a, as the pressure relief valve's "rated capacity." There are pressure relief valves that are designed for high backpressure applications which perform satisfactory with a reduced rated capacity but at a capacity greater than what is required for the application. I suggest wording similar to what is used for the inlet. Specifically, "... will not reduce the relieving capacity below that required or adversely affect the proper operation of the pressure relief device."

NB07-1301

COMMITTEE: National Board Inspection Code
Subgroup Pressure Relief Devices

TO: Denis DeMichael, DuPont
Thakor Patel, Farris
Kevin Simmons, Tyco
Kevin Fitzsimmons, Cater Chambers
Joe Ball, SG-PRD Secretary
Frank Hart, SG-PRD Chairman

ADDRESS WRITER CARE OF:
Industrial Valve Sales & Service, Inc.
P.O. Box 1468
Mobile, AL 36633-1468
Phone: (251)675-5282
Fax: (251)679-5018
E-mail: acox@indvalve.com

DATE: January 13, 2008

SUBJECT: New Business NB07- 1301 – QC System for Replacement Critical Parts

BACKGROUND / RATIONALE: This item is intended to address discussions regarding replacement critical part fabrication by the Original PRV Manufacturer. A "VR" Certificate Holder's Quality System must include a method of determining that parts received from the Original PRV Manufacturer meet the Original PRV Manufacturer's specifications. Consider the following:

1) A provision should be added to require OEMs to provide Replacement Critical Parts equivalent to a ASME Program Parts.

2) Parts Identification – Allows VR Holder to identify part for appropriate repair instructions:
   1) OEM Parts marking is a new concept. TG needs to consider.
      a. Manufacturer's identification symbol
      b. Manufacturer's Part Number
      c. Material Marking – Type and Traceability
         i. May be coded
      d. Hydrostatic Testing Mark (where applicable)

OEM must hold current ASME Certification for the PRV Design in order to furnish Replacement Critical Parts. Otherwise, how does VR Holder know parts meet the requirements of the OEM ASME accepted program?

If the OEM does not hold current ASME Certification, the OEM must furnish a C of C with the part(s) and MTRs, etc.

NOTE: RA-2255, i. *Repair and Inspection Program* (Second Sentence)
Repair procedures shall require verification that the critical parts meet the valve manufacturer's specification.

I have included a proposed revision to RE-1050 for your consideration.

Thank you for your consideration of this matter. I look forward to discussing this item.

Best Regards,

J. Alton Cox

1/2

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PART 3.57.5

EXISTING ~~RE-1050~~

~~RE-1950~~

~~All~~ Critical parts shall be fabricated by the valve manufacturer or to ~~his~~ the manufacturers specifications. Critical parts are those that may affect the valve flow passage, capacity function, or pressure-retaining integrity.

All critical parts not fabricated by the valve manufacturer shall be supplied with material test certification for the material used to fabricate the part.

Replacement critical parts receiving records shall be attached or be traceable to the valve repair document (see RA-2255 (i)). These records shall conform to at least one of the following.

a. Receiving records documenting the shipping origin of the part fabricated by the valve manufacturer (such as packing list) from the valve manufacturer or assembler of the valve type.

b. A document prepared by the "VR" Certificate holder certifying that the replacement part used in the repair has the manufacturer's identification on the part or is otherwise labeled or tagged by the manufacturer and meets the manufacturer's acceptance criteria (e.g. critical dimensions found in maintenance manual).

c. Receiving records for replacement critical parts obtained from a source other than the valve manufacturer or assembler of the valve type shall include a certificate of compliance that provides as a minimum:
   1. The part manufacturer and part designation.
   2. A certifying statement that either:
      a. The part was fabricated by the valve manufacturer and meets the manufacturer's acceptance criteria (e.g. critical dimensions found in maintenance manual), or
      b. The part meets the manufacturer's specifications and was fabricated from material as identified by the attached material test report
   3. The signature of an authorized individual of the part source, and
   4. The name and address of the part source for whom the authorized individual is signing.

Material for bolting shall meet the manufacturer's specification, but does not require material test certification if marked as required by the material specification.

PART 3

PROPOSED REVISION TO ~~RE-1050~~

S7.5 a)

All replacement critical parts furnished by the original valve manufacturer shall be fabricated in accordance with the original valve manufacturer's ASME accepted Quality System.

Replacement critical parts shall be marked/tagged with:

a. Manufacturer's identification symbol
b. Manufacturer's Part Number
c. Material Marking – Type and Traceability (may be coded)
d. Hydrostatic Testing Marking (as applicable)

The valve manufacturer shall hold current ASME Certification for the PRV Design in order to furnish replacement critical parts.

If the valve manufacturer or assembler does not hold current ASME Certification, the valve manufacturer shall furnish a Certificate of Compliance with the part(s) and material test reports (refer to section c. below).

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ATTACHMENT 4

National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2009 Draft Addendum - Cycle B

PLEASE SUBMIT ONLY ONE COMMENT/RECOMMENDATION PER PAGE
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Comments Must be Received No Later Than: June 1, 2009

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: May 26, 2009

Commenter Name: Brian W. Moore

Commenter Address: Hartford Steam Boiler

One State Street, P.O. Box 5024

Hartford, CT 06102-5024

Commenter Phone: 860-722-5657

Commenter Fax: 860-722-5530

Commenter Email: brian_moore@hsb.com

Section/Subsection Referenced: Part 1 3.7.5.1 b) 1) (NB07-1205)

Comment/Recommendation: *Proposed Solution:* ☐ New Text ☒ Revise Text ☐ Delete Text

For readability, I suggest revising the paragraph to read:

1) In a single hot-water boiler installation, ~~Stop~~ stop valves shall be located at an accessible point in the supply and return pipe connections as near the boiler as is convenient and practicable~~, of a single hot water boiler installation~~ to permit draining the boiler without emptying the system.

Source: ☒ Own Experience/Idea ☐ Other Source/Article/Code/Standard _____

Submit Form To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email: rhough@nationalboard.org

NB Use Only

Commenter No. Issued: PR09-02
Comment No. Issued: 03

Project Committee Referred To: Installation

NB09-0501

I wish to request the committee to consider the following request for new or additional Code rules.

Purpose:
To create new or additional Code rules in Part 1.

Background:
There appears to be a lack of consistency in the application of Parts 1 and 2 of the 2007 NBIC.

Part 2, Section 2.3.6. gives instructions to inspect Specific Types of Pressure Vessels. For instance Section 2.3.6.5. has requirements for Inspection of Pressure Vessels with Quick Actuating Closures which includes references to specific controls and safety interlocks. However, Part 1 has no mention of these specific requirements.

Should not all of the specific requirements for Inspection of Specific Types of Pressure Vessels, controls and safety devices that the Owner-User, Inspector, etc. is told to look for in Part 2 also be described as Installation requirements in Part 1 so that they are verified as complete and properly installed before the equipment is put into operation?

It would seem appropriate that the Owner-User, Inspector, etc. are required to ensure that all of the items addressed for Inservice Inspection in Part 2 are included in Part 1 to be addressed at the time of Installation, rather than waiting until some later date for the Inservice Inspection requirements of Part 2 to find any deficiencies in the installation.

Proposed Revisions
Add the appropriate rules to Part 1 to ensure that Installation rules address the same requirements for pressure vessels and controls as will later be required for Inservice Inspection.

Statement of Need
Part 1 does not presently address all of the requirements for Installation of specific types of pressure vessels that are listed for Inservice Inspection in Part 2, Section 2.3.6.

These requirements are needed in Part 1 to ensure they are not overlooked during equipment installation and later found as deficiencies at the time of Inservice Inspection.

Background Information
The needed Installation information is missing from the current edition of Part 1 of the NBIC.

Laurence Calvert
Senior Technical Specialist
Technical Standards and Safety Authority
Tel: 416-734-3431
Toll-free: 1-877-682-8772
Fax: 416-231-6183
website: www.tssa.org

NB09-0601

National Board of Boiler and Pressure Vessel Inspectors

National Board Inspection Code

Submission of Public Review Comment
Draft 2007 Edition

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Comments Must be Received No Later Than: June 15, 2007

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: June 14, 2007

Commenter Name: Ken Nichols

Commenter Address: WTC 2B2 32901 Weyerhaeuser Way So
Federal Way, WA 98001

Commenter Phone: 253 924 6602

Commenter Fax: 253 924 4239

Commenter Email: Ken.nichols@weyerhaeuser.com

Section/Subsection Referenced: 2.2

Comment/Recommendation: *Proposed Solution:* ☐ New Text ☒ Revise Text ☐ Delete Text

Wording makes it difficult to determine if thermal fluid heaters are "boilers". First sentence says power boiler is a vessel in which water or other liquid is heated. Paragraph 2.2.a seems to contradict, as it says a power boiler generates steam or other vapor. I do not have a suggested re-wording; I do not know the original intent of the author(s).

Source: ☒ Own Experience/Idea ☐ Other Source/Article/Code/Standard _____

Submit Form To: Robin Hellman, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhellman@nationalboard.org

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Commenter No. Issued: PR07-21
Comment No. Issued: 02
Project Committee Referred To: Installation

1/2

(2)

[redacted]

THE
NATIONAL
BOARD
OF BOILER AND
PRESSURE VESSEL
INSPECTORS

October 15, 2008

Ken Nichols
WTC 2B2
32901 Weyerhaeuser Way South
Federal Way, WA 98001

Dear Mr. Nichols:

Thank you for submitting PR07-2102, public review comment concerning thermal fluid heaters. The action item, NB07-1212 was opened to address your concern. The committee feels your concern is valid and is working to address the issue of Power Boiler definitions in NBIC Installation Section 2.2. The verbiage appears contradictory. The NBIC Committee has determined the intent is NOT to include Thermal Fluid Heaters as power boilers and this item has been closed.

The committee also determined that this issue needs to be developed further and has opened a new action item, NB09-0601.

Thank you for your continued support and urge you to contact us with any additional questions or concerns.

Thank you,

Robin Hough
NBIC Committee Coordinator

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WEB SITE
nationalboa

2/2

NB09-0801

[redacted]

December 8, 2008

Secretary, NBIC Committee
The National Board of Boiler and Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, OH 43229

Subject: Request a revision to Present Code Rules; NBIC 2007 Part 1, paragraph 2.8.1(1), page 25

Dear Ms. Secretary:

THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS
DONALD E. TANNER, EXECUTIVE DIRECTOR

Background

This paragraph conflicts with the requirements of ASME Section I, paragraph PFT-47.1. This conflict will have boilers built with lower operating water levels than the NBIC requires in Paragraph 2.8.1 (1).

PFT-47.1, page 137	Part 1, 2.8.1 (1), page 25
Boilers of the horizontal firetube type that exceed 16 in. (400 mm) in inside diameter shall be so set that when the water is at the lowest visible level in the gage glass there shall be 3 in. (25 mm) above the lowest permissible water level as determined by the Manufacturer. Horizontal firetube boilers that do not exceed 16 in. (400 mm) in inside diameter shall have the lowest visible in the gage glass at least 1 in. (25 mm) above the lowest permissible level as determined by the Manufacturer.	Boilers of the horizontal firetube type shall be so set that when the water is at the lowest visible reading in the water gage glass there shall be at least 3 in. (75 mm) of water over the highest point of the tubes, flues, or crown sheet.

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TRAINING DEPARTMENT Fax 614.847.5542
EMAIL getinfo@nationalboard.org
WEB SITE nationalboard.org

I propose that the NBIC paragraph reflect the current ASME Section I paragraphs.

Sincerely,

Robert E. Ferrell
Senior Staff Engineer
The National Board of Boiler and
Pressure Vessel Inspectors
614 888 8320 x404

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(4)

may be omitted. The opening shall be reinforced in accordance with PG-32 through PG-44.

PFT-45.3 When a dome is located on the barrel of a locomotive-type boiler or on the shell of a horizontal-return tubular boiler, the outside diameter of the dome shall not exceed six-tenths the inside diameter of the shell or barrel of the boiler unless the portion of the barrel or shell under the dome (the neutral sheet) is stayed to the head or shell of the dome by stays which conform in spacing and size to the requirements given in PG-46. With such stayed construction the outside diameter of a dome located on the barrel or shell of a boiler is limited to eight-tenths of the barrel or shell inside diameter.

PFT-45.4 All domes shall be so arranged that any water can drain back into the boiler.

PFT-45.5 Flanges of domes shall be formed with a corner radius, measured on the inside, of at least twice the thickness of the plate for plates 1 in. (25 mm) in thickness or less, and at least three times the thickness of the plate for plates over 1 in. (25 mm) in thickness.

PFT-45.6 In a locomotive-type boiler with a dome on a tapered course, the maximum allowable diameter of the dome shall be based on that diameter of the tapered course which intersects the axis or center line of the dome.

SETTING

PFT-46 METHOD OF SUPPORT

PFT-46.1 The design and attachment of lugs, hangers, saddles, and other supports shall meet the requirements of PG-22.1 and PG-55.

PFT-46.2 In applying the requirements of PFT-46.1, localized stresses due to concentrated support loads, temperature changes, and restraint against dilation of the boiler due to pressure shall be provided for. Lugs, brackets, saddles, and pads shall conform satisfactorily to the shape of the shell or surface to which they are attached or with which they are in contact.

PFT-46.3 A horizontal-return tubular boiler over 72 in. (1 800 mm) in diameter shall be supported from steel hangers by the outside-suspension-type setting, independent of the furnace side walls.

PFT-46.4 A horizontal-return tubular boiler, 14 ft (4.3 m) or more in length, or over 54 in. (1 350 mm) and up to and including 72 in. (1 800 mm) in diameter, shall be supported by the outside-suspension-type setting as specified in PFT-46.3, or, for wall-supported boilers, at four points by not less than eight steel lugs set in pairs. A horizontal-return tubular boiler up to and including 54 in. (1 350 mm) in diameter shall be supported by the outside-suspension-type setting as specified in PFT-46.3, or, for wall-supported boilers, by not less than two steel lugs on each side. If more than four lugs are used on wall-supported boilers, they shall be set in four pairs, the lugs of each pair to be spaced not over 2 in. (50 mm) apart and the load to be equalized between them (see Fig. PFT-46.1). If the boiler is supported on structural steel work, the steel supporting members shall be so located that heat from the furnace cannot impair their strength.

PFT-46.5 Figure PFT-46.2 illustrates an acceptable design of hanger bracket for welded attachment to welded horizontal-return tubular boilers with the additional requirement that the hanger pin be located at the vertical center line over the center of a welded contact surface. The bracket plates shall be spaced at least 2½ in. (64 mm) apart, but this dimension shall be increased if necessary to permit access for the welding operation.

PFT-46.6 Wet-bottom stationary boilers shall be supported so as to have a minimum clearance of 12 in. (300 mm) between the underside of the wet-bottom and the floor to facilitate inspection. Other types of firetube boilers set horizontally shall be supported so that they have a minimum clearance of 12 in. (300 mm) between the metal surface of the shell and the floor. Boiler insulation, saddles, or other supports shall be arranged so that inspection openings are readily accessible.

PIPING, FITTINGS, AND APPLIANCES

PFT-47 WATER LEVEL INDICATORS

PFT-47.1 Boilers of the horizontal firetube type that exceed 16 in. (400 mm) in inside diameter shall be so set that when the water is at the lowest visible level in the gage glass there shall be at least 3 in. (75 mm) above the lowest permissible water level as determined by the Manufacturer.

Horizontal firetube boilers that do not exceed 16 in. (400 mm) in inside diameter shall have the lowest visible level in the gage glass at least 1 in. (25 mm) above the lowest permissible water level as determined by the Manufacturer.

PFT-47.2 Boilers of locomotives shall have at least one gage glass provided with top and bottom shutoff cocks and lamp.

The lowest visible level in the gage glass shall be not less than 3 in. [75 mm] for boilers over 36 in. (900 mm) in inside diameter, nor less than 2 in. (50 mm) above the lowest permissible water level as determined by the Manufacturer for boilers 36 in. (900 mm) or less but greater than 16 in. (400 mm) in inside diameter nor less than 1 in. (25 mm) above the lowest permissible water-level as determined by the Manufacturer for boilers 16 in. (400 mm) or less in inside diameter. These are minimum dimensions,

2/2

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National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2009 Draft Addendum- Cycle B

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Comments Must be Received No Later Than: June 1, 2009

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: 04-09-09

Commenter Name: Raymond Snyder

Commenter Address: 15C Costa Loop
Auburndale, FL 33823

Commenter Phone: 863-965-4417

Commenter Fax: 863-967-0185

Commenter Email: Raymond.Snyder@ARSeinc.com

Section/Subsection Referenced: Part 2 Inspection NB07-1006 - S1.4.2.1

Comment/Recommendation: Proposed Solution: ☐ New Text ☒ Revise Text ☐ Delete Text

Table of Contents - Add New item: S1.4.2.1(a)
Rivet Head wastage for Rivet Joint in Tension

Text - New Number t Heading. ~~Following~~ before NOTES Pg 106
ADD. S1.4.2.1(a) Rivet Head wastage for Rivet Joint in Tension.
And add figure S1.4.2.1(a)

Source: ☐ Own Experience/Idea ☐ Other Source/Article/Code/Standard Proper Numbering Agreement.

Submit Form To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhough@nationalboard.org

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Commenter No. Issued: PR09-04
Comment No. Issued: 01
Project Committee Referred To: SC Inspection

d) Most discontinuities (cracks, porosity, and inclusions) reduce the amount of base material available to absorb (attenuate) x-rays or gamma rays, thus allowing more energy to pass through the material. Most discontinuities will appear as dark shapes on the radiographic film.

e) The technique used for radiography depends largely on the equipment used and what experience has shown will produce the best results. It is not the function of the technician to indicate the procedure to be followed, provided the procedure and films satisfy all requirements of the applicable Code of Construction. The radiographic film provides a permanent record of the results of the examination.

4.2.6 EDDY CURRENT

Eddy current is an examination method that measures changes in a magnetic field caused by discontinuities. Eddy current can also detect a loss of material on inaccessible surfaces and be used to detect changes in hardness of a material. There are three general types of eddy current coils: the concentric coil which surrounds the part to be tested (e.g., tubing); the probe coil which is brought adjacent to the part to be tested; and the bobbin coil which is inserted into the part to be tested (e.g., tubing).

4.2.7 METALLOGRAPHIC

Metallographic examination is a method of locally polishing, etching, and viewing the surface of a pressure-retaining item with either acetate tape (e.g., replication) or a field microscope to determine the condition of the metal microstructure.

4.2.8 ACOUSTIC EMISSION

Acoustic emission is a method of detecting and monitoring discontinuities in a pressure-retaining item or load-bearing structure. This method utilizes wave guides, transducers, cables, and a sophisticated data acquisition system to collect transient acoustic emissions generated by the rapid release of energy from localized sources within the material being tested. Signal amplitude, frequency, and location are collected for many hours of operation at various loads or pressures. Analysis of the data can determine if any part of the system requires additional nondestructive examination with a more sensitive test method.

4.3 TESTING METHODS

All testing methods should be performed by experienced personnel using written procedures acceptable to the Inspector.

4.3.1 PRESSURE TESTING

a) During an inspection of a pressure-retaining item, there may be certain instances where inservice conditions have adversely affected the tightness of the component or the inspection discloses unusual, hard to evaluate forms of deterioration that may affect the safety of the vessel. In these specific instances, a pressure test using air, water, or other suitable test medium may be required at the discretion of the Inspector to assess leak tightness of the pressure-retaining item.

b) The Inspector is cautioned that a pressure test will not provide any indication of the amount of remaining service life or the future reliability of a pressure-retaining item. The pressure test in this instance only serves to determine if the pressure-retaining item contains defects that will not allow the item to retain pressure. In certain instances, pressure tests of inservice components may reduce the remaining service life of the component due to causing permanent deformation of the item.

c) If an inservice pressure test is required, the following precautions shall be met:

1) The test pressure should not exceed 90% of the set pressure of the lowest setting pressure relief device on the component to avoid damage to pressure relief devices.

2) Test pressure should be selected or adjusted in agreement between the Inspector and the owner-user. When the original test pressure includes consideration of corrosion allowance, the test pressure may be further adjusted based upon the remaining corrosion allowance.

3) The metal temperature during a pressure test should not be less than 60°F (16°C) unless the owner-user provides information on the toughness characteristics of the vessel material to indicate the acceptability of a lower test temperature.

4) The metal temperature shall not be more than 120°F (49°C) unless the owner-user specifies the requirement for a higher test temperature. If the owner-user specifies a test temperature higher than 120°F (49°C), then precautions shall be taken to afford the Inspector close examination without risk of injury.

5) When contamination of the vessel contents by any medium is prohibited or when a pressure test is not practical, other testing methods described below may be used provided the precautionary requirements of the applicable Section of the original construction code or other standards are followed. In such cases, there shall be agreement as to the testing procedure between the owner-user and the Inspector.

4.3.2 LEAK TESTING

a) Leak testing for the purpose of detecting any leakage may be performed when a pressure test cannot be performed. Some methods or techniques for leak testing may include bubble test (direct pressure or vacuum), helium mass spectrometer, pressure change, or flow measurement. Use of leak test procedures shall be in agreement between the owner-user and the Inspector. Use of written procedures and experienced personnel is required when performing leak tests. The Inspector shall review the written procedure to become familiar with limitations, adequacy, methods, and acceptance standards identified.

4.3.3 EVIDENCE OF LEAKAGE IN A BOILER

For additional understanding regarding a leak in a boiler see 2.2.7 for the extent of a possible defect, a pressure test may be performed as follows:

a) To determine tightness, the test pressure shall be no greater than the maximum allowable working pressure stamped on the pressure-retaining item.

b) During a pressure test where the test pressure will exceed 90% of the set pressure of a pressure relief device, the device shall be removed whenever possible. If not possible or practical, a spindle restraint such as a gag may be used provided that the valve manufacturer's instructions and recommendations are followed. Extreme caution should be employed to ensure only enough force is applied to contain pressure. Excessive mechanical force applied to the spindle restraint may result in damage to the seat and/or spindle and may interfere with the proper operation of the valve. The spindle restraint shall be removed following the test.

2/3

(3)

George Galanes
<GGalanes@MWGen.com>
10/10/2008 03:27 PM

To tparks@nationalboard.org
cc RHough@nationalboard.org
bcc
Subject New Action Item for Part 3 NBIC

Terry;
I would like to request a new action item related to a cautionary statement in Part 3 of the NBIC related to pressure testing of pressure retaining objected fabricated if steels prior to 1970. I am thinking along the lines of cautioning the Inspectors to verify the composition of the steel plate to assure that 60 deg F is suitable for pressure testing. I was going to prepare words for two locations in part 3 that reference the 60 deg metal temperature. We state in the NBIC if the owner can provide toughness data to lower the test temperature this is acceptable. On the flip side, we need to caution Inspectors that objects built of carbon steel plate before 1970 may need to have the temperature of the metal adjusted upward for a pressure test to assure adequate notch toughness.

I can handle this item and use the EPRI handout as background information for the suggested cautionary note.

Regards,

George Galanes, P.E.
Mgr., Metallurgy and QA
Midwest Generation EME, LLC
Joliet Station/Chicago Annex
1800 Channahon Rd
Joliet, Illinois, 60436-8539
(Phone) 815-207-5897
(Fax) 312-788-5218

3/3

3) Supports and Attachments — These vessels are usually suspended from the ceiling by hangers or straps causing concentration of stresses in these areas. Specifically inspect for corrosion, wear, and cracks in these areas.

2.3.6.4 LIQUID AMMONIA VESSELS

Vessels in liquid ammonia service are susceptible to stress corrosion cracking (SCC) (see 3.3.2[b]) in areas of high stress. High strength and coarse-grained materials seem to be more at risk of SCC than are fine-grained or more moderate strength materials, although no commonly used steels appear to be immune to the problem. Postweld heat treatment of new or weld-repaired vessels or cold formed heads is beneficial in reducing the incidence of SCC. The presence of 0.2% minimum water in the liquid ammonia also inhibits SCC. Any leak should be thoroughly investigated and the necessary corrective action initiated.

a) Inspection of Parts and Appurtenances

1) Where existing openings permit, perform a visual internal inspection of the vessel. Look for any obvious cracks (very advanced SCC) and note areas that are subject to high stress such as welds, welded repairs, head-to-shell transitions, sharp interior corners, and interior surfaces opposite external attachments or supports. Alternatively, an internal inspection may be conducted from the outside utilizing suitable NDE, e.g., ultrasonic techniques.

2) If valves or fittings are in place, check to ensure that these are complete and functional. Parts made of copper, zinc, silver, or alloys of these metals are unsuitable for ammonia service and should be replaced with parts fabricated of steel or other suitable materials.

3) Fittings should be removed or otherwise protected from power buffing or light sandblasting when preparing the interior surface of the vessels for inspection.

4) All interior welds and highly stressed areas should be examined by the wet fluorescent magnetic particle-testing method (WFMT) using an A/C yoke for magnetization. Note that weld cracks are often transverse in orientation. It is extremely important to ensure that the NDE method used will disclose cracks in any orientation.

5) If cracks are discovered, a calculation must be made to determine what depth of grinding may be carried out for crack removal (without encroaching on the minimum thickness required by the construction standard or equivalent).

6) Where possible, crack removal by grinding is the preferred method of repair. Since the stresses at the crack tips are quite high, even very fine cracking should be eliminated.

7) Where crack depth is such that removal requires weld repair, a weld procedure should be employed that will minimize HAZ hardening and residual stresses. Whenever possible, weld repairs regardless of their size should be postweld heat treated.

8) Re-inspect by WFMT to ensure complete crack removal.

9) It is not intended to inhibit or limit the use of other evaluation methods. It is recognized that acoustic emission and fracture mechanics are acceptable techniques for assessing structural integrity of vessels. Analysis by fracture mechanics may be used to assess the structural integrity of vessels when complete re-

moval of all ammonia stress cracks is not practical. If alternative methods are used, the above recommendation that all cracks be removed, even fine cracks may not apply.

b) Inspection of Insulated Vessels

1) Insulated pressure vessels can suffer from aggressive external corrosion that is often found beneath moist insulation. The Inspector should closely examine the external insulation scaling surfaces for cold spots, bulges, rust stains, or any unusual conditions in previous repair areas. Bulging or distorted insulation on refrigerated vessels may indicate the formation of ice patches between the vessel shell and insulation due to trapped moisture. Careful observation is also required where the temperature of insulated vessels cycle continually through the freezing temperature range.

2) The lower 1/3 to 1/2 and the bottom portions of insulated vessels should receive special focus, as condensation or moisture may gravitate down the vessel shell and soak into the insulation keeping it moist for long periods of time. Penetration locations in the insulation such as saddle supports, nozzles, or fittings should be examined closely for potential moisture ingress paths. When moisture penetrates the insulation, the insulation may actually work in reverse holding moisture in the insulation and/or near the vessel shell.

3) Insulated vessels that are run on an intermittent basis, or that have been out of service require close scrutiny. In general, a visual inspection of the external surfaces of insulated vessels should be conducted once per year.

4) The most common and superior method to inspect for suspected corrosion under insulation damage (CUI) is to completely or partially remove the insulation for visual inspection. The method most commonly utilized to inspect for CUI without insulation removal is by x-ray and isotope radiography (film or digital) or by real time radiography utilizing imaging scopes and surface profilers. The real time imaging tools will work well if the vessel geometry and insulation thickness allows. Other less common methods to detect CUI include specialized electromagnetic methods (pulsed eddy current and electromagnetic waves), and long range ultrasonic techniques (guided waves).

5) There are also several methods to detect moisture soaked insulation, which is often the beginning for potential CUI damage. Moisture probe detectors, neutron backscatter, and thermography are tools that can be used for CUI moisture screening.

6) Proper surface treatment (coating) of the vessel external shell and maintaining weather tight external insulation are the keys to prevention of CUI damage.

c) Gages and Pressure-Relieving Devices

1) The Inspector should note the pressure indicated by the gage and compare it with other gages on the same system. If the pressure gage is not mounted on the vessel itself, it should be ascertained that the gage is installed on the system in such a manner that it correctly indicates actual pressure in the vessel.

2) See 2.5 for the inspection of safety relief devices (pressure relief valves) used to prevent the overpressure of liquid ammonia vessels. Pressure-relief devices in ammonia service shall not be tested in place using system pressure. Bench testing is required.

2/2

(6)

NB07-1013

NB07-1013

richard.b.stone@power.alstom.com

03/31/2007 09:13 PM

To: rschuele@nationalboard.org
cc: doyle396@earthlink.com, george.secerbo@fra.dot.gov, greenchili@ids.net, histmachry@alltel.net, linnwm@supernet.com, mjanssen@monide.us, SALee@UP.com, Ssr16e@msn.com,
Subject: Re: NBIC Subgroup Locomotive Boilers - 2007 Revision: Addition of Illustrations to Inspection Section

Hello Bob;

I've reviewed our section of the 2007 NBIC in the "Inspection Section" and "Repair Section" have been placed into separate volumes.

I recommend the following changes be made:

1) The "Repair Section" should contain all of the illustrations now in print and which are being prepared.

2) The existing illustrations of our Appendix 3 that identify the boiler components also should be added to the "Inspection Section". The purpose of this double listing is to guide the personnel performing the inspection as to what the components that are discussed in the inspection text look like. When we prepared the our original Appendix 3 this was not necessary because Inspection and Repair were together with all of the illustrations within a few pages of each other.

The specific illustrations that should be added to the "Inspection Section" are:

Figure 3-3020 Threaded Staybolts

Figure 3-3030-a Flexible Staybolts - Welded Sleeves Caps and Gaskets

Figure 3-3030-b Ball Socket Type Flexible Staybolts

Figure 3-3040 Seal Welded Staybolts

Figure 3-3060 Diagonal Braces, Gusset Braces and Throat Sheet/Tube Sheet Braces

Figure 3-3080 Patch Bolts

Figure 3-3130-a Locomotive Firebox Thermic Syphon Installation

Figure 3-3330 Stayed Firebox Sheet Grooved or Wasted at Mudring

Figure 21 Arch Tubes (Bob, this illustration was last printed in the 2001 NBIC and has been missing since then)

Figures 3-305X Crown Bars, Girder Stays, Sling Stays, Expansion Stays & Baldwin-Type Expansion Stays (Add the complete series of figures for this section as shown in NB07-1010 Tracking Number. This includes 3-3055A, 3-3057-A, 3-3057-B)

Figure 3-305X Diagonal Brace Ends (this figure is shown in NB07-1010 Tracking Number)

I recommend Figure 3-3320 Typical Firebox Patches also be included since it shows common repairs that will be found in many fireboxes. (Bob, my records show the caption for this illustration "Typical Firebox Patches" has been missing for several years. It should be added back to the

1 of 3

illustration for the 2007 NBIC.)

It also may be useful to include some of the other Figures that illustrate repairs since the inspection and review of these past repairs will form part of the inspection process. Let me know if you would like to list these.

Best regards.

Dick

richard.b.stone@power.alstom.com

03/31/2007 09:33 PM

To: rschuele@nationalboard.org
cc: doyle396@earthlink.com, george.secarbo@fra.dot.gov, greenchill@tds.net, histmachry@attbi.net, linnwm@supernet.com, mjanssen@mnonida.us, SALee@UP.com, Sar16e@msn.com,
Subject: Re: NBIC Subgroup Locomotive Boilers - Missing Arch Tube Illustration & Missing Caption for Figure 3-3320

Hello Bob;

As I mentioned in my previous e-mail, the following two items are missing from our Appendix 3 Locomotive Boilers:

1) The illustration "Arch Tubes" is missing from the NBIC 2004 and proposed NBIC 2007 Edition. The original number for it was Figure 21 and it was last included in the 2001 Edition.

   I believe I have the original illustration in my file if you need another copy of it.

2) The caption "Typical Firebox Patches" is missing from Figure 3-3320. My records show the caption has been missing for several years.

I recommend both items be reinserted into the 2007 NBIC.

Best regards.

Dick

3 of 3

(9)

SUBMITTED 11:50 pm CDT 19 MAY 2008

NB08-1904

National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2008 Draft Addendum- Cycle B

PLEASE SUBMIT ONLY ONE COMMENT/RECOMMENDATION PER PAGE
Make additional copies as needed

Comments Must be Received No Later Than: May 19, 2008

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: 19 MAY 2008

Commenter Name: THOMAS A ROGERS
Commenter Address: PO BOX 98186
LUBBOCK TX 79499
Commenter Phone: 806 790 1238 806 7973797
Commenter Fax: 806 7973798
Commenter Email: tr_containertech@sbcglobal.net

Section/Subsection Referenced: PART 2 SUPPLEMENT 6

Comment/Recommendation: *Proposed Solution:* ☒ New Text ☐ Revise Text ☐ Delete Text

CONDITION OF INTERNAL STRUCTURES (PIPES BAFFLES) IS AN IMPORTANT INSPECTION PROBLEM LOOSE STRUCTURES INSIDE TANKS DESTROY INTERNAL PRD's.

Source: ☒ Own Experience/Idea ☐ Other Source/Article/Code/Standard 49CFR PART 180 SUBPART F

Submit Forms To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhough@nationalboard.org

NB Use Only
Commenter No. Issued: _____ Project Committee Referred To: _____
Comment No. Issued: _____

NB09-0303

National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2009 Draft Addendum- Cycle A

PLEASE SUBMIT ONLY ONE COMMENT/RECOMMENDATION PER PAGE
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Comments Must be Received No Later Than: December 8, 2008

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: 12/08/2008

Commenter Name: Brian W. Moore, P.E.

Commenter Address: Hartford Steam Boiler
One State Street
P.O. Box 5024
Hartford, CT 06102-5024

Commenter Phone: 860-722-5657

Commenter Fax: 860-722-5530

Commenter Email: brian_moore@hsb.com

Section/Subsection Referenced: Part 2 Section 2.2.12.8

Comment/Recommendation: *Proposed Solution:* ☒New Text ☐Revise Text ☐Delete Text

This may be a new action item. In paragraph a) I suggest changing BTUs to the units of measure independent term "thermal energy".

This will make the statement independent of U.S. Customary or metric units.

Source: ☒ Own Experience/Idea ☐ Other Source/Article/Code/Standard

Submit Form To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhough@nationalboard.org

NB Use Only

Commenter No. Issued: PR09-02

Comment No. Issued: 01

Project Committee Referred To: SC on Inspection

(1)

NB09-0304

National Board of Boiler and Pressure Vessel Inspectors
National Board Inspection Code
Submission of Public Review Comment
2009 Draft Addendum- Cycle A

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Comments Must be Received No Later Than: December 8, 2008

Instructions: If unable to submit electronically, please print this form and fax or mail. Print or type clearly.

Date: 12/08/2008

Commenter Name: Brian W. Moore, P.E.

Commenter Address: Hartford Steam Boiler
One State Street
P.O. Box 5024
Hartford, CT 06102-5024

Commenter Phone: 860-722-5657

Commenter Fax: 860-722-5530

Commenter Email: brian_moore@hsb.com

Section/Subsection Referenced: Part 2 Section 2.2.12.3 e)

Comment/Recommendation: *Proposed Solution:* ☐New Text ☒Revise Text ☐Delete Text

See attached comments.

Source: ☒ Own Experience/Idea ☐ Other Source/Article/Code/Standard

Submit Form To: Robin Hough, Secretary, NBIC Committee, The National Board of Boiler & Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43229, fax 614-847-1828, email, rhough@nationalboard.org

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Commenter No. Issued: PR09-02

Comment No. Issued: 02

Project Committee Referred To: SC on Inspection

1/2

(12)

ATTACHMENT 6

Comments must be submitted on the attached Public Review Comment Form

Draft 2009 Addendum

Cycle A

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

Deleted items are designated by strikethrough.
Additions are designated by double underline.

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614) 888-8320
FAX: (614) 847-1828

DIRECTORY OF REVISIONS

Part 1 Installation

1.4.2 a)
- **Revised to include all Pressure Retaining Items**

2.5.3
- **Added wording for remote emergency shutdown switches**

2.8.2
- **Revised to clarify valve type**

2.9.6
- **Changed numbering for clarity**

3.4.2
- **Revised wording for clarity**

4.5.3
- **Revised wording to clarify the location of the Pressure Relief Device in relation to the vessel**

4.5.6 e)
- **Added wording to address pressure vessels designed for human occupancy**

5.3.3
- **Revised wording to clarify the location of the Pressure Relief Device in relation to the vessel**

Part 2 Inspection

2.2.8
- **Deleted text**

2.2.10.2
- **Deleted text**

2.2.10.3
- **Re-numbered paragraph**

2.2.10.4
- **Re-numbered paragraph and deleted text**

2.2.10.5 thru 2.2.10.7
- **Re-numbered paragraphs**

2.2.12.1
- **Re-numbered paragraph and added text**

2.2.12.2 thru 2.2.12.8
- **Re-numbered paragraph**

2.2.12.9
- **Re-numbered paragraph and added text**

2.5.3 a)
- **Added wording to refer to Supplement 8**

S1.4.3 a)
- **Added wording to measure the height of water gage glass in Locomotive Boilers**

S2.6.2
- **Added wording to address areas that exhibit thinning in Historical Boilers**

S2.10.3
- **Added metric tables for Historical Boilers**

S6.16
- **Added section to address Pressure Relief Devices in the DOT supplement**

S8

- **Added Supplement to address Pressure Differential Between Safety or Safety Relief Valve Setting and Boiler or Pressure Vessel Operating Pressure**

Part 3 Repairs and Alterations

2.5.2

- **Clarified wording**

2.5.3 d)

- **Corrected reference**

2.5.3 e)

- **Added new paragraph for Non-destructive examination of welds and re-numbered old paragraph 2.5.3 e) to 2.5.3 f)**

3.2.6

- **Added paragraph to reference other codes and standards**

3.3.4.2

- **Deleted duplicated wording**

5.7.1

- **Deleted wording**

5.7.2 c)

- **Added new paragraph**

5.7.4

- **Added new paragraph**

5.7.5

- **Added new paragraph**

5.9.2

- **Revised figure reference**

5.9.5

- **Clarified wording for stamping requirements**

5.9.6

- **Deleted paragraph and subparagraphs**

5.11

- **Revised paragraph reference**

5.11.2

- **Revised paragraph reference**

5.11.3

- **Revised paragraph reference**

5.12

- **Revised figures 5.7.5 a-g**

S1.2.6

- **Added wording and figures to Locomotive supplement**

S1.2.8

- **Added wording to patch bolt repair and alteration**

S1.2.9.7

- **Added paragraph to address ferrules**

S2.11.5

- **Added wording and figure to repairs of firebox and tubesheet knuckles to address flanges**

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Part 1 Installation

NB08-0317

1.4.2 a)

1.4.2 EQUIPMENT CERTIFICATION

a) All boilers, pressure vessels, piping, and other pressure-retaining items shall have documented certification from the manufacturer indicating that the boiler, pressure vessel, piping, or any other pressure-retaining items complies with the requirements of the code of construction. The certification shall identify the 'Addenda' for a code of construction to which ~~the boiler was fabricated.~~all pressure retaining items were fabricated.

NB08-1201

2.5.3 ELECTRICAL

2.5.3.1 WIRING

~~a)~~ All wiring for controls, heat generating apparatus, and other appurtenances necessary for the operation of the boiler or boilers should be installed in accordance with the provisions of national or international standards and comply with the applicable local electrical codes.

2.5.3.2 REMOTE EMERGENCY SHUTDOWN SWITCHES

~~b)~~a) A manually operated remote shutdown switch or circuit breaker shall be located just outside the boiler room door and marked for easy identification. Consideration should also be given to the type and location of the switch to safeguard against tampering.

b) For boiler rooms exceeding 500 sq. ft (46.5 sq. m) floor area or containing one or more boilers having a combined fuel capacity of 1,000,000 Btu/hr (293kW) or more, additional manually operated remote emergency shutdown switches shall be located at suitably identified points of egress acceptable to the jurisdiction.

c)Where a boiler is located indoors in a facility and not in a boiler room, a remote emergency shutdown switch shall be located within 50 feet of the boiler along the primary egress route from the boiler area.

~~c) If the boiler room door is on the building exterior, the shutdown switch shall be located just inside the door. If there is more than one door to the boiler room, there shall be a shutdown switch located at each door of egress.~~

~~1) For atmospheric-gas burners, and oil burners where a fan is on a common shaft with the oil pump, the complete burner and controls should be shut off.~~

~~2) For power burners with detached auxiliaries, only the fuel input supply to the firebox need be shut off.~~

d) Consideration should be given to the type and location of the remote emergency shutdown switch(es) to safeguard against tampering. Where approved by the Jurisdiction, alternate locations of remote emergency switch(es) may be provided.

e) For atmospheric-gas burners and for oil burners where a fan is on the common shaft with the oil pump, the emergency remote shutdown switch(es) or circuit breaker(s) must disconnect all power to the burner controls.

f) For power burners with detached auxiliaries, the emergency remote shutdown switches or circuit breaker(s)need only shut off the fuel input to the burner.

~~d)~~ **~~2.5.3.3~~ CONTROLS AND HEAT GENERATING APPARATUS**

~~1)~~a) Oil and gas-fired and electrically heated boilers shall be equipped with suitable primary (flame safeguard) safety controls, safety limit switches and controls, and burners or electric elements as required by a nationally or internationally recognized standard.

~~2)~~b) The symbol of the certifying organization that has investigated such equipment as having complied with a nationally recognized standard shall be affixed to the equipment and shall be considered as evidence that the unit was manufactured in accordance with that standard.

~~3)~~c) These devices shall be installed in accordance with jurisdictional and environmental requirements, manufacturer's recommendations, and/or industry standards, as applicable.

NB08-0316

2.8.2b)
PRESSURE GAGE

a) Each steam boiler shall have a pressure gage connected to the steam space or to the steam connection to the water column. When a pressure-reducing valve is installed in the steam supply piping, a pressure gage shall be installed on the low pressure side of the pressure-reducing valve.
b) The dial range shall not be less than 1.5 times or no greater than two times the pressure at which the lowest ~~safety~~ pressure relief valve is set.

NB08-0318
~~2.9.5.1~~ 2.9.6 MOUNTING AND DISCHARGE REQUIREMENTS

a) Every boiler shall have outlet connections for the safety or safety relief valve, or valves, independent of any other outside steam connection, the area of opening shall be at least equal to the aggregate areas of inlet connections of all of the attached safety or safety relief valves. An internal collecting pipe, splash plate, or pan should be used, provided the total area for inlet of steam thereto is not less than twice the aggregate areas of the inlet connections of the attached safety or safety relief valves. The holes in such collecting pipes shall be at least 1/4 in. (6 mm) in diameter, and the least dimension in any other form of opening for inlet of steam shall be 1/4 in. (6 mm). If safety or safety relief valves are attached to a separate steam drum or dome, the opening between the boiler proper and the steam drum or dome shall be not less than ten times the total area of the safety valve inlet.

NB07-1201
3.4.2 LADDERS AND RUNWAYS

a) All walkways, runways, and platforms shall be:

1) of metal construction;
2) provided between or over the top of boilers that are more than 8 ft. (2.4 m) above the operating floor to afford accessibility for normal operation, maintenance, and inspection;
3) constructed of safety treads, standard grating, or similar material and have a minimum width of 30 in. (760 mm);
4) of bolted, welded, or riveted construction; and
5) equipped with handrails 42 in. (1070 mm) high with an intermediate rail and 4 in. (100 mm) toe board.

b) Stairways that serve as a means of access to walkways, runways, or platforms shall not exceed an angle of 45 degrees from the horizontal and be equipped with handrails 42 in. (1070 mm) high with an intermediate ~~grid.~~rail.

c) Ladders that serve as a means of access to walkways, runways, or platforms shall:

4.5.3 LOCATION

a) The pressure relief device shall be installed directly on the pressure vessel, unless the source of pressure is external to the vessel and is under such positive control that the pressure cannot exceed the maximum~~ allowable working pressure then the device may be installed elsewhere in the system provided it is in communication with the vessel at all times~~.overpressure permitted by the original code of construction and the pressure relief device cannot be isolated from the vessel, except as permitted by 4.5.6 e) 2).

NB07-1210

4.5.6 e) 5) Add a new paragraph

5) Pressure vessels designed for human occupancy (such as decompression or hyperbaric chambers) shall be provided with a quick opening stop valve between the pressure vessel and its pressure relief valve. The stop valve shall be normally sealed open with a frangible seal and be readily accessible to the pressure relief attendant.

NB07-1201 (cont.)
5.3.3 LOCATION

The pressure relief device, except those covered by Sections 2 and 3 of this Part, may be installed at any location in the system provided the pressure cannot exceed the maximum overpressure permitted by the original code of construction~~allowable working pressure~~. Pressure drop to the pressure relief device under flowing conditions shall be considered when determining pressure relief device location. ~~The device shall be in communication with the piping system it is protecting at all times.~~The pressure relief device shall not be isolated from the piping system except as permitted by 5.3.6 e).

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Part 2 Inspection

2.2.8 BOILER CORROSION CONSIDERATION

g) Grooving is usually progressive and when it is detected, its effect should be carefully evaluated and corrective action taken.

~~h) The fireside surfaces of tubes in horizontal firetube boilers usually deteriorate more rapidly at the ends nearest the fire. The Inspector should examine the tube ends to determine if there has been serious reduction in thickness. The tube surfaces in some vertical tube boilers are more susceptible to deterioration at the upper ends when exposed to the heat of combustion. These tube ends should be closely examined to determine if there has been a serious reduction in thickness. The upper tube sheet in a vertical "dry top" boiler should be inspected for evidence of overheating.~~

~~i)~~h) Pitting and corrosion on the waterside surfaces of the tubes should be examined. In vertical firetube boilers, excessive corrosion and pitting is often noted at and above the water level.

~~j) The surfaces of tubes should be carefully examined to detect corrosion, erosion, bulges, cracks, or evidence of defective welds. Tubes may become thinned by high velocity impingement of fuel and ash particles or by the improper installation or use of soot blowers. A leak from a tube frequently causes serious corrosion or erosion on adjacent tubes.~~

~~k) In restricted fireside spaces, such as where short tubes or nipples are used to join drums or headers, there is a tendency for fuel and ash to lodge at junction points. Such deposits are likely to cause corrosion if moisture is present, and the area should be thoroughly cleaned and examined.~~

2.2.10 INSPECTION OF BOILER PIPING, PARTS, AND APPURTENANCES

2.2.10.1 BOILER PIPING

Piping should be inspected in accordance with 2.4.

~~2.2.10.2 STAYS AND STAYBOLTS~~

~~a) All stays, whether diagonal or through, should be inspected to determine whether or not they are in even tension. Staybolt ends and the stayed plates should be examined to determine whether cracks exist. In addition, stayed plates should be inspected for bulging in the general area of the stay. Each staybolt end should be checked for excessive cold working (heading) and seal welds as evidence of a possible leakage problem. Stays or staybolts that are not in tension or adjustment should be repaired. Broken stays or staybolts shall be replaced.~~

~~b) The Inspector should test firebox staybolts by tapping one end of each bolt with a hammer and, where practicable, a hammer or other heavy tool should be held on the opposite end to make the test more effective.~~

~~An unbroken bolt should give a ringing sound while a broken bolt will give a hollow or non-responsive sound. Staybolts with telltale holes should be examined for evidence of leakage, which will indicate a broken or cracked bolt. Broken staybolts shall be replaced.~~

2.2.10.~~3~~ 2 FLANGED OR OTHER CONNECTIONS

a) The manhole and reinforcing plates, as well as nozzles or other connections flanged or bolted to the boiler, should be examined for evidence of defects both internally and externally. Whenever possible, observation should be made from both sides, internally and externally, to determine whether connections are properly made to the boiler.

b) All openings leading to external attachments, such as water column connections, low water fuel cut-off devices, openings in dry pipes, and openings to safety valves, should be examined to ensure they are free from obstruction.

2.2.10.~~4~~ 3 MISCELLANEOUS

e) When tubes have been re-rolled or replaced, they should be inspected for proper workmanship. Where tubes are readily accessible, they may have been over rolled. Conversely, when it is difficult to reach the tube ends, they may have been under rolled.

~~f) Drums and headers should be inspected internally and externally for signs of leakage, corrosion, overheating, and erosion. Inspect blowdown piping and connections for expansion and flexibility. Check header seals for gasket leakage.~~

~~g) Soot blower mechanical gears, chains, pulleys, etc., should be checked for broken or worn parts. Inspect supply piping to the soot blowers for faulty supports, leakage, and expansion and contraction provisions. Check design for proper installation to allow for complete drainage of condensate, which may cause erosion.~~

~~h~~f) Valves should be inspected on boiler feedwater, blowdown, drain, and steam systems for gland leakage, operability, tightness, handle or stem damage, body defects, and general corrosion.

2.2.10.~~5~~ 4 GAGES

a) Ensure that the water level indicated is correct by having the gage tested as follows:

1) Close the lower gage glass valve, then open the drain cock and blow the glass clear.

2) Close the drain cock and open the lower gage glass valve. Water should return to the gage glass immediately.

3) Close the upper gage glass valve, then open the drain cock and allow the water to flow until it runs clean.

4) Close the drain cock and open the upper gage glass valve. Water should return to the gage glass immediately.

5) If the water return is sluggish, the test should be discontinued. A sluggish response could indicate an obstruction in the pipe connections to the boiler. Any leakage at these fittings should be promptly corrected to avoid damage to the fittings or a false waterline indication.

2.2.10.~~6~~ 5 PRESSURE RELIEF DEVICES
See 2.5 for the inspection of safety devices (pressure relief valves) used to prevent overpressure of boilers.

2.2.10.~~7~~ 6 CONTROLS
a) Verify operation of low water protection devices by observing the blowdown of these controls or the actual lowering of boiler water level under carefully controlled conditions with the burner operating. This test should shut off the heat source to the boiler.

2.2.12.~~1~~ 3 WATERTUBE BOILERS

a) Typically constructed of drums, headers, and tubes, watertube boilers are used to produce steam or hot water commonly in large quantities. They range in size and pressure from small package units to extremely large field erected boilers with pressures in excess of 3000 psig (41.37 MPa gage). These boilers may be fired by many types of fuels such as wood, coal, gas, oil, trash, and black liquor. Their size and type of construction poses mechanical and thermal cyclic stresses.

b) There are many locations both internal and external where moisture and oxygen combine causing primary concern for corrosion. The fuels burned in watertube boilers may contain ash, which can form an abrasive grit in the flue gas stream. The abrasive action of the ash in high velocity flue gas can quickly erode boiler tubes.

c) Unique parts associated with this type of construction such as casing, expansion supports, superheater, economizer, soot blowers, drums, headers, and tubes should be inspected carefully and thoroughly in accordance with 2.2.

d) The surfaces of tubes should be carefully examined to detect corrosion, erosion, bulges, cracks, or evidence of defective welds. Tubes may become thinned by high velocity impingement of fuel and ash particles or by the improper installation or use of soot blowers. A leak from a tube frequently causes serious corrosion or erosion on adjacent tubes.

e) In restricted fireside spaces, such as where short tubes or nipples are used to join drums or headers, there is a tendency for fuel and ash to lodge at junction points. Such deposits are likely to cause corrosion if moisture is present, and the area should be thoroughly cleaned and examined.

f) Drums and headers should be inspected internally and externally for signs of leakage, corrosion, overheating, and erosion. Inspect blowdown piping and connections for expansion and flexibility. Check header seals for gasket leakage.

g) Soot blower mechanical gears, chains, pulleys, etc., should be checked for broken or worn parts. Inspect supply piping to the soot blowers for faulty supports, leakage, and expansion and contraction provisions. Check design for proper installation to allow for complete drainage of condensate, which may cause erosion.

2.2.12.~~2~~ 9 KRAFT OR SULFATE BLACK LIQUOR RECOVERY BOILERS
a) Kraft or Sulfate Black Liquor Recovery boilers are used in the pulp and paper industry. Black liquor is a by-product of pulp processing. It contains organic and inorganic

constituents concentrated to at least 58% solids for firing in the recovery boilers. The organic material that is dissolved in the pulping process combusts and the spent pulping chemicals form a molten pool in the furnace. The molten material, or "smelt," drains from the furnace wall through smelt spouts into a smelt dissolving tank for recovery of the chemicals. Ultimately, the by-product of the recovery process is steam used for processing and power. Gas or oil auxiliary burners are used to start the self-sustaining black liquor combustion process and may be used to produce supplemental steam if sufficient liquor is not available.

2.2.12.~~3~~ 7 THERMAL FLUID HEATERS

a) Design and Operating Features

1) Many thermal fluid heaters are pressure vessels in which a synthetic or organic fluid is heated or vaporized. Some thermal fluid heaters operate at atmospheric pressure. The fluids are typically flammable, are heated above the liquid flash point, and may be heated above the liquid boiling point. The heaters are commonly direct-fired by combustion of a fuel or by electric resistance elements. Heater design may be similar to an electric resistance heated boiler, to a firetube boiler or, more commonly, to a watertube boiler. Depending on process heating requirements, the fluid may be vaporized with a natural circulation, but more often, the fluid is heated and circulated by pumping the liquid. Use of thermal fluid heating permits heating at a high temperature with a low system pressure (600°F to 700°F [316°C to 371°C] at pressures just above atmospheric]. To heat water to those temperatures, would require pressures of at least 1 530 psig (10.55 MPa).

2.2.12.~~4~~ 8 WASTE HEAT BOILERS

a) Waste heat boilers are usually of firetube or watertube type and obtain their heat from an external source or process in which a portion of the BTUs have been utilized. Generation of electrical energy is usually the primary application of waste heat boilers. The biggest disadvantage of this type of boiler is that it is not fired on the basis of load demand. Since the boiler does not have effective control over the amount of heat entering the boiler, there may be wide variations or fluctuations of metal temperatures. Waste process gasses are usually in a temperature range of 400°F (205°C) to 800°F (427°C), where combustion gasses of conventional-fired boilers are at about 2000°F (1093°C). Special design considerations are made to compensate for lower combustion gas temperatures such as the use of finned high-efficiency heat absorbing tubes, and by slowing the velocity of gasses through the boiler.

2.2.12.~~5~~ 1 CAST-IRON BOILERS

a) Cast-iron boilers are used in a variety of applications to produce low or high pressure steam and hot water heat. Cast-iron boilers should only be used in applications that allow for nearly 100% return of condensate or water, and are not typically used in process-type service. These boilers are designed to operate with minimum scale, mud, or sludge, which could occur if makeup water is added to this system.

2.2.12.~~6~~ ~~4~~ ELECTRIC BOILERS

a) Electric boilers are heated by an electrical energy source, either by use of electric resistant coils or induction coils. These boilers may be used in either high or low pressure steam or hot water applications.

2.2.12.~~7~~ ~~5~~ FIRED COIL WATER HEATERS

a) Fired coil water heaters are used for rapid heating of potable water or hot water service. This design utilizes a coil through which the water being heated is passed. This type of heater has very little volume and may be used in conjunction with a hot-water storage vessel.

2.2.12.~~8~~ ~~6~~ FIRED STORAGE WATER HEATERS

a) Fired storage water heaters are vertical pressure vessels containing water to which heat is applied. Typically gas burners are located directly beneath the storage vessel. These heaters should be insulated and fitted with an outer jacket and may be lined with porcelain, glass, galvanized metal, cement, or epoxy.

2.2.12.~~9~~ ~~2~~ FIRETUBE BOILERS

c) Firetube boilers are subject to thermal stresses due to cycling, which may cause tube leakage and corrosion of joints. The following items are common areas of inspection:

1) Waterside — scale buildup on and around the furnace tube. Scale on or around the firetubes in the first pass after the furnace (gas temperatures >1800°F [982°C]). Scale and corrosion buildup on stay rods hiding the actual diameter. Corrosion pitting on all pressure boundaries.

2) Fireside — Tube to tube sheet joint leakage. Look for rust trails left by weeping joints. When in doubt where the leakage is coming from, perform a liquid penetrant exam. Take note of refractory locations protecting steel that is not water cooled. Partial or complete removal of the refractory may be required for inspection purposes. Condensation of combustion gas dripping out of the fireside gaskets during a cold boiler start up is expected. However, if it continues after the water temperature in the boiler is at least 150°F (66°C), then investigation to determine the source of water shall be conducted.

~~h~~3) The fireside surfaces of tubes in horizontal firetube boilers usually deteriorate more rapidly at the ends nearest the fire. The Inspector should examine the tube ends to determine if there has been serious reduction in thickness. The tube surfaces in some vertical tube boilers are more susceptible to deterioration at the upper ends when exposed to the heat of combustion. These tube ends should be closely examined to determine if there has been a serious reduction in thickness. The upper tube sheet in a vertical “dry top” boiler should be inspected for evidence of overheating.

~~a~~4) All stays, whether diagonal or through, should be inspected to determine whether or not they are in even tension. Staybolt ends and the stayed plates should be examined to determine whether cracks exist. In addition, stayed plates should be inspected for bulging in the general area of the stay. Each staybolt end should be checked for excessive cold working (heading) and seal welds as evidence of a possible leakage problem. Stays or staybolts that are not in tension or adjustment should be repaired. Broken stays or staybolts shall be replaced.

~~b~~5) The Inspector should test firebox staybolts by tapping one end of each bolt with a hammer and, where practicable, a hammer or other heavy tool should be held on the opposite end to make the test more effective. An unbroken bolt should give a ringing sound while a broken bolt will give a hollow or non-responsive sound. Staybolts with telltale holes should be examined for evidence of leakage, which will indicate a broken or cracked bolt. Broken staybolts shall be replaced.

d) Practical considerations lead to the use of basically cylindrical shells. Flat-end tubesheet surfaces are supported by various methods: diagonal stays, through-bolts, or the tubes themselves. Tubes may be rolled, welded, or rolled and seal-welded into the tubesheets. For steam applications, the water level is maintained several inches above the uppermost row of tubes, which allows for a steam space in the upper portion of the boiler shell. There are several different types of firetube boilers:

NB08-1801
2.5.3 CONDITIONS

a) Check for evidence that the valve or device is leaking or not sealing properly. Evidence of leakage through pressure relief valves may indicate that the system is being operated at a pressure that is too close to the valve's set pressure. See Supplement 8.
b) Seals for adjustments should be intact and show no evidence of tampering.

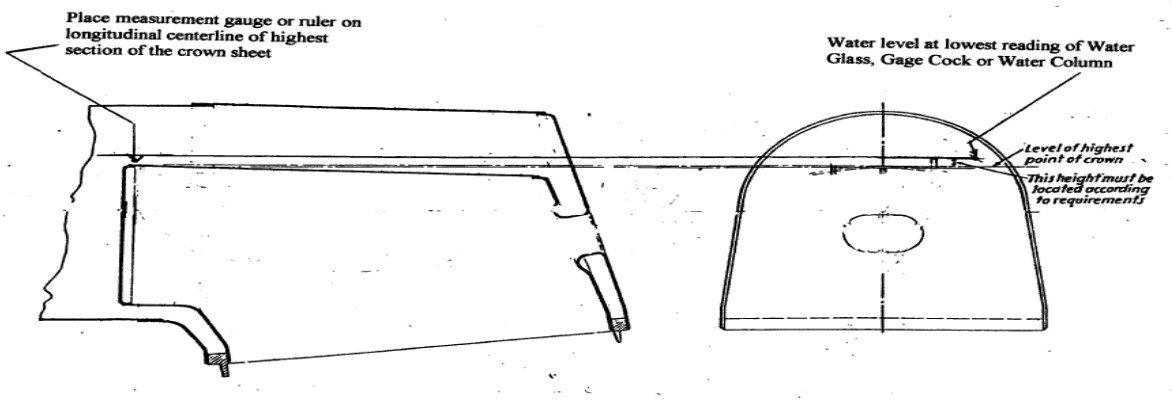
NB07-1012

S1.4.3 METHOD OF CHECKING HEIGHT OF WATER GAGE GLASS
The height of the bottom gage cock and water glass or water column above the highest section of the crown sheet should be checked to confirm it meets the height requirements for the service intended and those of the regulatory agency. It is especially important this be checked if the water glass location or piping was changed, or if a new crown sheet or complete firebox is installed.
Water Height Measurement Method
The following method is intended for use where it is possible to enter the boiler shell interior to measure the water level at the highest section of the crown sheet.
1. Level the locomotive in the longitudinal and transverse planes so that it is in the position used for normal operation.
2. Place a measurement gage or ruler on the longitudinal centerline of the highest section of the crown sheet. The measurement gage or ruler must be placed vertical and tangent to the highest section of the crown sheet.

3. Fill the boiler with water until water exits the lowest gage cock and/or is just visible at the bottom of the water glass or water column.
4. Measure the height of water over the crown sheet using the ruler or gage.
5 Record the height reading and compare it to the required height. Repeat Steps 3 to 5 and compare the readings of the first and second tests.

S1.4.3-a

Water Height Measurement Method



FLEXIBLE SPIRIT LEVEL METHOD

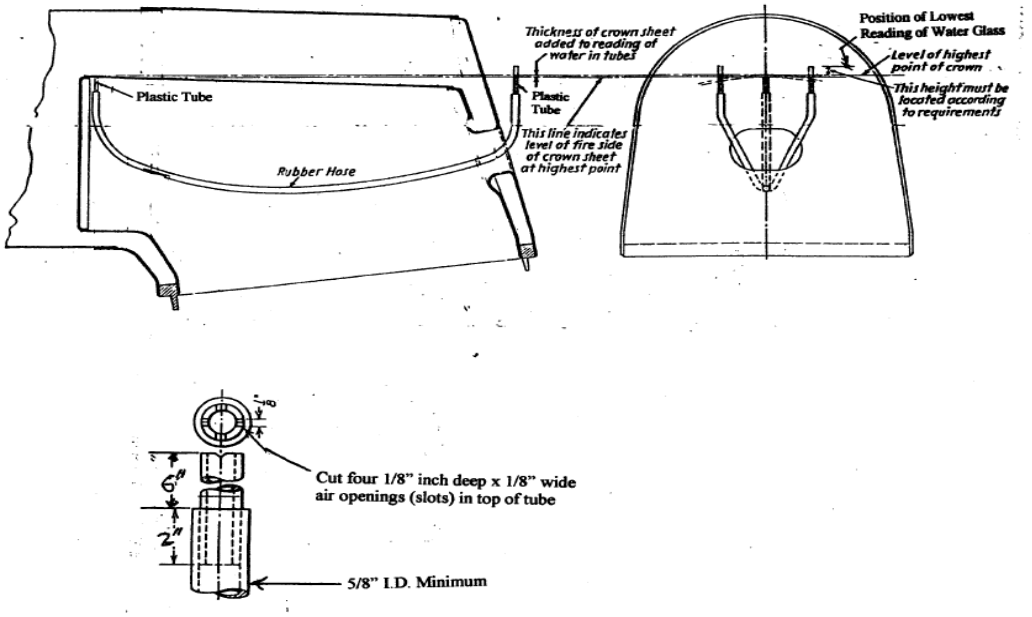
The following method is intended for use where it is difficult to enter the boiler shell interior to measure the water level. The method is based on use of a flexible spirit level made from flexible rubber hose and clear plastic tubing. The measurements are taken from the fireside of the crown sheet.

1. The flexible spirit hose is made from a suitable length of flexible rubber tubing, such as garden hose, with a minimum internal diameter of 5/8". The length must be long enough to extend from the front of the firebox to the back head without kinks or sharp bends. At each end of the hose fasten an 8" long piece or clear plastic tube using hose clamps. The upper end of each piece of tubing must have four 1/8" deep x 1/8" wide air openings (slots) cut into it in order to allow the air to be vented out when held against the crown sheet.
2. Fill the hose with water and bring the clear plastic tubes side by side vertically to observe the water level. If the level is not the same, there is an air bubble or other obstruction in the hose. Repair it and retest the water level before proceeding.
3. Level the locomotive in the longitudinal and transverse planes so that it is in the position used for normal operation.
4. Locate the approximate longitudinal centerline of the fireside of the crown sheet and the highest section of the crown sheet using a ruler and chalk.
5. Place one end of the hose against the approximate center of crown sheet at the highest point with the plastic tube held vertical.

6. Place the other end of the hose and tube against the back head exterior vertical centerline and hold vertically in a position slightly lower than the crown sheet.
7. Slowly raise the end of the hose held against the back head until water is discharged from the tube held against the crown sheet. Hold both tubes in position until the water stops flowing. At this point the level of water in the tube held at the back head will show the height of the bottom side of the crown sheet. Mark this water level position on the back head.
8. Repeat the measuring procedure several times, each time moving the tube held against the crown sheet laterally to another position to confirm the highest location of the crown sheet has been located. Mark the level position of each measurement on the back head.
9. Above the line on the back head obtained by the spirit level measurement make a second line of the same curvature but higher by a height equal to the crown sheet thickness plus the 1/8" deep slots cut into the tubing. This second line represents the top(waterside) of the crown sheet at the highest point.
10. Use the second line as the reference point for measurements to determine whether the water glasses and/or water column are located at the required height above the crown sheet. To simplify taking the measurements the second line can be extended across the back head by use of a long ruler and precision spirit level.

Flexible Spirit Level Method

S1.4.3-b



NB07-0914
S2.6.2

f) Recurring UT testing shall be performed by randomly checking 10% of original UT checks. Areas of thinning identified during previous inspections shall be given particular attention. If material loss is determined, additional testing may be requested by the Inspector.

g) Particular attention should be placed upon areas that typically exhibit thinning. These areas would include the ogee curve, the mudlegs, the fusible plug, around feedwater inlets, and around the firebox door ring.

~~g)~~ h) The owner/operator shall maintain the initial and recurring grid mapped UT readings in conjunction with the calculations in permanent boiler records. Documentation shall be available to the Inspector for review and acceptance.

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25	8.5
300	1163.	1224	1286	1347	1408	1469	1531	1592	1653	1714	1775	1837	1898	1959	2020	2082
325	1074	1130	1187	1243	1300	1356	1413	1469	1526	1582	1639	1695	1752	1808	1865	1921
350	997	1050	1102	1154	1207	1259	1312.	1364	1417	1469	1522	1574	1627	1679	1732	1784
375	931	980	1029	1078	1126	1175	1224	1273	1322	1371	1420	1469	1518	1567	1616	1665
400	872	918	964	1010	1056	1102	1148	1194	1240	1286	1332	1378	1423	1469	1515	1561
425	821	864	908	951	994	1037	1080	1124	1167	1210	1253	1296	1340	1383	1426	1469
450	775	816	857	898	939	980	1020	1061	1102	1143	1184	1224	1265	1306	1347	1388
475	735	773	812	851	889	928	967	1005	1044	1083	1121	1160	1199	1237	1276	1315
500	698	735	771	808	845	882	918	955	992	1029	1065	1102	1139	1175	1212	1249
525	665	700	735	770	805	840	875	910	945	980	1015	1050	1085	1119	1154	1189
550	634	668	701	735	768	801	835	868	902	935	968	1002	1035	1069	1102	1135
575	607	639	671	703	735	767	799	830	862	894	926	958	990	1022	1054	1086
600	582	612	643	673	704	735	765	796	827	857	888	918	949	980	1010	1041
625	558.	588	617	647	676	705	735	764	793	823	852	882	911	940	970	999
650	537	565	593	622	650	678	706	735	763	791	819	848	876	904	932	961
675	517	544	571	599	626	653	680	707	735	762	789	816	844	871	898	925
700	499.	525	551	577	603	630	656	682	708	735	761	787	813	840	866	892
725	481	507	532	557	583	608	633	659	684	709	735	760	785	811	836	861
750	465	490	514	539	563	588	612	637	661	686	710	735	759	784	808	833
775	450	474	498	521	545	569	592	616	640	664	687	711	735	758	782	806
800	436	459	482	505	528	551	574	597	620	643	666	689	712	735	758	781
825	423	445	468	490	512	534	557	579	601	623	646	668	690	712	735	757
850	411	432	454	475	497	519	540	562	583	605	627	648	670	691	713	735
875	399	420	441	462	483	504	525	546	567	588	609	630	651	672	693	714
900	388	408	429	449	469	490	510	531	551	571	592	612	633	653	673	694
925	377	397	417	437	457	477	496	516	536	556	576	596	616	635	655	675
950	367	387	406	425	445	464	483	503	522	541	561	580	599	619	638	657
975	358	377	396.	414	433	452	471	490	509	527	546	556	584	603	622	640
1000	349	367	386	404	422	441	459	478	496	514	533	551	569	588	606	624
1025	340	358	376	394	412	430	448	466	484	502	520	538	555	573	591	609
1050	332	350	367	385	402	420	437	455	472	490	507	525	542	560	577	595
1075	325.	342	359	376	393	410	427	444	461	478	495	513	530	547	564	581
1100	317	334	351	367	384	401	417	434	451	468	484	501	518	534	551	568
1125	310	327	343	359	375	392	408	424	441	457	473	490	506	522	539	555
1150	303	319	335	351	367	383	399	415	431	447	463	479	495	511	527	543

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 58 %
R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety, 6
P = MAWP, kPa

Table S2.10.3.1 Metric (Page 1 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Single Riveted Lap Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	8.75	9	9.25	9.5	9.78	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	12.25	12.5
300	2143	2204	2265	2326	2395	2449	2510	2571	2633	2694	2755	2816	2877	2939	3000	3061
325	1978	2034	2091	2147	2211	2261	2317	2374	2430	2487	2543	2600	2656	2713	2769	2826
350	1837	1889	1942	1994	2053	2099	2152	2204	2256	2309	2361	2414	2466	2519	2571	2624
375	1714	1763	1812	1861	1916	1959	2008	2057	2106	2155	2204	2253	2302	2351	2400	2449
400	1607	1653	1699	1745	1796	1837	1883	1929	1974	2020	2066	2112	2158	2204	2250	2296
425	1513	1556	1599	1642	1691	1729	1772	1815	1858	1901	1945	1988	2031	2074	2118	2161
450	1429	1469	1510	1551	1597	1633	1673	1714	1755	1796	1837	1877	1918	1959	2000	2041
475	1353	1392	1431	1469	1513	1547	1585	1624	1663	1701	1740	1779	1817	1856	1895	1933
500	1286	1322	1359	1396	1437	1469	1506	1543	1580	1616	1653	1690	1726	1763	1800	1837
525	1224	1259	1294	1329	1369	1399	1434	1469	1504	1539	1574	1609	1644	1679	1714	1749
550	1169	1202	1236	1269	1306	1336	1369	1403	1436	1469	1503	1536	1570	1603	1636	1670
575	1118	1150	1182	1214	1250	1278	1310	1342	1374	1405	1437	1469	1501	1533	1565	1597
600	1071	1102	1133	1163	1198	1224	1255	1286	1316	1347	1378	1408	1439	1469	1500	1531
625	1029	1058	1087	1117	1150	1175	1205	1234	1264	1293	1322	1352	1381	1411	1440	1469
650	989	1017	1045	1074	1105	1130	1159	1187	1215	1243	1272	1300	1328	1356	1385	1413
675	952	980	1007	1034	1064	1088	1116	1143	1170	1197	1224	1252	1279	1306	1333	1360
700	918	945	971	997	1026	1050	1076	1102	1128	1154	1181	1207	1233	1259	1286	1312
725	887	912	937	963	991	1013	1039	1064	1089	1115	1140	1165	1191	1216	1241	1267
750	857	882	906	931	958	980	1004	1029	1053	1078	1102	1126	1151	1175	1200	1224
775	829	853	877	901	927	948	972	995	1019	1043	1066	1090	1114	1138	1161	1185
800	804	827	849	872	898	918	941	964	987	1010	1033	1056	1079	1102	1125	1148
825	779	801	824	846	871	891	913	935	957	980	1002	1024	1046	1069	1091	1113
850	756	778	799	821	845	864	886	908	929	951	972	994	1016	1037	1059	1080
875	735	756	777	798	821	840	861	882	903	924	945	966	987	1008	1029	1050
900	714	735	755	775	798	816	837	857	878	898	918	939	959	980	1000	1020
925	695	715	735	755	777	794	814	834	854	874	894	913	933	953	973	993
950	677	696	715	735	756	773	793	812	831	851	870	889	909	928	947	967
975	659	678	697	716	737	754	772	791	810	829	848	867	885	904	923	942
1000	643	661	680	698	719	735	753	771	790	808	827	845	863	882	900	918
1025	627	645	663	681	701	717	735	753	771	788	806	824	842	860	878	896
1050	612	630	647	665	684	700	717	735	752	770	787	805	822	840	857	875
1075	598	615	632	649	668	683	700	718	735	752	769	786	803	820	837	854
1100	584	601	618	634	653	668	685	701	718	735	751	768	785	801	818	835
1125	571	588	604	620	639	653	669	686	702	718	735	751	767	784	800	816
1150	559	575	591	607	625	639	655	671	687	703	719	735	751	767	783	799

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 58 %
R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 6
P = MAWP, kPa

Table S2.10.3.1 Metric (Page 2 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Single Riveted Lap Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25	8.5
300	1484	1562	1640	1718	1797	1875	1953	2031	2109	2187	2265	2343	2421	2500	2578	2675.
325	1370	1442	1514	1586	1658	1730	1803	1875	1947	2019	2091	2163	2235	2307	2379	2469.
350	1272	1339	1406	1473	1540	1607	1674	1741	1808	1875	1942	2009	2076	2142	2209	2292.
375	1187	1250	1312	1375	1437	1500	1562	1625	1687	1750	1812	1875	1937	2000	2062	2140.
400	1113	1172	1230	1289	1347	1406	1465	1523	1582	1640	1699	1758	1816	1875	1933	2006.
425	1048	1103	1158	1213	1268	1323	1378	1434	1489	1544	1599	1654	1709	1764	1820	1888.
450	989	1041	1094	1146	1198	1250	1302	1354	1406	1458	1510	1562	1614	1666	1718	1783.
475	937	987	1036	1085	1135	1184	1233	1283	1332	1381	1431	1480	1529	1579	1628	1689.
500	890	937	984	1031	1078	1125	1172	1219	1265	1312	1359	1406	1453	1500	1547	1605.
525	848	893	937	982	1027	1071	1116	1161	1205	1250	1294	1339	1384	1428	1473	1528.
550	810	852	895	937	980	1023	1065	1108	1150	1193	1236	1278	1321	1363	1406	1459.
575	774	815	856	897	937	978	1019	1060	1100	1141	1182	1223	1263	1304	1345	1395.
600	742	781	820	859	898	937	976	1015	1055	1094	1133	1172	1211	1250	1289	1337.
625	712	750	787	825	862	900	937	975	1012	1050	1087	1125	1162	1200	1237	1284.
650	685	721	757	793	829	865	901	937	973	1009	1045	1082	1118	1154	1190	1234.
675	660	694	729	764	798	833	868	903	937	972	1007	1041	1076	1111	1146	1189.
700	636	670	703	736	770	803	837	870	904	937	971	1004	1038	1071	1105	1146.
725	614	646	679	711	743	776	808	840	873	905	937	970	1002	1034	1067	1107.
750	594	625	656	687	719	750	781	812	844	875	906	937	969	1000	1031	1070.
775	574	605	635	665	695	726	756	786	816	847	877	907	937	968	998	1035.
800	557	586	615	644	674	703	732	762	791	820	849	879	908	937	967	1003.
825	540	568	596	625	653	682	710	739	767	795	824	852	881	909	937	973.
850	524	551	579	607	634	662	689	717	744	772	799	827	855	882	910	944.
875	509	536	562	589	616	643	670	696	723	750	777	803	830	857	884	917.
900	495	521	547	573	599	625	651	677	703	729	755	781	807	833	859	892.
925	481	507	532	557	583	608	633	659	684	709	735	760	785	811	836	867.
950	469	493	518	543	567	592	617	641	666	691	715	740	765	789	814	845.
975	457	481	505	529	553	577	601	625	649	673	697	721	745	769	793	823.
1000	445	469	492	516	539	562	586	609	633	656	680	703	726	750	773	802.
1025	434	457	480	503	526	549	572	594	617	640	663	686	709	732	754	783.
1050	424	446	469	491	513	536	558	580	603	625	647	670	692	714	736	764.
1075	414	436	458	480	501	523	545	567	589	610	632	654	676	698	719	746.
1100	405	426	447	469	490	511	533	554	575	596	618	639	660	682	703	729.
1125	396	417	437	458	479	500	521	542	562	583	604	625	646	667	687	713.
1150	387	408	428	448	469	489	509	530	550	571	591	611	632	652	672	698.

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 74 %

R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 6
P = MAWP, kPa

Table S2.10.3.2 Metric (Page 1 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Double Riveted Lap Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	8.75	9	9.25	9.5	9.78	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	12.25	12.5
300	2734	2812	2890	2968	3056	3124	3203	3281	3359	3437	3515	3593	3671	3749	3827	3906
325	2524	2596	2668	2740	2821	2884	2956	3028	3100	3173	3245	3317	3389	3461	3533	3605
350	2343	2410	2477	2544	2619	2678	2745	2812	2879	2946	3013	3080	3147	3214	3281	3348
375	2187	2250	2312	2375	2445	2500	2562	2625	2687	2750	2812	2874	2937	2999	3062	3124
400	2050	2109	2168	2226	2292	2343	2402	2461	2519	2578	2636	2695	2753	2812	2871	2929
425	1930	1985	2040	2095	2157	2205	2261	2316	2371	2426	2481	2536	2591	2647	2702	2757
450	1823	1875	1927	1979	2037	2083	2135	2187	2239	2291	2343	2395	2447	2500	2552	2604
475	1727	1776	1825	1875	1930	1973	2023	2072	2121	2171	2220	2269	2319	2368	2417	2467
500	1640	1687	1734	1781	1833	1875	1922	1968	2015	2062	2109	2156	2203	2250	2296	2343
525	1562	1607	1651	1696	1746	1785	1830	1875	1919	1964	2009	2053	2098	2142	2187	2232
550	1491	1534	1576	1619	1667	1704	1747	1789	1832	1875	1917	1960	2002	2045	2088	2130
575	1426	1467	1508	1549	1594	1630	1671	1712	1752	1793	1834	1875	1915	1956	1997	2038
600	1367	1406	1445	1484	1528	1562	1601	1640	1679	1718	1758	1797	1836	1875	1914	1953
625	1312	1350	1387	1425	1467	1500	1537	1575	1612	1650	1687	1725	1762	1800	1837	1875
650	1262	1298	1334	1370	1410	1442	1478	1514	1550	1586	1622	1658	1694	1730	1767	1803
675	1215	1250	1284	1319	1358	1389	1423	1458	1493	1528	1562	1597	1632	1666	1701	1736
700	1172	1205	1239	1272	1310	1339	1373	1406	1439	1473	1506	1540	1573	1607	1640	1674
725	1131	1164	1196	1228	1264	1293	1325	1358	1390	1422	1454	1487	1519	1551	1584	1616
750	1094	1125	1156	1187	1222	1250	1281	1312	1344	1375	1406	1437	1468	1500	1531	1562
775	1058	1089	1119	1149	1183	1209	1240	1270	1300	1330	1361	1391	1421	1451	1482	1512
800	1025	1055	1084	1113	1146	1172	1201	1230	1260	1289	1318	1347	1377	1406	1435	1465
825	994	1023	1051	1079	1111	1136	1165	1193	1221	1250	1278	1307	1335	1363	1392	1420
850	965	992	1020	1048	1078	1103	1130	1158	1185	1213	1241	1268	1296	1323	1351	1378
875	937	964	991	1018	1048	1071	1098	1125	1152	1178	1205	1232	1259	1285	1312	1339
900	911	937	963	989	1019	1041	1068	1094	1120	1146	1172	1198	1224	1250	1276	1302
925	887	912	937	963	991	1013	1039	1064	1089	1115	1140	1165	1191	1216	1241	1267
950	863	888	913	937	965	987	1011	1036	1061	1085	1110	1135	1159	1184	1209	1233
975	841	865	889	913	940	961	985	1009	1033	1058	1082	1106	1130	1154	1178	1202
1000	820	844	867	890	917	937	961	984	1008	1031	1055	1078	1101	1125	1148	1172
1025	800	823	846	869	894	914	937	960	983	1006	1029	1052	1075	1097	1120	1143
1050	781	803	826	848	873	893	915	937	960	982	1004	1027	1049	1071	1094	1116
1075	763	785	807	828	853	872	894	916	937	959	981	1003	1025	1046	1068	1090
1100	746	767	788	810	833	852	873	895	916	937	959	980	1001	1023	1044	1065
1125	729	750	771	792	815	833	854	875	896	917	937	958	979	1000	1021	1041
1150	713	734	754	774	797	815	835	856	876	897	917	937	958	978	998	1019

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 74 %
R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 6
P = MAWP, kPa

Table S2.10.3.2 Metric (Page 2 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Double Riveted Lap Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25	8.5
300	1564	1647	1729	1811	1894	1976	2058	2141	2223	2305	2388	2470	2552	2635	2717	2799
325	1444	1520	1596	1672	1748	1824	1900	1976	2052	2128	2204	2280	2356	2432	2508	2584
350	1341	1411	1482	1553	1623	1694	1764	1835	1905	1976	2047	2117	2188	2258	2329	2399
375	1251	1317	1383	1449	1515	1581	1647	1713	1778	1844	1910	1976	2042	2108	2174	2239
400	1173	1235	1297	1359	1420	1482	1544	1606	1667	1729	1791	1853	1914	1976	2038	2100
425	1104	1162	1220	1279	1337	1395	1453	1511	1569	1627	1685	1744	1802	1860	1918	1976
450	1043	1098	1153	1208	1262	1317	1372	1427	1482	1537	1592	1647	1702	1756	1811	1866
475	988	1040	1092	1144	1196	1248	1300	1352	1404	1456	1508	1560	1612	1664	1716	1768
500	939	988	1037	1087	1136	1186	1235	1284	1334	1383	1433	1482	1531	1581	1630	1680
525	894	941	988	1035	1082	1129	1176	1223	1270	1317	1364	1411	1458	1506	1553	1600
550	853	898	943	988	1033	1078	1123	1168	1213	1257	1302	1347	1392	1437	1482	1527
575	816	859	902	945	988	1031	1074	1117	1160	1203	1246	1289	1332	1375	1418	1461
600	782	823	865	906	947	988	1029	1070	1112	1153	1194	1235	1276	1317	1359	1400
625	751	790	830	869	909	948	988	1028	1067	1107	1146	1186	1225	1265	1304	1344
650	722	760	798	836	874	912	950	988	1026	1064	1102	1140	1178	1216	1254	1292
675	695	732	768	805	842	878	915	951	988	1025	1061	1098	1134	1171	1208	1244
700	670	706	741	776	812	847	882	917	953	988	1023	1059	1094	1129	1164	1200
725	647	681	715	750	784	818	852	886	920	954	988	1022	1056	1090	1124	1158
750	626	659	692	725	757	790	823	856	889	922	955	988	1021	1054	1087	1120
775	606	637	669	701	733	765	797	829	861	892	924	956	988	1020	1052	1084
800	587	618	648	679	710	741	772	803	834	865	895	926	957	988	1019	1050
825	569	599	629	659	689	719	748	778	808	838	868	898	928	958	988	1018
850	552	581	610	639	668	697	726	756	785	814	843	872	901	930	959	988
875	536	565	593	621	649	677	706	734	762	790	819	847	875	903	932	960
900	521	549	576	604	631	659	686	714	741	768	796	823	851	878	906	933
925	507	534	561	587	614	641	668	694	721	748	774	801	828	854	881	908
950	494	520	546	572	598	624	650	676	702	728	754	780	806	832	858	884
975	481	507	532	557	583	608	633	659	684	709	735	760	785	811	836	861
1000	469	494	519	543	568	593	618	642	667	692	716	741	766	790	815	840
1025	458	482	506	530	554	578	602	627	651	675	699	723	747	771	795	819
1050	447	470	494	518	541	565	588	612	635	659	682	706	729	753	776	800
1075	437	460	483	505	528	551	574	597	620	643	666	689	712	735	758	781
1100	427	449	472	494	516	539	561	584	606	629	651	674	696	719	741	763
1125	417	439	461	483	505	527	549	571	593	615	637	659	681	703	725	746
1150	408	430	451	473	494	515	537	558	580	601	623	644	666	687	709	730

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 78 %

R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 6
P = MAWP, kPa

Table S2.10.3.3 Metric (Page 1 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Triple Riveted Lap Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	8.75	9	9.25	9.5	9.78	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	12.25	12.5
300	2882	2964	3046	3129	3221	3293	3376	3458	3540	3623	3705	3787	3870	3952	4034	4158.
325	2660	2736	2812	2888	2973	3040	3116	3192	3268	3344	3420	3496	3572	3648	3724	3838.
350	2470	2541	2611	2682	2761	2823	2893	2964	3035	3105	3176	3246	3317	3387	3458	3564.
375	2305	2371	2437	2503	2577	2635	2701	2766	2832	2898	2964	3030	3096	3162	3227	3326.
400	2161	2223	2285	2347	2416	2470	2532	2594	2655	2717	2779	2841	2902	2964	3026	3118.
425	2034	2092	2150	2208	2274	2325	2383	2441	2499	2557	2615	2673	2732	2790	2848	2935.
450	1921	1976	2031	2086	2147	2196	2250	2305	2360	2415	2470	2525	2580	2635	2690	2772.
475	1820	1872	1924	1976	2034	2080	2132	2184	2236	2288	2340	2392	2444	2496	2548	2626.
500	1729	1778	1828	1877	1933	1976	2025	2075	2124	2174	2223	2272	2322	2371	2421	2495.
525	1647	1694	1741	1788	1841	1882	1929	1976	2023	2070	2117	2164	2211	2258	2305	2376.
550	1572	1617	1662	1707	1757	1796	1841	1886	1931	1976	2021	2066	2111	2156	2201	2268.
575	1503	1546	1589	1632	1680	1718	1761	1804	1847	1890	1933	1976	2019	2062	2105	2169.
600	1441	1482	1523	1564	1610	1647	1688	1729	1770	1811	1853	1894	1935	1976	2017	2079.
625	1383	1423	1462	1502	1546	1581	1620	1660	1699	1739	1778	1818	1857	1897	1936	1996.
650	1330	1368	1406	1444	1487	1520	1558	1596	1634	1672	1710	1748	1786	1824	1862	1919.
675	1281	1317	1354	1391	1432	1464	1500	1537	1573	1610	1647	1683	1720	1756	1793	1848.
700	1235	1270	1306	1341	1380	1411	1447	1482	1517	1553	1588	1623	1658	1694	1729	1782.
725	1192	1226	1261	1295	1333	1363	1397	1431	1465	1499	1533	1567	1601	1635	1669	1720.
750	1153	1186	1219	1251	1288	1317	1350	1383	1416	1449	1482	1515	1548	1581	1614	1663.
775	1115	1147	1179	1211	1247	1275	1307	1339	1370	1402	1434	1466	1498	1530	1562	1609.
800	1081	1112	1142	1173	1208	1235	1266	1297	1328	1359	1389	1420	1451	1482	1513	1559.
825	1048	1078	1108	1138	1171	1198	1228	1257	1287	1317	1347	1377	1407	1437	1467	1512.
850	1017	1046	1075	1104	1137	1162	1191	1220	1250	1279	1308	1337	1366	1395	1424	1467.
875	988	1016	1044	1073	1104	1129	1157	1186	1214	1242	1270	1299	1327	1355	1383	1425.
900	961	988	1015	1043	1074	1098	1125	1153	1180	1208	1235	1262	1290	1317	1345	1386.
925	935	961	988	1015	1045	1068	1095	1122	1148	1175	1202	1228	1255	1282	1308	1348.
950	910	936	962	988	1017	1040	1066	1092	1118	1144	1170	1196	1222	1248	1274	1313.
975	887	912	937	963	991	1013	1039	1064	1089	1115	1140	1165	1191	1216	1241	1279.
1000	865	889	914	939	966	988	1013	1037	1062	1087	1112	1136	1161	1186	1210	1247.
1025	843	868	892	916	943	964	988	1012	1036	1060	1084	1108	1133	1157	1181	1217.
1050	823	847	870	894	920	941	964	988	1012	1035	1059	1082	1106	1129	1153	1188.
1075	804	827	850	873	899	919	942	965	988	1011	1034	1057	1080	1103	1126	1160.
1100	786	808	831	853	878	898	921	943	966	988	1010	1033	1055	1078	1100	1134.
1125	768	790	812	834	859	878	900	922	944	966	988	1010	1032	1054	1076	1109.
1150	752	773	795	816	840	859	881	902	924	945	967	988	1009	1031	1052	1085.

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 78 %

R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 6
P = MAWP, kPa

Table S2.10.3.3 Metric (Page 2 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Triple Riveted Lap Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25	8.5
300	1973	2077	2181	2285	2389	2493	2597	2701	2804	2908	3012	3116	3220	3324	3428	3531
325	1822	1918	2013	2109	2205	2301	2397	2493	2589	2685	2780	2876	2972	3068	3164	3260
350	1692	1781	1870	1959	2048	2137	2226	2315	2404	2493	2582	2671	2760	2849	2938	3027
375	1579	1662	1745	1828	1911	1994	2077	2160	2244	2327	2410	2493	2576	2659	2742	2825
400	1480	1558	1636	1714	1792	1870	1948	2025	2103	2181	2259	2337	2415	2493	2571	2649
425	1393	1466	1540	1613	1686	1760	1833	1906	1980	2053	2126	2200	2273	2346	2419	2493
450	1316	1385	1454	1523	1593	1662	1731	1800	1870	1939	2008	2077	2147	2216	2285	2354
475	1246	1312	1378	1443	1509	1574	1640	1706	1771	1837	1902	1968	2034	2099	2165	2230
500	1184	1246	1309	1371	1433	1496	1558	1620	1683	1745	1807	1870	1932	1994	2057	2119
525	1128	1187	1246	1306	1365	1424	1484	1543	1603	1662	1721	1781	1840	1899	1959	2018
550	1076	1133	1190	1246	1303	1360	1416	1473	1530	1586	1643	1700	1756	1813	1870	1926
575	1030	1084	1138	1192	1246	1301	1355	1409	1463	1517	1572	1626	1680	1734	1788	1843
600	987	1039	1091	1143	1194	1246	1298	1350	1402	1454	1506	1558	1610	1662	1714	1766
625	947	997	1047	1097	1147	1197	1246	1296	1346	1396	1446	1496	1546	1595	1645	1695
650	911	959	1007	1055	1103	1151	1198	1246	1294	1342	1390	1438	1486	1534	1582	1630
675	877	923	969	1016	1062	1108	1154	1200	1246	1293	1339	1385	1431	1477	1523	1570
700	846	890	935	979	1024	1068	1113	1157	1202	1246	1291	1335	1380	1424	1469	1513
725	817	860	903	946	989	1032	1074	1117	1160	1203	1246	1289	1332	1375	1418	1461
750	789	831	872	914	956	997	1039	1080	1122	1163	1205	1246	1288	1329	1371	1413
775	764	804	844	885	925	965	1005	1045	1086	1126	1166	1206	1246	1287	1327	1367
800	740	779	818	857	896	935	974	1013	1052	1091	1130	1169	1207	1246	1285	1324
825	718	755	793	831	869	906	944	982	1020	1058	1095	1133	1171	1209	1246	1284
850	697	733	770	806	843	880	916	953	990	1026	1063	1100	1136	1173	1210	1246
875	677	712	748	783	819	855	890	926	962	997	1033	1068	1104	1140	1175	1211
900	658	692	727	762	796	831	866	900	935	969	1004	1039	1073	1108	1143	1177
925	640	674	707	741	775	808	842	876	910	943	977	1011	1044	1078	1112	1145
950	623	656	689	722	754	787	820	853	886	918	951	984	1017	1050	1082	1115
975	607	639	671	703	735	767	799	831	863	895	927	959	991	1023	1055	1087
1000	592	623	654	686	717	748	779	810	841	872	904	935	966	997	1028	1059
1025	578	608	638	669	699	730	760	790	821	851	882	912	942	973	1003	1034
1050	564	594	623	653	683	712	742	772	801	831	861	890	920	950	979	1009
1075	551	580	609	638	667	696	725	754	783	812	841	870	899	928	957	986
1100	538	567	595	623	652	680	708	737	765	793	821	850	878	906	935	963
1125	526	554	582	609	637	665	692	720	748	776	803	831	859	886	914	942
1150	515	542	569	596	623	650	677	704	732	759	786	813	840	867	894	921

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 82 %

R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 5
P = MAWP, kPa

Table S2.10.3.4 Metric (Page 1 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Buttstrap Double Riveted Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	8.75	9	9.25	9.5	9.75	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	12.25	12.5
300	3635	3739	3843	3947	4051	4155	4259	4362	4466	4570	4674	4778	4882	4986	5089	5193
325	3356	3452	3547	3643	3739	3835	3931	4027	4123	4219	4314	4410	4506	4602	4698	4794
350	3116	3205	3294	3383	3472	3561	3650	3739	3828	3917	4006	4095	4184	4273	4362	4451
375	2908	2991	3074	3158	3241	3324	3407	3490	3573	3656	3739	3822	3905	3988	4072	4155
400	2727	2804	2882	2960	3038	3116	3194	3272	3350	3428	3506	3583	3661	3739	3817	3895
425	2566	2639	2713	2786	2859	2933	3006	3079	3153	3226	3299	3373	3446	3519	3593	3666
450	2424	2493	2562	2631	2701	2770	2839	2908	2978	3047	3116	3185	3254	3324	3393	3462
475	2296	2362	2427	2493	2558	2624	2690	2755	2821	2886	2952	3018	3083	3149	3214	3280
500	2181	2244	2306	2368	2430	2493	2555	2617	2680	2742	2804	2867	2929	2991	3054	3116
525	2077	2137	2196	2255	2315	2374	2433	2493	2552	2612	2671	2730	2790	2849	2908	2968
550	1983	2040	2096	2153	2210	2266	2323	2379	2436	2493	2549	2606	2663	2719	2776	2833
575	1897	1951	2005	2059	2113	2168	2222	2276	2330	2384	2439	2493	2547	2601	2655	2710
600	1818	1870	1922	1973	2025	2077	2129	2181	2233	2285	2337	2389	2441	2493	2545	2597
625	1745	1795	1845	1895	1944	1994	2044	2094	2144	2194	2244	2293	2343	2393	2443	2493
650	1678	1726	1774	1822	1870	1918	1965	2013	2061	2109	2157	2205	2253	2301	2349	2397
675	1616	1662	1708	1754	1800	1847	1893	1939	1985	2031	2077	2123	2170	2216	2262	2308
700	1558	1603	1647	1692	1736	1781	1825	1870	1914	1959	2003	2048	2092	2137	2181	2226
725	1504	1547	1590	1633	1676	1719	1762	1805	1848	1891	1934	1977	2020	2063	2106	2149
750	1454	1496	1537	1579	1620	1662	1703	1745	1787	1828	1870	1911	1953	1994	2036	2077
775	1407	1447	1488	1528	1568	1608	1648	1689	1729	1769	1809	1849	1890	1930	1970	2010
800	1363	1402	1441	1480	1519	1558	1597	1636	1675	1714	1753	1792	1831	1870	1909	1948
825	1322	1360	1397	1435	1473	1511	1549	1586	1624	1662	1700	1737	1775	1813	1851	1888
850	1283	1320	1356	1393	1430	1466	1503	1540	1576	1613	1650	1686	1723	1760	1796	1833
875	1246	1282	1318	1353	1389	1424	1460	1496	1531	1567	1603	1638	1674	1709	1745	1781
900	1212	1246	1281	1316	1350	1385	1420	1454	1489	1523	1558	1593	1627	1662	1696	1731
925	1179	1213	1246	1280	1314	1347	1381	1415	1449	1482	1516	1550	1583	1617	1651	1684
950	1148	1181	1214	1246	1279	1312	1345	1378	1410	1443	1476	1509	1542	1574	1607	1640
975	1119	1151	1182	1214	1246	1278	1310	1342	1374	1406	1438	1470	1502	1534	1566	1598
1000	1091	1122	1153	1184	1215	1246	1278	1309	1340	1371	1402	1433	1465	1496	1527	1558
1025	1064	1094	1125	1155	1186	1216	1246	1277	1307	1338	1368	1398	1429	1459	1490	1520
1050	1039	1068	1098	1128	1157	1187	1217	1246	1276	1306	1335	1365	1395	1424	1454	1484
1075	1015	1043	1072	1101	1130	1159	1188	1217	1246	1275	1304	1333	1362	1391	1420	1449
1100	991	1020	1048	1076	1105	1133	1161	1190	1218	1246	1275	1303	1331	1360	1388	1416
1125	969	997	1025	1053	1080	1108	1136	1163	1191	1219	1246	1274	1302	1329	1357	1385
1150	948	975	1003	1030	1057	1084	1111	1138	1165	1192	1219	1246	1273	1301	1328	1355

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 82 %

R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 5
P = MAWP, kPa

Table S2.10.3.4 Metric (Page 2 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Buttstrap Double Riveted Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25	8.5
300	2118	2229	2341	2452	2564	2675	2787	2898	3010	3121	3233	3344	3455	3567	3678	3790
325	1955	2058	2161	2264	2367	2469	2572	2675	2778	2881	2984	3087	3190	3293	3395	3498
350	1815	1911	2006	2102	2197	2293	2389	2484	2580	2675	2771	2866	2962	3057	3153	3248
375	1694	1783	1873	1962	2051	2140	2229	2319	2408	2497	2586	2675	2764	2854	2943	3032
400	1588	1672	1756	1839	1923	2006	2090	2174	2257	2341	2424	2508	2592	2675	2759	2842
425	1495	1574	1652	1731	1810	1888	1967	2046	2124	2203	2282	2360	2439	2518	2597	2675
450	1412	1486	1561	1635	1709	1783	1858	1932	2006	2081	2155	2229	2304	2378	2452	2527
475	1338	1408	1478	1549	1619	1690	1760	1830	1901	1971	2042	2112	2182	2253	2323	2394
500	1271	1338	1404	1471	1538	1605	1672	1739	1806	1873	1940	2006	2073	2140	2207	2274
525	1210	1274	1338	1401	1465	1529	1592	1656	1720	1783	1847	1911	1975	2038	2102	2166
550	1155	1216	1277	1338	1398	1459	1520	1581	1642	1702	1763	1824	1885	1946	2006	2067
575	1105	1163	1221	1279	1338	1396	1454	1512	1570	1628	1687	1745	1803	1861	1919	1977
600	1059	1115	1170	1226	1282	1338	1393	1449	1505	1561	1616	1672	1728	1783	1839	1895
625	1017	1070	1124	1177	1231	1284	1338	1391	1445	1498	1552	1605	1659	1712	1766	1819
650	977	1029	1080	1132	1183	1235	1286	1338	1389	1440	1492	1543	1595	1646	1698	1749
675	941	991	1040	1090	1139	1189	1239	1288	1338	1387	1437	1486	1536	1585	1635	1684
700	908	955	1003	1051	1099	1147	1194	1242	1290	1338	1385	1433	1481	1529	1576	1624
725	876	922	969	1015	1061	1107	1153	1199	1245	1291	1338	1384	1430	1476	1522	1568
750	847	892	936	981	1025	1070	1115	1159	1204	1248	1293	1338	1382	1427	1471	1516
775	820	863	906	949	992	1036	1079	1122	1165	1208	1251	1294	1338	1381	1424	1467
800	794	836	878	920	961	1003	1045	1087	1129	1170	1212	1254	1296	1338	1379	1421
825	770	811	851	892	932	973	1013	1054	1094	1135	1175	1216	1257	1297	1338	1378
850	747	787	826	866	905	944	984	1023	1062	1102	1141	1180	1220	1259	1298	1338
875	726	764	803	841	879	917	955	994	1032	1070	1108	1147	1185	1223	1261	1299
900	706	743	780	817	855	892	929	966	1003	1040	1078	1115	1152	1189	1226	1263
925	687	723	759	795	831	868	904	940	976	1012	1048	1085	1121	1157	1193	1229
950	669	704	739	774	810	845	880	915	950	986	1021	1056	1091	1126	1162	1197
975	652	686	720	755	789	823	857	892	926	960	995	1029	1063	1098	1132	1166
1000	635	669	702	736	769	803	836	869	903	936	970	1003	1037	1070	1104	1137
1025	620	652	685	718	750	783	816	848	881	913	946	979	1011	1044	1077	1109
1050	605	637	669	701	732	764	796	828	860	892	924	955	987	1019	1051	1083
1075	591	622	653	684	715	747	778	809	840	871	902	933	964	995	1027	1058
1100	578	608	638	669	699	730	760	790	821	851	882	912	942	973	1003	1034
1125	565	594	624	654	684	713	743	773	803	832	862	892	921	951	981	1011
1150	552	582	611	640	669	698	727	756	785	814	843	872	901	931	960	989

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 88 %
R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 5
P = MAWP, kPa

Table S2.10.3.5 Metric (Page 1 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Buttstrap Triple Riveted Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	8.75	9	9.25	9.5	9.75	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	12.25	12.5
300	3901	4013	4124	4236	4347	4459	4570	4682	4793	4905	5016	5127	5239	5350	5462	5573
325	3601	3704	3807	3910	4013	4116	4219	4321	4424	4527	4630	4733	4836	4939	5042	5145
350	3344	3440	3535	3631	3726	3822	3917	4013	4108	4204	4299	4395	4491	4586	4682	4777
375	3121	3210	3299	3389	3478	3567	3656	3745	3834	3924	4013	4102	4191	4280	4369	4459
400	2926	3010	3093	3177	3260	3344	3428	3511	3595	3678	3762	3846	3929	4013	4096	4180
425	2754	2833	2911	2990	3069	3147	3226	3305	3383	3462	3541	3619	3698	3777	3855	3934
450	2601	2675	2750	2824	2898	2972	3047	3121	3195	3270	3344	3418	3493	3567	3641	3716
475	2464	2534	2605	2675	2746	2816	2886	2957	3027	3098	3168	3238	3309	3379	3450	3520
500	2341	2408	2475	2541	2608	2675	2742	2809	2876	2943	3010	3076	3143	3210	3277	3344
525	2229	2293	2357	2420	2484	2548	2612	2675	2739	2803	2866	2930	2994	3057	3121	3185
550	2128	2189	2250	2310	2371	2432	2493	2554	2614	2675	2736	2797	2858	2918	2979	3040
575	2035	2094	2152	2210	2268	2326	2384	2443	2501	2559	2617	2675	2733	2792	2850	2908
600	1951	2006	2062	2118	2174	2229	2285	2341	2397	2452	2508	2564	2619	2675	2731	2787
625	1873	1926	1980	2033	2087	2140	2194	2247	2301	2354	2408	2461	2515	2568	2622	2675
650	1801	1852	1904	1955	2006	2058	2109	2161	2212	2264	2315	2367	2418	2469	2521	2572
675	1734	1783	1833	1883	1932	1982	2031	2081	2130	2180	2229	2279	2328	2378	2427	2477
700	1672	1720	1768	1815	1863	1911	1959	2006	2054	2102	2150	2197	2245	2293	2341	2389
725	1614	1660	1707	1753	1799	1845	1891	1937	1983	2029	2076	2122	2168	2214	2260	2306
750	1561	1605	1650	1694	1739	1783	1828	1873	1917	1962	2006	2051	2096	2140	2185	2229
775	1510	1553	1596	1640	1683	1726	1769	1812	1855	1899	1942	1985	2028	2071	2114	2157
800	1463	1505	1547	1588	1630	1672	1714	1756	1797	1839	1881	1923	1965	2006	2048	2090
825	1419	1459	1500	1540	1581	1621	1662	1702	1743	1783	1824	1865	1905	1946	1986	2027
850	1377	1416	1456	1495	1534	1574	1613	1652	1692	1731	1770	1810	1849	1888	1928	1967
875	1338	1376	1414	1452	1490	1529	1567	1605	1643	1682	1720	1758	1796	1834	1873	1911
900	1300	1338	1375	1412	1449	1486	1523	1561	1598	1635	1672	1709	1746	1783	1821	1858
925	1265	1301	1338	1374	1410	1446	1482	1518	1555	1591	1627	1663	1699	1735	1771	1808
950	1232	1267	1302	1338	1373	1408	1443	1478	1514	1549	1584	1619	1654	1690	1725	1760
975	1200	1235	1269	1303	1338	1372	1406	1440	1475	1509	1543	1578	1612	1646	1681	1715
1000	1170	1204	1237	1271	1304	1338	1371	1404	1438	1471	1505	1538	1572	1605	1639	1672
1025	1142	1174	1207	1240	1272	1305	1338	1370	1403	1435	1468	1501	1533	1566	1599	1631
1050	1115	1147	1178	1210	1242	1274	1306	1338	1369	1401	1433	1465	1497	1529	1561	1592
1075	1089	1120	1151	1182	1213	1244	1275	1306	1338	1369	1400	1431	1462	1493	1524	1555
1100	1064	1094	1125	1155	1186	1216	1246	1277	1307	1338	1368	1398	1429	1459	1490	1520
1125	1040	1070	1100	1130	1159	1189	1219	1248	1278	1308	1338	1367	1397	1427	1456	1486
1150	1018	1047	1076	1105	1134	1163	1192	1221	1250	1279	1309	1338	1367	1396	1425	1454

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 88 %
R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 5
P = MAWP, kPa

Table S2.10.3.5 Metric (Page 2 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Buttstrap Triple Riveted Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)														
	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25
300	2262	2381	2500	2619	2739	2858	2977	3096	3215	3334	3453	3572	3691	3810	3929
325	2088	2198	2308	2418	2528	2638	2748	2858	2968	3077	3187	3297	3407	3517	3627
350	1939	2041	2143	2245	2347	2449	2551	2653	2756	2858	2960	3062	3164	3266	3368
375	1810	1905	2000	2096	2191	2286	2381	2477	2572	2667	2762	2858	2953	3048	3143
400	1697	1786	1875	1965	2054	2143	2233	2322	2411	2500	2590	2679	2768	2858	2947
425	1597	1681	1765	1849	1933	2017	2101	2185	2269	2353	2437	2521	2605	2690	2774
450	1508	1588	1667	1746	1826	1905	1984	2064	2143	2223	2302	2381	2461	2540	2619
475	1429	1504	1579	1654	1730	1805	1880	1955	2030	2106	2181	2256	2331	2406	2482
500	1357	1429	1500	1572	1643	1715	1786	1857	1929	2000	2072	2143	2215	2286	2358
525	1293	1361	1429	1497	1565	1633	1701	1769	1837	1905	1973	2041	2109	2177	2245
550	1234	1299	1364	1429	1494	1559	1624	1689	1754	1818	1883	1948	2013	2078	2143
575	1180	1242	1305	1367	1429	1491	1553	1615	1677	1739	1802	1864	1926	1988	2050
600	1131	1191	1250	1310	1369	1429	1488	1548	1607	1667	1726	1786	1846	1905	1965
625	1086	1143	1200	1257	1314	1372	1429	1486	1543	1600	1657	1715	1772	1829	1886
650	1044	1099	1154	1209	1264	1319	1374	1429	1484	1539	1594	1649	1704	1759	1813
675	1005	1058	1111	1164	1217	1270	1323	1376	1429	1482	1535	1588	1640	1693	1746
700	970	1021	1072	1123	1174	1225	1276	1327	1378	1429	1480	1531	1582	1633	1684
725	936	985	1035	1084	1133	1182	1232	1281	1330	1380	1429	1478	1527	1577	1626
750	905	953	1000	1048	1095	1143	1191	1238	1286	1334	1381	1429	1476	1524	1572
775	876	922	968	1014	1060	1106	1152	1198	1244	1291	1337	1383	1429	1475	1521
800	848	893	938	982	1027	1072	1116	1161	1206	1250	1295	1340	1384	1429	1473
825	823	866	909	953	996	1039	1082	1126	1169	1212	1256	1299	1342	1386	1429
850	798	840	882	925	967	1009	1051	1093	1135	1177	1219	1261	1303	1345	1387
875	776	816	857	898	939	980	1021	1061	1102	1143	1184	1225	1266	1306	1347
900	754	794	833	873	913	953	992	1032	1072	1111	1151	1191	1230	1270	1310
925	734	772	811	850	888	927	965	1004	1043	1081	1120	1158	1197	1236	1274
950	714	752	790	827	865	902	940	978	1015	1053	1090	1128	1166	1203	1241
975	696	733	769	806	843	879	916	953	989	1026	1062	1099	1136	1172	1209
1000	679	714	750	786	822	857	893	929	964	1000	1036	1072	1107	1143	1179
1025	662	697	732	767	802	836	871	906	941	976	1011	1045	1080	1115	1150
1050	646	680	714	748	782	816	850	884	919	953	987	1021	1055	1089	1123
1075	631	665	698	731	764	797	831	864	897	930	964	997	1030	1063	1097
1100	617	649	682	714	747	779	812	844	877	909	942	974	1007	1039	1072
1125	603	635	667	699	730	762	794	826	857	889	921	953	984	1016	1048
1150	590	621	652	683	714	745	777	808	839	870	901	932	963	994	1025

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 94 %
R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 5
P = MAWP, kPa

Table S2.10.3.6 Metric (Page 1 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Buttstrap Quadruple Riveted Joint

Shell ID (mm)	Minimum Thickness of Shell Plate (mm)															
	8.75	9	9.25	9.5	9.75	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	12.25	12.5
300	4167	4286	4405	4525	4644	4763	4882	5001	5120	5239	5358	5477	5596	5715	5834	5953
325	3847	3957	4067	4176	4286	4396	4506	4616	4726	4836	4946	5056	5166	5276	5385	5495
350	3572	3674	3776	3878	3980	4082	4184	4286	4388	4491	4593	4695	4797	4899	5001	5103
375	3334	3429	3524	3620	3715	3810	3905	4001	4096	4191	4286	4382	4477	4572	4667	4763
400	3126	3215	3304	3393	3483	3572	3661	3751	3840	3929	4019	4108	4197	4286	4376	4465
425	2942	3026	3110	3194	3278	3362	3446	3530	3614	3698	3782	3866	3950	4034	4118	4202
450	2778	2858	2937	3016	3096	3175	3254	3334	3413	3493	3572	3651	3731	3810	3890	3969
475	2632	2707	2782	2858	2933	3008	3083	3158	3234	3309	3384	3459	3534	3610	3685	3760
500	2500	2572	2643	2715	2786	2858	2929	3000	3072	3143	3215	3286	3358	3429	3501	3572
525	2381	2449	2517	2585	2653	2722	2790	2858	2926	2994	3062	3130	3198	3266	3334	3402
550	2273	2338	2403	2468	2533	2598	2663	2728	2793	2858	2923	2987	3052	3117	3182	3247
575	2174	2236	2299	2361	2423	2485	2547	2609	2671	2733	2795	2858	2920	2982	3044	3106
600	2084	2143	2203	2262	2322	2381	2441	2500	2560	2619	2679	2739	2798	2858	2917	2977
625	2000	2057	2115	2172	2229	2286	2343	2400	2458	2515	2572	2629	2686	2743	2800	2858
650	1923	1978	2033	2088	2143	2198	2253	2308	2363	2418	2473	2528	2583	2638	2693	2748
675	1852	1905	1958	2011	2064	2117	2170	2223	2275	2328	2381	2434	2487	2540	2593	2646
700	1786	1837	1888	1939	1990	2041	2092	2143	2194	2245	2296	2347	2398	2449	2500	2551
725	1724	1774	1823	1872	1921	1971	2020	2069	2119	2168	2217	2266	2316	2365	2414	2463
750	1667	1715	1762	1810	1857	1905	1953	2000	2048	2096	2143	2191	2238	2286	2334	2381
775	1613	1659	1705	1751	1798	1844	1890	1936	1982	2028	2074	2120	2166	2212	2258	2305
800	1563	1607	1652	1697	1741	1786	1831	1875	1920	1965	2009	2054	2099	2143	2188	2233
825	1515	1559	1602	1645	1689	1732	1775	1818	1862	1905	1948	1992	2035	2078	2122	2165
850	1471	1513	1555	1597	1639	1681	1723	1765	1807	1849	1891	1933	1975	2017	2059	2101
875	1429	1470	1510	1551	1592	1633	1674	1715	1755	1796	1837	1878	1919	1959	2000	2041
900	1389	1429	1468	1508	1548	1588	1627	1667	1707	1746	1786	1826	1865	1905	1945	1984
925	1352	1390	1429	1467	1506	1545	1583	1622	1660	1699	1738	1776	1815	1854	1892	1931
950	1316	1354	1391	1429	1466	1504	1542	1579	1617	1654	1692	1730	1767	1805	1842	1880
975	1282	1319	1356	1392	1429	1465	1502	1539	1575	1612	1649	1685	1722	1759	1795	1832
1000	1250	1286	1322	1357	1393	1429	1465	1500	1536	1572	1607	1643	1679	1715	1750	1786
1025	1220	1255	1289	1324	1359	1394	1429	1464	1498	1533	1568	1603	1638	1673	1708	1742
1050	1191	1225	1259	1293	1327	1361	1395	1429	1463	1497	1531	1565	1599	1633	1667	1701
1075	1163	1196	1229	1263	1296	1329	1362	1396	1429	1462	1495	1528	1562	1595	1628	1661
1100	1137	1169	1201	1234	1266	1299	1331	1364	1396	1429	1461	1494	1526	1559	1591	1624
1125	1111	1143	1175	1207	1238	1270	1302	1334	1365	1397	1429	1461	1492	1524	1556	1588
1150	1087	1118	1149	1180	1211	1242	1273	1305	1336	1367	1398	1429	1460	1491	1522	1553

$$P = \frac{TS \cdot t \cdot E}{R \cdot FS}$$

TS = Tensile Strength 380 000 kPa
t = Thickness of Cylindrical Component, mm
E = Joint Efficiency 94 %
R = Radius of Shell (inside Diameter/2), mm
FS = Factor of Safety 5
P= MAWP , KPa

Table S2.10.3.6 Metric (Page 2 of 2)
Maximum Allowable Working Pressure for Cylindrical Components (Barrel)
For Buttstrap Quadruple Riveted Joint

Thickness of Stayed Surface, mm	Staybolt Spacing (Maximum Pitch),mm																				
	89	92	95	98	102	105	108	111	114	117	121	124	127	130	133	137	140	143	146	149	152
5	630	589	553	519	479	452	428	405	384	364	341	324	309	295	282	266	254	244	234	225	216
5.25	694	650	609	573	529	499	471	446	423	402	376	358	341	325	311	293	281	269	258	248	238
5.5	762	713	669	628	580	547	517	490	464	441	412	392	374	357	341	322	308	295	283	272	261
5.75	833	779	731	687	634	598	565	535	508	482	451	429	409	390	373	351	337	323	309	297	285
6	907	849	796	748	690	651	616	583	553	525	491	467	445	425	406	383	366	351	337	323	311
6.25	984	921	863	811	749	707	668	632	600	569	532	507	483	461	441	415	398	381	366	351	337
6.5	1064	996	934	878	810	765	723	684	649	616	576	548	523	499	477	449	430	412	395	380	365
6.75	1148	1074	1007	946	874	824	779	738	699	664	621	591	564	538	514	484	464	445	426	409	393
7	1234	1155	1083	1018	940	887	838	793	752	714	668	636	606	578	553	521	499	478	459	440	423
7.25	1324	1239	1162	1092	1008	951	899	851	807	766	716	682	650	620	593	559	535	513	492	472	454
7.5	1417	1326	1243	1168	1079	1018	962	911	863	820	766	730	696	664	634	598	573	549	526	505	486
7.75	1513	1416	1328	1248	1152	1087	1027	973	922	875	818	779	743	709	677	638	611	586	562	540	519
8	1612	1509	1415	1329	1227	1158	1095	1036	982	933	872	830	792	756	722	680	651	624	599	575	553
8.25	1714	1604	1505	1414	1305	1232	1164	1102	1045	992	927	883	842	803	768	723	693	664	637	612	588
8.5	1820	1703	1597	1501	1385	1307	1236	1170	1109	1053	984	937	894	853	815	768	735	705	676	649	624
8.75	1928	1805	1692	1590	1468	1385	1310	1240	1175	1116	1043	993	947	904	863	814	779	747	717	688	661
9	2040	1909	1791	1683	1553	1466	1385	1312	1243	1180	1104	1051	1002	956	914	861	824	790	758	728	699
9.25	2155	2017	1891	1777	1641	1548	1463	1385	1313	1247	1166	1110	1058	1010	965	909	871	835	801	769	739
9.5	2273	2127	1995	1875	1731	1633	1544	1461	1385	1315	1230	1171	1116	1065	1018	959	919	880	845	811	779
9.75	2394	2241	2101	1975	1823	1720	1626	1539	1459	1385	1295	1233	1176	1122	1072	1010	968	927	890	854	821
8	1612	1509	1415	1329	1227	1158	1095	1036	982	933	872	830	792	756	722	680	651	624	599	575	553
8.25	1714	1604	1505	1414	1305	1232	1164	1102	1045	992	927	883	842	803	768	723	693	664	637	612	588
8.5	1820	1703	1597	1501	1385	1307	1236	1170	1109	1053	984	937	894	853	815	768	735	705	676	649	624
8.75	1928	1805	1692	1590	1468	1385	1310	1240	1175	1116	1043	993	947	904	863	814	779	747	717	688	661
9	2040	1909	1791	1683	1553	1466	1385	1312	1243	1180	1104	1051	1002	956	914	861	824	790	758	728	699
9.25	2155	2017	1891	1777	1641	1548	1463	1385	1313	1247	1166	1110	1058	1010	965	909	871	835	801	769	739
9.5	2273	2127	1995	1875	1731	1633	1544	1461	1385	1315	1230	1171	1116	1065	1018	959	919	880	845	811	779
9.75	2394	2241	2101	1975	1823	1720	1626	1539	1459	1385	1295	1233	1176	1122	1072	1010	968	927	890	854	821
10	2519	2357	2211	2077	1918	1810	1710	1619	1535	1457	1363	1297	1237	1180	1128	1063	1018	976	936	899	863
10.25	2646	2476	2322	2182	2015	1901	1797	1701	1613	1531	1432	1363	1300	1240	1185	1117	1069	1025	983	944	907
10.5	2777	2599	2437	2290	2114	1995	1886	1785	1692	1607	1502	1430	1364	1301	1243	1172	1122	1076	1032	991	952

$P = t^2 \cdot S \cdot C / p^2$

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

For Thicknesses 11 mm and less, C = 2.1
For Thicknesses larger than 11 mm, C = 2.2
MAWP is expressed in kPa

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

Thickness of Stayed Surface, in.	Staybolt Spacing (Maximum Pitch), in.																				
	3.5	3.625	3.75	3.875	4	4.125	4.25	4.375	4.5	4.625	4.75	4.875	5	5.125	5.25	5.375	5.5	5.625	5.75	5.875	6
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
t = Thickness of Stayed Surface, in.
S = 13 800 psi

$P = t^2 \cdot S \cdot C / p^2$

For Thicknesses 0.4375 and less, C = 2.1
For Thicknesses larger than 0.4375, C=2.2
MAWP is expressed in psi

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

Staybolt Spacing, mm	Actual Diameter of Corroded Staybolts, mm																								
	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20	20.5	21	21.5	22
90	458	505	555	606	660	716	775	835	898	964	1031	1101	1173	1248	1325	1404	1485	1569	1655	1743	1833	1926	2021	2119	2219
92.5	434	478	525	574	625	678	733	791	850	912	976	1043	1111	1181	1254	1329	1406	1485	1566	1650	1736	1824	1914	2006	2100
95	411	454	498	544	592	643	695	750	806	865	926	988	1053	1120	1189	1260	1333	1408	1485	1564	1646	1729	1814	1902	1991
97.5	391	431	473	517	562	610	660	712	766	821	879	938	1000	1063	1129	1196	1265	1337	1410	1485	1562	1641	1722	1805	1890
100	371	409	449	491	535	580	627	677	728	781	835	892	950	1011	1073	1137	1203	1271	1340	1412	1485	1560	1637	1716	1797
102.5	353	390	428	467	509	552	597	644	693	743	795	849	905	962	1021	1082	1145	1209	1276	1344	1414	1485	1558	1634	1710
105	337	371	407	445	485	526	569	614	660	708	758	809	862	917	973	1031	1091	1153	1216	1281	1347	1415	1485	1557	1630
107.5	321	354	389	425	463	502	543	586	630	675	723	772	822	875	928	984	1041	1100	1160	1222	1285	1350	1417	1485	1555
110	307	338	371	406	442	479	519	559	601	645	690	737	786	835	887	940	994	1050	1108	1167	1227	1290	1353	1418	1485
112.5	293	323	355	388	422	458	496	535	575	617	660	705	751	799	848	898	950	1004	1059	1115	1173	1233	1294	1356	1420
115	281	310	340	371	404	439	474	512	550	590	632	674	719	764	811	860	910	961	1013	1068	1123	1180	1238	1298	1359
117.5	269	296	325	356	387	420	454	490	527	565	605	646	688	732	777	824	871	920	971	1023	1076	1130	1186	1243	1302
120	258	284	312	341	371	403	436	470	505	542	580	619	660	702	745	790	835	882	931	980	1031	1084	1137	1192	1248
122.5	247	273	299	327	356	387	418	451	485	520	557	594	633	674	715	758	802	847	893	941	990	1040	1091	1144	1197
125	238	262	288	314	342	371	402	433	466	500	535	571	608	647	687	728	770	813	858	904	950	999	1048	1098	1150
127.5	228	252	276	302	329	357	386	416	448	480	514	549	585	622	660	699	740	782	824	868	914	960	1007	1056	1105
130	220	242	266	291	316	343	371	400	431	462	494	528	562	598	635	673	712	752	793	835	879	923	969	1016	1063
132.5	211	233	256	280	305	330	357	385	415	445	476	508	541	576	611	648	685	724	763	804	846	889	933	978	1024
135	204	225	247	269	293	318	344	371	399	428	458	489	522	555	589	624	660	697	735	775	815	856	898	942	986
137.5	196	217	238	260	283	307	332	358	385	413	442	472	503	535	568	601	636	672	709	747	786	825	866	908	950
140	189	209	229	251	273	296	320	345	371	398	426	455	485	516	547	580	614	648	684	720	758	796	835	876	917
142.5	183	202	221	242	263	286	309	333	358	384	411	439	468	498	528	560	592	626	660	695	731	768	806	845	885
145	177	195	214	234	254	276	298	322	346	371	397	424	452	481	510	541	572	604	637	671	706	742	779	816	855
147.5	171	188	206	226	246	267	288	311	334	359	384	410	437	465	493	523	553	584	616	649	683	717	753	789	826
150	165	182	200	218	238	258	279	301	323	347	371	396	422	449	477	505	535	565	596	627	660	693	728	763	799
152.5	160	176	193	211	230	249	270	291	313	336	359	384	409	435	461	489	517	546	576	607	639	671	704	738	773
155	155	170	187	204	223	241	261	282	303	325	348	371	396	421	447	473	501	529	558	588	618	649	682	714	748
157.5	150	165	181	198	216	234	253	273	293	315	337	360	383	407	433	458	485	512	540	569	599	629	660	692	724
160	145	160	175	192	209	227	245	264	284	305	326	348	371	395	419	444	470	496	524	551	580	609	640	670	702
162.5	141	155	170	186	202	220	238	256	276	296	316	338	360	383	406	431	456	481	508	535	562	591	620	650	681
165	136	150	165	180	196	213	230	249	267	287	307	328	349	371	394	418	442	467	492	519	545	573	601	630	660
167.5	132	146	160	175	191	207	224	241	259	278	298	318	339	360	382	405	429	453	478	503	529	556	584	612	640
170	128	142	155	170	185	201	217	234	252	270	289	309	329	350	371	393	416	440	464	489	514	540	567	594	622
172.5	125	138	151	165	180	195	211	227	245	262	281	300	319	340	361	382	404	427	450	474	499	524	550	577	604
175	121	134	147	160	175	189	205	221	238	255	273	291	310	330	350	371	393	415	438	461	485	509	535	560	587
177.5	118	130	143	156	170	184	199	215	231	248	265	283	302	321	341	361	382	403	425	448	471	495	520	545	570
180	115	126	139	152	165	179	194	209	225	241	258	275	293	312	331	351	371	392	414	436	458	482	505	530	555

$$P = \frac{\pi \cdot d2 \cdot TS}{FS \cdot 4 \cdot p2}$$

TS = 5200 kPa
P = MAWP kPa
FS = 1.1

d = Min. Diameter of corroded staybolt
p = Staybolt spacing, mm

Table S2.10.4.1 (Metric Units)
Maximum Allowable Working Pressure Based on the Load Carrying Capacity of a Single Corroded Staybolt

Staybolt Spacing, in.	Actual Diameter of Corroded Staybolts, in.																						
	0.35	0.375	0.4	0.425	0.45	0.475	0.5	0.525	0.55	0.575	0.6	0.625	0.65	0.675	0.7	0.725	0.75	0.775	0.8	0.825	0.85	0.875	0.9
3.5	54	61	70	79	89	99	109	120	132	145	157	171	185	199	214	230	246	263	280	298	316	335	354
3.625	50	57	65	74	83	92	102	112	123	135	147	159	172	186	200	214	229	245	261	277	294	312	330
3.75	47	54	61	69	77	86	95	105	115	126	137	149	161	174	187	200	214	229	244	259	275	292	308
3.875	44	50	57	64	72	80	89	98	108	118	128	139	151	162	175	187	201	214	228	243	258	273	289
4	41	47	54	60	68	76	84	92	101	111	120	131	141	152	164	176	188	201	214	228	242	256	271
4.125	39	44	50	57	64	71	79	87	95	104	113	123	133	143	154	165	177	189	201	214	227	241	255
4.25	36	42	47	54	60	67	74	82	90	98	107	116	125	135	145	156	167	178	190	202	214	227	240
4.375	34	39	45	51	57	63	70	77	85	92	101	109	118	127	137	147	157	168	179	190	202	214	227
4.5	32	37	42	48	54	60	66	73	80	87	95	103	112	120	130	139	149	159	169	180	191	202	214
4.625	31	35	40	45	51	56	63	69	76	83	90	98	106	114	123	132	141	150	160	170	181	192	203
4.75	29	33	38	43	48	54	59	65	72	78	85	93	100	108	116	125	134	143	152	162	171	182	192
4.875	28	32	36	41	46	51	56	62	68	74	81	88	95	103	110	118	127	135	144	153	163	173	183
5	26	30	34	39	43	48	54	59	65	71	77	84	90	98	105	113	120	129	137	146	155	164	174
5.125	25	29	33	37	41	46	51	56	62	67	73	80	86	93	100	107	115	122	130	139	147	156	165
5.25	24	27	31	35	39	44	49	54	59	64	70	76	82	89	95	102	109	117	124	132	140	149	157
5.375	23	26	30	33	38	42	46	51	56	61	67	72	78	84	91	97	104	111	119	126	134	142	150
5.5	22	25	28	32	36	40	44	49	54	59	64	69	75	81	87	93	100	106	113	120	128	136	143
5.625	21	24	27	31	34	38	42	47	51	56	61	66	72	77	83	89	95	102	108	115	122	130	137
5.75	20	23	26	29	33	37	40	45	49	54	58	63	68	74	79	85	91	97	104	110	117	124	131
5.875	19	22	25	28	31	35	39	43	47	51	56	61	66	71	76	82	87	93	99	106	112	119	126
6	18	21	24	27	30	34	37	41	45	49	54	58	63	68	73	78	84	89	95	101	107	114	120
6.125	17	20	23	26	29	32	36	39	43	47	51	56	60	65	70	75	80	86	91	97	103	109	116
6.25	17	19	22	25	28	31	34	38	41	45	49	54	58	62	67	72	77	82	88	93	99	105	111
6.375	16	19	21	24	27	30	33	36	40	44	47	51	56	60	65	69	74	79	84	90	95	101	107
6.5	16	18	20	23	26	29	32	35	38	42	46	50	54	58	62	67	71	76	81	86	92	97	103
6.625	15	17	20	22	25	28	31	34	37	40	44	48	52	56	60	64	69	73	78	83	88	93	99
6.75	14	17	19	21	24	27	29	32	36	39	42	46	50	54	58	62	66	71	75	80	85	90	95
6.875	14	16	18	20	23	26	28	31	34	37	41	44	48	52	56	60	64	68	73	77	82	87	92
7	13	15	17	20	22	25	27	30	33	36	39	43	46	50	54	57	61	66	70	74	79	84	89

S = 7500 psi
P = MAWP psi
FS = 1.1

$$P = \frac{\Pi * d2 * TS}{FS * 4 * p2}$$

d = Minimum diameter of corroded staybolt
p = Staybolt spacing in.

Table S2.10.4.1 [US Customary Units]
Maximum Allowable Working Pressure Based on the Load Carrying Capacity of a Single Corroded Staybolt

S6.16 PRESSURE RELIEF DEVICES

S6.16.1 SCOPE

This Section provides details for the application, continued service inspection, and repair of pressure relief devices specified for overpressure protection of transport tanks.

Pressure relief devices are provided for all transport tanks to prevent internal pressure from exceeding design values. They may also be provided to prevent excessive internal vacuum. Overpressure protection may be provided by reclosing pressure relief valves, non-reclosing devices such as rupture disks or breaking bar or breaking pin valves, or combinations of pressure relief valves and non-reclosing devices.

S6.16.2 SAFETY CONSIDERATIONS

When inspections of pressure relief devices are being performed, inspectors should be aware that tests of these devices involve the discharge of the test fluid, which can result in high velocity fluid flow, possible high or low temperature fluids, and high noise levels. If a test is being performed with the service fluid, it should be a fluid that is safe for discharge and not toxic or hazardous. Due to the nature of fluids being transported, most testing will involve removing the device from the transport tank and testing it on a test stand. (See S6.12.1, Pre-Inspection Activities)

S6.16.3 INSTALLATION PROVISIONS

Incorrect installation of a pressure relief device can have a detrimental effect on device performance. The following provisions shall be followed when installing pressure relief devices on transport tanks.

a. Inlet piping shall have an area at least equal to the pressure relief device inlet size with no restrictions which can affect flow through the device.
b. Pressure relief devices shall be installed to be in communication with the vapor space of the tank in its normal transport orientation as near as practicable on the longitudinal center line, and in the center of the tank.
c. If discharge piping is provided, it shall have an area at least equal to the pressure relief device, be as short and straight as possible, and of a length that will not affect the pressure relief device flow performance. It will typically discharge upward, and should be directed away from personnel that may be around the tank at ground level.
d. Provisions for protection of the outlet of pressure relief devices from contamination from the effects of rain, weather etc. shall be provided. Where rain caps are provided the fit shall not be tight enough to affect the valve performance.
e. Pressure relief devices may be installed inside of a protective housing consisting of mechanical elements designed to protect the valve during roll-over events. These elements shall not obstruct the outlet of the device.
f. If a rupture disk is used in combination with a pressure relief valve, it shall be located inboard of the pressure relief valve.

g. When a rupture disk is used in combination with a pressure relief valve, a device to detect leakage through the rupture disk, or actuation of the rupture disk shall be provided. These devices detect leakage or actuation by observation of the accumulation of pressure between the disk and the pressure relief valve, and shall consist of a needle valve, try-cock, tell tale indicator or pressure gage. Where a valve is provided, it shall be closed during normal operation. Leaking disks or disks which have discharged shall be replaced as soon as possible.

h. Block valves shall not be used on either device inlets or outlets.

S6.16.4 PRESSURE RELIEF DEVICE INSPECTION

For pressure relief valves, inspection shall consist of an External and Internal Visual Inspection and a Pressure Test to determine valve function. For non-reclosing pressure relief devices, inspection shall consist of an External and Internal Visual Inspection as well.

S6.16.5 SCHEDULE OF INSPECTIONS

Pressure relief devices shall be inspected at the frequency as required by Tables S6.13.4, S6.14 or S6.16.3. For both an External Visual Inspection and a Pressure Test, the frequency of inspection for pressure relief devices shall be the same as the frequency required for inspection of the transport tank itself.

S6.16.6 EXTERNAL VISUAL INSPECTION OF PRESSURE RELIEF DEVICES

The following items shall be inspected during the External Visual Inspection.

a. Pressure relief device nameplate data shall be reviewed, and the marked device set pressure compared to the transport tank data. The pressure relief device set pressure shall not exceed the tank maximum allowable working pressure (MAWP) except as permitted by the applicable transport tank specification Appendix.

b. Where seals are provided to seal external adjustments of pressure relief valves, the seal must be intact and bear the identification of the organization responsible for performing the adjustment. If the valve has been repaired or reset, it must bear a supplemental nameplate identifying the organization responsible for the repair or resetting.

c. Valves that have the set pressure adjustment permanently sealed by means such as a rivet or roll pin through the adjustment, shall be checked to assure there has been no tampering with the set pressure adjustment.

d. Check for evidence of leakage through the valve. For a valve installed with a rupture disk at the inlet, the rupture disk leakage detection device shall be checked for signs of leakage through the disk. When possible this inspection should be performed with normal transport tank operating pressure present.

e. All connecting bolting shall be present and tight.

f. Evidence of rust or corrosion of the pressure relief device shall be investigated.

g. Where drain holes are provided on the side of the valve, check that the drain hole is not plugged.

h. Check that a valve spindle restraint (test gag) has not been left in place after pressure testing of the transport tank.

i. Check for proper orientation of rupture disk devices. These devices will have a flow direction arrow or other designation such as inlet or vent side to designate the flow direction. Installation of rupture disk devices in the reverse direction can cause a disk to burst at a higher pressure than its marked burst pressure.

S6.16.7 PRESSURE TESTING OF PRESSURE RELIEF VALVES

A check of pressure relief valve operation shall be performed to assure the valve is functioning properly. This testing shall be performed at the time of the transport tank pressure test when the tank pressure test will necessitate removal of the pressure relief valve. When the valve is removed for testing, the connection on the transport tank shall be inspected for corrosion or deposits which could block or reduce the connection area.

a. Prior to the test, the inlet and outlet passages of the valve shall be visually inspected for corrosion or deposits of material which could affect valve operation.
b. The test fluid shall be air or other suitable non-hazardous gas.
c. The valve shall be installed on a test stand and a calibrated test gage of suitable range shall be used.
d. Valves shall be tested for the following operational characteristics.

1. Seat Leakage: The test pressure shall be increased to seat leakage test pressure at which there should be no leakage as determined by a bubble test. This pressure will typically be 90% of the stamped set pressure or the pressure prescribed for the applicable transport tank specification. There shall be no audible or visible leakage at the specified seat leakage test pressure.

2. Set Pressure: The set pressure definition used by the valve manufacturer to originally set the valve shall be determined, and shall be used during evaluations of valve performance. For most transport tank valves this will usually be the “start” to “discharge” pressure which is the pressure at which the first audible discharge is detected. The test pressure shall be increased until the set pressure is determined. The valve shall open within the tolerance for set pressure as specified by the applicable transport tank specification.

3. Re-seal pressure: The test pressure shall then be decreased and the pressure at which the valve reseals shall be recorded. The valve shall reseal at or above the pressure specified by the applicable transport tank specification, or above the normal transport tank operating pressure.

4. It is recommended that the test sequence be repeated several times to assure repeatable valve performance. Erratic performance may indicate damage to the valve, including damage or deposits on the seating surface.

e. The results of testing shall be documented and be made available to the Inspector.

f. Testing shall be performed by trained individuals from an organization acceptable to the Competent Authority.

S6.16.8 CORRECTION OF DEFECTS

Any failure of the valve to meet applicable test specifications shall be brought to the attention of the Inspector and owner, and steps shall be taken to correct the defect. If repairs are required they shall be performed by a qualified organization acceptable to the Competent Authority.

When a valve is to be repaired, it shall be completely disassembled, cleaned, all parts inspected, and repaired as necessary. It shall then be tested and all adjustments resealed with a seal identifying the repair organization. Parts replaced shall be from the valve manufacturer or meet the valve manufacturer's specifications. Where soft goods such as gaskets, o-rings, and other seals are replaced, new parts shall be used.

Repairs shall be identified with a repair nameplate which includes the organization responsible for the repair, date of the repair, and a unique identifier identifying repair documentation. The goal of the repair is to bring the valve back to a "like new" condition.

A valve found to be defective may be replaced by a new valve or previously repaired valve. Care shall be taken to assure that the replacement valve meets the same requirements as the valve being replaced.

S6.16.9 INSPECTION OF RUPTURE DISKS AND NON-RECLOSING DEVICES

Rupture disks and other non-reclosing devices cannot be tested. In lieu of the required pressure test for a pressure relief valve, the disk and disk holder must be removed from the transport tank and the disk inlet and outlet surfaces visually inspected. (This is considered the "Internal Inspection".) Signs of corrosion, damage, or deposits will require that the rupture disk be replaced.

A program to periodically replace rupture disks is recommended to prevent premature disk opening during normal operation. This can be caused by corrosion or deterioration of the disk or fatigue of the disk material due to cyclic operation of the transport tank and vibration during normal operation. The rupture disk manufacturer may have recommendations for the frequency of disk replacement.

Replacement disks shall have the same specifications for burst pressure and coincident temperature as the disk being replaced, unless the service conditions for the transport vessel are being changed. It is recommended that replacement disks be specified by the complete disk description including model number, burst pressure and coincident temperature, and the lot number from the disk being replaced. Disks and disk holders from different manufacturers shall not be interchanged.

S6.17 DEFINITIONS

NB08-1801

SUPPLEMENT 8 — PRESSURE DIFFERENTIAL BETWEEN SAFETY OR SAFETY RELIEF VALVE SETTING AND BOILER OR PRESSURE VESSEL OPERATING PRESSURE

S8.1 SCOPE

If a safety valve or safety relief valve is subjected to pressure at or near its set pressure, it will tend to weep or simmer, and deposits may accumulate in the seat and disk area. Eventually, this can cause the valve to freeze close and thereafter the valve could fail to open at the set pressure. Unless the source of pressure to the boiler or pressure vessel is interrupted, the pressure could exceed the rupture pressure of the vessel. It is important that the pressure differential between the valve set pressure and the boiler or pressure vessel operating pressure is sufficiently large to prevent the valve from weeping or simmering.

S8.2 HOT WATER HEATING BOILERS

For hot water heating boilers, the recommended pressure differential between the pressure relief valve set pressure and the boiler operating pressure should be at least 10 psi (70 kPa), or 25% of the boiler operating pressure, whichever is greater. Two examples follow:

a) If the safety relief valve of a hot-water heating boiler is set to open at 30 psi (200 kPa), the boiler operating pressure should not exceed 20 psi (140 kPa).

b) If the safety relief valve of a hot water heating boiler is set to open at 100 psi (700 kPa), the boiler operating pressure should not exceed 75 psi (520 kPa). Section IV of the ASME Code does not require that safety relief valves used on hot water heating boilers have a specified blowdown. Therefore, to help ensure that the safety relief valve will close tightly after opening and when the boiler pressure is reduced to the normal operating pressure, the pressure at which the valve closes should be well above the operating pressure of the boiler.

S8.3 STEAM HEATING BOILERS

For steam heating boilers, the recommended pressure differential between the safety valve set pressure and boiler operating pressure should be at least 5 psi (35 kPa), i.e., the boiler operating pressure should not exceed 10 psi (70 kPa).

Since some absorption-type refrigeration systems use the steam heating boiler for their operation, the boiler operating pressure may exceed 10 psi (70 kPa). If the boiler operating pressure is greater than 10 psi (70 kPa), it should not exceed 15 psi (100 kPa), minus the blowdown pressure of the safety valve.

This recommendation can be verified by increasing the steam pressure in the boiler until the safety valve pops, then slowly reducing the pressure until it closes, to ensure that this closing pressure is above the operating pressure.

S8.4 POWER BOILERS

For power boilers (steam), the recommended pressure differentials between the safety valve set pressure and the boiler operating pressure are as follows:

MINIMUM PRESSURE DIFFERENTIAL AS
PERCENTAGE OF BOILER DESIGN PRESSURE

DESIGN PRESSURE :	over 15 psi to 300 psi	(100 KPa to 2.10 MPa)
	10% but not less than 7 psi over 300 psi to 1000 psi	(50 KPa) (2.14 MPa to 6.89 MPa)
	7% but not less than 30 psi over 1000 psi to 2000 psi	(200 KPa) (6.89 MPa to 13.8 MPa)
	5% but not less than 70 psi over 2000 psi per designer's judgment	(480 KPa) (13.8 MPa)

Notes: 1. Above 2000 psi (13.8 MPa) the pressure differential between operating pressure and the maximum allowable working pressure is a matter for the designer's judgement , taking into consideration such factors as satisfactory operating experience and the intended service conditions.

2. Safety relief valves in hot water service are more susceptible to damage and subsequent leakage, than safety valves relieving steam. It is recommended that the maximum allowable working pressure of the boiler and safety relief valve setting for high-temperature hot water boilers be selected substantially higher than the desired operating pressure, so as to minimize the time the safety relief valve must lift.

S8.5 PRESSURE VESSELS

Due to the variety of service conditions and the various designs of pressure relief valves, only general guidelines can be given regarding differentials between the set pressure of the valve and the operating pressure of the vessel. Operating difficulty will be minimized by providing an adequate differential for the application. The following is general advisory information on the characteristics of the intended service and of the pressure relief valves that may bear on the proper pressure differential selection for a given application. These considerations should be reviewed early in the system design since they may dictate the maximum allowable working pressure of the system.

To minimize operational problems it is imperative that the user consider not only normal operating conditions of the fluids (liquids or gases), pressures, and temperatures, but also start-up and shutdown conditions, process upsets, anticipated ambient conditions, instrument response time, pressure surges due to quick-closing valves, etc. When such conditions are not considered, the pressure relief devices may become, in effect, a pressure controller, a duty for which it was not designed. Additional consideration should be given to the hazard and pollution associated with the release of the fluid. Larger differentials may be appropriate for fluids which are toxic, corrosive, or exceptionally valuable.

The blowdown characteristics and capability are the first consideration in selecting a compatible valve and operating margin. After a self-actuated release of pressure, the

valve must be capable of reclosing above the normal operating pressure. For example: if the valve is set at 100 psi (700 kPa) with a 7% blowdown, it will close at 93 psi (640 kPa). The operating pressure must be maintained below 93 psi (640 kPa) in order to prevent leakage or flow from a partially open valve. Users should exercise caution regarding the blowdown adjustment of large, spring-loaded valves. Test facilities, whether owned by the manufacturer, repair house, or user, may not have sufficient capacity to accurately verify the blowdown setting. The setting cannot be considered accurate unless made in the field on an actual installation.

Pilot operated valves represent a special case from the standpoint of both blowdown and tightness. The pilot portion of some pilot operated valves can be set at blowdowns as short as 2%. This characteristic is not, however, reflected in the operation of the main valve in all cases. The main valve can vary considerably from the pilot depending on the location of the two components in the system. If the pilot is installed remotely from the main valve, significant time and pressure lags can occur, but reseating of the pilot assures reseating of the main valve. The pressure drop in connecting piping between the pilot and the main valve must not be excessive, otherwise the operation of the main valve will be adversely affected.

Tightness capability is another factor affecting valve selection, whether spring-loaded or pilot operated. Tightness varies somewhat depending on whether metal or resilient seats are specified and also on such factors as corrosion and temperature. The required tightness and test method should be specified to comply at a pressure not lower than the normal operating pressure of the process. It should be remembered that any degree of tightness obtained should not be considered permanent. Service operation of a valve almost invariably reduces the degree of tightness.

The following minimum pressure differentials are recommended unless the safety or safety relief valve has been designed or tested in a specific or similar service and a smaller differential has been recommended by the manufacturer:

a) for set pressures up to 70 psi (480 kPa), the recommended pressure differential is 5 psi (35 kPa);

b)for set pressure between 70 and 1000 psi (480 kPa and 6.89 MPa), the recommended pressure differential is 10% of set pressure; and

c) for set pressures above 1000 psi (6.89MPa), the recommended pressure differential is 7% of set pressure.

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

Part 3 Repairs and Alterations

NB08-0315

2.5.2 POSTWELD HEAT TREATMENT (PWHT)

a) Postweld heat treatment shall be performed as required by the original code of construction, the construction standard or code selected in accordance with a written procedure. The procedure shall contain the parameters for postweld heat treatment.

b) When it is impractical or detrimental to postweld heat treat (PWHT) the entire item or band around the item, the following local PWHT method may be performed on spherical or cylindrical pressure-retaining items using the time and temperature parameters in the original code of construction and in accordance with a ~~written acceptance by the Inspector~~ written procedure acceptable to the Inspector and, when required, by the Jurisdiction.

NB08-0309

2.5.3 ALTERNATIVE WELDING MEHODS WITHOUT POST-WELD HEAT TREATMENT

d) The detailed welding methods listed in the following subsections may be used as an alternative to postweld heat treatment (PWHT). Subsection 2.5.3.1 is a method in which the welding procedure requires an elevation of the preheat temperature. In contrast, 2.5.3.2 thru 2.5.3.5, are methods in which the welding procedure requires the use of a temper-bead welding technique. In 2.5.3.5 ~~2.5.4.5~~ is a method in which the welding procedure used for joining dissimilar materials requires either an elevation of the preheat temperature or a temper-bead welding technique, depending on the chemical composition of the base metal that is joined to an austenitic steel. Temperbead welding procedure nomenclature is defined in Section IX of the *ASME Boiler and Pressure Vessel Code*. Typically, this technique minimizes heat input of the initial beads, thus limiting heat beyond the weld heat-affected zone (HAZ) of the base metal. Heat input shall be increased for successive beads in accordance with the rules of QW-290 for temper bead welding in Section IX of the *ASME Boiler and Pressure Vessel Code*. The welding procedure and welder performance qualifications shall, in all cases, be in accordance with the requirements of the latest edition and addenda of Section IX of the *ASME Boiler and Pressure Vessel Code*.

NB08-0308

2.5.3 ALTERNATIVE WELDING METHODS WITHOUT POST-WELD HEAT TREATMENT

e) Non Destructive Examination of Welds

1) Prior to welding, the area prepared for welding shall be examined using either the magnetic particle (MT) or the liquid Penetrant (PT) examination method to determine that no defects exist. After the finished weld has reached ambient temperature, the weld shall be examined again by either of the above methods to

determine that no defects exist using acceptance standards acceptable to the Inspector or original Code of Construction. In addition, welds greater than 3/8 in. (9.6 mm) deep or welds in a boiler, pressure vessel, or piping systems that were originally required to be radiographed by the rules of the original Code of Construction, shall be radiographically examined. In situations where it is not practical to perform radiography, the accessible surfaces of each nonradiographed repair weld shall be fully examined using the MT or PT method to determine that no defects exist and the maximum allowable working pressure and/or allowable temperature shall be re-evaluated to the satisfaction of the jurisdiction at the location of installation.

f) ~~e)~~ Methods that may be used as alternatives to postweld heat treatment are described in the following subsections.

NB03-1901

3.2.6 REFERENCE TO OTHER CODES AND STANDARDS

Other codes, standards, and practices pertaining to the repair and alteration of pressure-retaining items can provide useful guidance. Use of these codes, standards and practices is subject to review and acceptance by the Inspector, and when required, by the Jurisdiction. The user is cautioned that the referenced codes, standards and practices may address methods categorized as repairs; however, some of these methods are considered alterations by the NBIC.

In the event of a conflict with the requirements of the NBIC, the requirements of the NBIC take precedence.
Some examples are as follows:
(a) National Board Bulletin - National Board Classic Articles Series.
(b) ASME PCC-1, Guidelines for Pressure Boundary Bolted Flange Joint Assembly .
(c) ASME PCC-2, Repair of Pressure Equipment and Piping.

NB08-0310

3.3.4.2 DEFECT REPAIRS

~~Before a repair is made to a defect in a welded joint or base metal, care should be taken to investigate its cause and to determine its extent and likelihood of recurrence.~~

NB07-2701

5.7 STAMPING REQUIREMENTS FOR REPAIRS AND ALTERATIONS

5.7.1 GENERAL

The stamping of or attaching of a nameplate to a pressure-retaining item shall indicate that the work was performed in accordance with the requirements of this Code. Such stamping or attaching of a nameplate shall be done only with the knowledge and authorization of the Inspector. The “R” Certificate Holder responsible for the repair or the construction portion of the alteration shall apply the stamping. For a rerating where no physical changes are made to the pressure-retaining item, the “R” Certificate Holder responsible for design shall apply the stamping. ~~Required stamping and nameplate information is shown in 5.9.6.~~

5.7.2 STAMPING REQUIREMENTS FOR REPAIRS

a) Pressure-retaining items repaired in accordance with the NBIC shall be stamped as required by this section.

b) Subject to the acceptance of the Jurisdiction and the concurrence of the Inspector, nameplates and stamping may not be required for routine repairs (See 3.3.2). In all cases, the type and extent of repairs necessary shall be considered prior to waiving the requirement.

c) Stamping or nameplate shall be applied adjacent to the original manufacturer's stamping or nameplate. A single repair nameplate or stamping may be used for more than one repair to a pressure-retaining item provided it is carried out by the same Certificate Holder. The date of each repair, corresponding with the date on the associated Form R-1, shall be stamped on the nameplate

5.7.4 STAMPING REQUIREMENTS FOR PARTS

Stamping or nameplate shall be applied in a conspicuous location on the part.

5.7.5 SPECIFIC REQUIREMENTS FOR STAMPING AND NAMEPLATES

a) Required data shall be in characters of at least 5/32 in. (4 mm) high, except that characters for pressure relief valve repair nameplates may be smaller. Markings may be produced by casting, etching, embossing, debossing, stamping, or engraving.The selected method shall not result in any harmful contamination of or sharp discontinuities to the pressure-retaining item. See Figures 5.7.5 –a thru 5.7.5-g.

b) The National Board code symbols ("R","VR", and "NR") are to be stamped; do not emboss.

c) Stamping directly on items, when used, shall be done with blunt-nose continuous or blunt-nose interrupted dot die stamps. If direct stamping would be detrimental to the item, required markings may appear on a nameplate affixed to the item.

d) The Certificate Holder shall use its full name as shown on the *Certificate of Authorization* or an abbreviation acceptable to the National Board.

e) The letters "RP" shall be stamped below the "R" symbol stamp to indicate organizations accredited for performing repairs or alterations to fiber-reinforced plastic items.

f) The letter "G" shall be stamped below the "R" symbol stamp to indicate organizations accredited for performing repairs or alterations to graphite pressure equipment.

5.9.2 REPAIR NAME PLATE

When a pressure relief valve is repaired, a metal repair nameplate stamped with the information required below shall be securely attached to the valve adjacent to the original manufacturer's stamping or nameplate. If not mounted directly on the valve, the nameplate shall be securely attached so as not to interfere with valve operation and sealed in accordance with the quality system.

a) Prior to attachment of the repair nameplate, the previous repair nameplate, if applicable, shall be removed from the repaired valve.

b) As a minimum, the information on the valve repair nameplate (See Figure ~~5.9.6-e~~5.7.5 e) shall include:

5.9.5 REPLACEMENT OF ILLEGIBLE OR MISSING NAME PLATES

a) Illegible Nameplates

When the information on the original manufacturer's or assembler's nameplate or stamping is illegible, but traceability can be confirmed, the nameplate or stamping will be augmented ~~or replaced~~ by a nameplate furnished by the "VR" stamp holder stamped "duplicate". It shall contain all information that originally appeared on the nameplate or valve, as required by the applicable section of the ASME Code, except the "V", "HV", or "UV" symbol and the National Board mark. The repair organization's nameplate, with the "VR" stamp and other required data specified in 5.9.2, will make the repairer responsible to the owner and the Jurisdiction that the information on the duplicate nameplate is correct

~~**5.9.6 REQUIREMENTS FOR STAMPING AND NAME PLATE INFORMATION**~~

~~**5.9.6.1 SCOPE**~~

~~When a pressure-retaining item is repaired or altered, the Certificate Holder shall attach a nameplate or stamp the item, except when otherwise permitted by these rules. Similarly,when pressure relief devices are repaired, the attachment of a nameplate is required. Thespecific requirements for nameplates/stamping are described in this Part. See Figures 5.9.6-athru 5.9.6-g~~.

~~**5.9.6.2 GENERAL REQUIREMENTS FOR STAMPING AND NAMEPLATES**~~

~~a) Required data shall be in characters of at least 5/32 in. (4 mm) high, except that characters for pressure relief valve repair nameplates may be smaller. Markings may be produced by casting, etching, embossing, debossing, stamping, or engraving.The selected method shall not result in any harmful contamination of or sharp discontinuities to the pressure-retaining item.~~

~~b) The National Board code symbols ("R","VR", and "NR") are to be stamped; do not emboss.~~

~~c) Stamping directly on items, when used, shall be done with blunt-nose continuous or blunt-nose interrupted dot die stamps. If direct stamping would be detrimental to the item, required markings may appear on a nameplate affixed to the item.~~

~~d) The Certificate Holder shall use its full name as shown on the *Certificate of Authorization* or an abbreviation acceptable to the National Board.~~

~~e) The letters "RP" shall be stamped below the "R" symbol stamp to indicate organizations accredited for performing repairs or alterations to fiber-reinforced plastic items.~~

~~f) The letter "G" shall be stamped below the "R" symbol stamp to indicate organizations~~

~~accredited for performing repairs or alterations to graphite pressure equipment.~~

5.7.5-a

~~**5.9.6.3 ADDITIONAL STAMPING REQUIREMENTS FOR REPAIRS**~~

~~Stamping or nameplate shall be applied adjacent to the original manufacturer's stamping or nameplate. A single repair nameplate or stamping may be used for more than one repair to a pressure-retaining item provided it is carried out by the same Certificate Holder. The date of each repair, corresponding with the date on the associated Form R-1, shall be stamped on the nameplate.~~

~~**5.9.6.4 ADDITIONAL STAMPING REQUIREMENTS FOR ALTERATIONS AND RE-RATINGS**~~

~~Stamping or nameplate shall be applied adjacent to the original manufacturer's stamping or nameplate.~~

~~**5.9.6.5 ADDITIONAL STAMPING REQUIREMENTS FOR PARTS**~~

~~Stamping or nameplate shall be applied in a conspicuous location on the part.~~

5.11 STAMPING FOR FIBER - REINFORCED VESSELS

The attaching of a nameplate to a repaired or altered vessel or tank shall indicate that the work was performed in accordance with the requirements of this Code. The attachment of a nameplate shall be done only with the knowledge and authorization of the Inspector. The Certificate Holder responsible for the repair or alteration shall apply the stamping nameplate. Required stamping and nameplate information are shown in ~~5.9.6.~~5.7

5.11.2 STAMPING FOR REPAIRS

Pressure-retaining items repaired in accordance with the NBIC shall have a nameplate as required by Section ~~5.9.6~~5.7. Subject to the acceptance of the jurisdiction and the concurrence of the Inspector, nameplates may not be required for routine repairs. See 5.7.2(b). In all cases, the type and extent of repairs necessary shall be considered prior to waiving the requirement.

5.11.3 STAMPING FOR ALTERATIONS

The nameplate shall be applied in accordance with Section ~~5.9.6~~5.7. The location of the nameplate shall be documented on the Form R-2.

5.12 STAMPING REQUIREMENTS FOR YANKEE DRYERS

a) Stamping is not required for repairs that do not affect the pressure-retaining capability of the Yankee shell, as indicated on the De-rate Curve, or other pressure-retaining parts, as indicated on the original *Manufacturer's Data Report*.

b) Stamping is required for repairs that do affect the pressure-retaining capability of the Yankee shell, as indicated on the De-rate Curve, or other pressure-retaining parts as indicated on the original *Manufacturer's Data Report*.

c) Stamping is required for alterations as listed in Supplement S5.7.2

d) Stamping, when required, shall meet the requirements for stamping in 5.7.3. The location of stamping shall be described in the remarks section of Form R-2.

FIGURE 5.7.5-a
Required markings for repairs, with use of National Board Form R-1

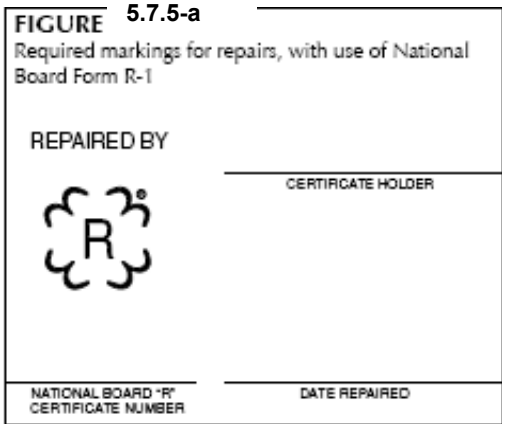


FIGURE 5.7.5-b
Required markings for alterations, with use of National Board Form R-2

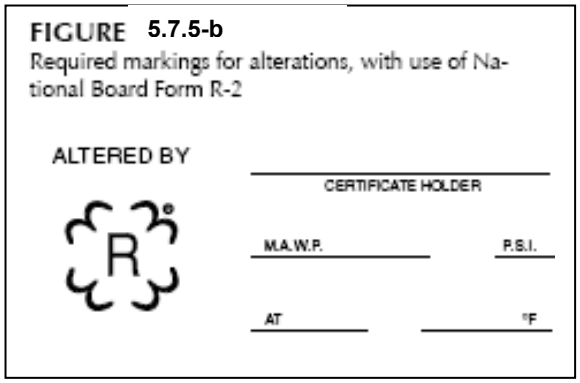


FIGURE 5.7.5-c
Required markings for re-ratings, with use of National Board Form R-2

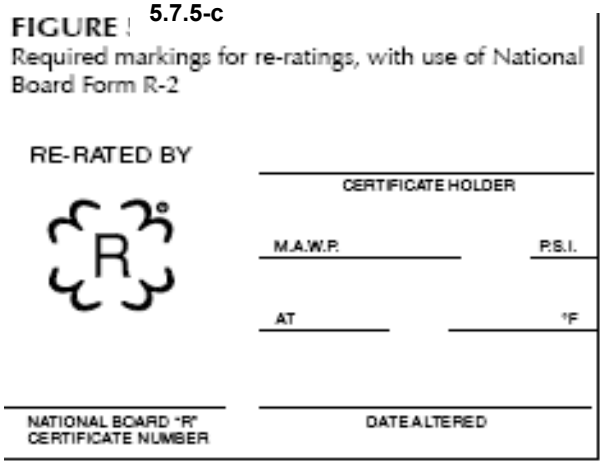


FIGURE 5.7.5-d
Required markings for parts fabricated by welding, with use of National Board Form R-3

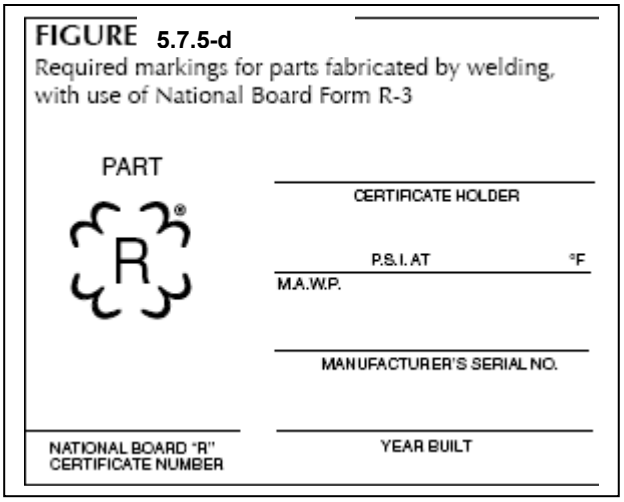
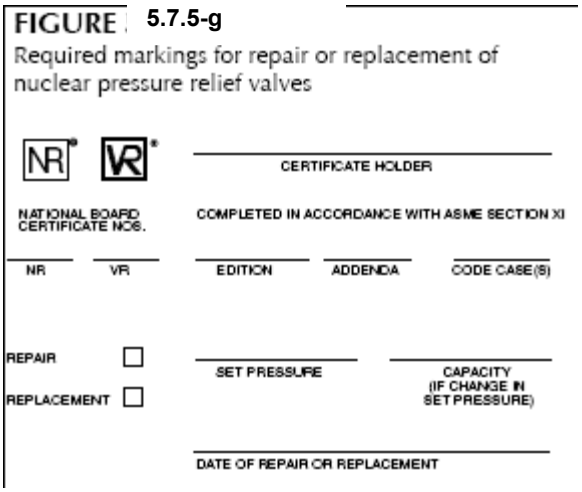


FIGURE 5.7.5-g
Required markings for repair or replacement of nuclear pressure relief valves



Note 1: To be indicated only when changed.

FIGURE 5.7.5-e
Required markings for repair of ASME/National Board "V," "UV," and "HV"-stamped pressure relief valves

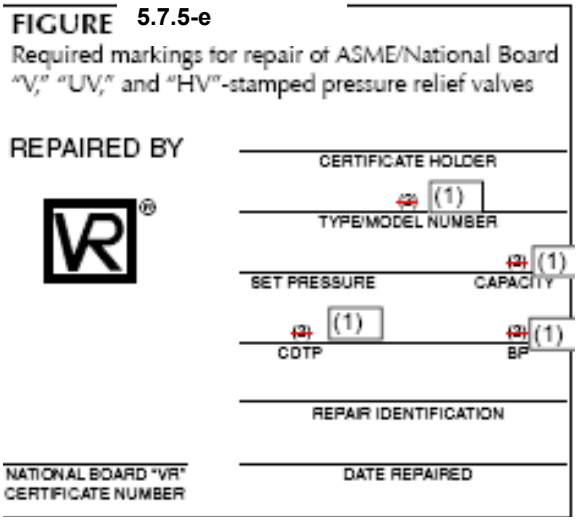
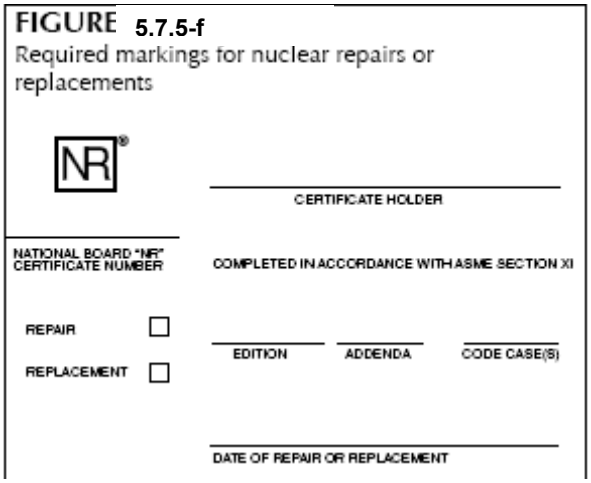


FIGURE 5.7.5-f
Required markings for nuclear repairs or replacements



S1.2.6 DIAGONAL BRACES, GUSSET BRACES, AND THROAT SHEET/TUBESHEET BRACES

(See Figures S1.2.6 a) & S 1.2.6 b)
a) Loose or damaged braces shall be repaired or replaced.

b) Only steel braces may be repaired by welding. All such welds shall be full penetration. Wrought iron braces shall not be repaired by welding. When repairs or alterations are completed, the tightness and condition of the braces and their staybolts, rivets, clevises, eyes, and pins shall be verified.

c) For pins that are fitted with nuts the pin length shall be sized so that all threads of the nut are engaged upon completion of installation.

d) Replacement of diagonal stays having loop type ends shall be considered a repair.

S1.2.6.1 GIRDER STAYS AND CROWN BARS

(See Figures S1.2.6.1 a & S1.2.6.1 b)

a) When repairs or alterations are completed, the installation and condition of the crown bars or girder stays and all associated fittings, including stays, rivets, pins, washers, nuts, thimbles, spacers and retainers shall be verified.

b) Crown bars, girder stays and the associated parts shall have the correct fit, alignment and bearing to the firebox and boiler sheets.

c) Wrought iron crown bars and girder stays, and all associated fittings, shall not be repaired by welding or application of riveted or bolted patches.

d) Steel crown bars, steel girder stays and associated steel brackets may be repaired or fabricated by welding. Welded repairs and components shall be made and examined in accordance with the ASME Boiler & Pressure Vessel Code Section I.

e) Steel crown bars, steel girder stays and associated steel brackets wasted or worn to less than 60% of original thickness shall not be repaired by weld build up.

f) On stays and pins that are fitted with nuts the stay or pin length shall be sized so that all threads of the nut are engaged upon completion of installation.

g) When driving crown bolts the opposite bolt end shall be bucked or braced to prevent damaging the bolt threads in the firebox sheet. Bracing can be done several ways such as using a pneumatic holder-on or heavy steel bucking bar. The crown bolt head is to be driven in such a manner as to expand radially the crown bolt body and threads into the sheet prior to forming the head. Merely driving over the head is not acceptable.

h) Telltale holes shall be reopened after driving.

i) Crown bolts shall have either 1 1 - or 1 2- thread pitch in the firebox sheets. Stay threads shall have good close fit in the firebox sheet. Changing the thread pitch from 1 1 to 12 or the reverse shall be considered a repair.

S1.6.2 SLING STAYS
(See Figures S1.2.6.2 a & S1.2.6.2 b)

a) When repairs or alterations are completed, the installation and condition of the sling stays and all associated fittings, including brackets, rivets, pins, washers, nuts, thimbles and spacers, shall be verified.

b) Sling stays and the associated parts shall have the correct fit, alignment and bearing to the crown bars, girder stays, firebox sheets and boiler sheets.

c) On pins that are fitted with nuts the pin length shall be sized so that all threads of the nut are engaged upon completion of installation.

d) Sling stays fabricated or repaired by welding shall be welded and examined in accordance with the ASME Boiler & Pressure Vessel Code Section I.

e) Holes and slots in sling stays should have all edges rounded off.

f) When driving sling stay eye brackets the opposite bracket end shall be bucked or braced to prevent damaging the threads. Bracing can be done several ways such as using a pneumatic holder-on or heavy steel bucking bar. The head of the sling stay eye bracket is to be driven in such a manner as to expand radially the body and threads into the sheet prior to forming the head. Merely driving over the head is not acceptable.

g) All sling stays, nuts, and pins shall be retained mechanically or have mechanical retainers installed when renewed or replaced.

S1.2.6.3 EXPANSION STAYS
(See Figures S1.2.6.3 a & S1.2.6.3 b)

a) When repairs or alterations are completed, the installation and condition of the expansion stays and all associated fittings, including brackets, rivets, pins, washers, nuts, thimbles and spacers, shall be verified.

b) Wrought iron expansion stay brackets shall not be repaired by welding.

c) Expansion stays shall not be repaired by welding.

d) Worn pin holes and expansion slots of steel expansion stay brackets may be repaired by welding.

e) On stays and pins that are fitted with nuts the stay or pin length shall be sized so that all threads of the nut are engaged upon completion of installation.

f) Stay length shall be sized so the length of the stay projecting through the sheet is not less than 118" and is sufficient to produce a full head after driving.

g) Stays shall have either 1 1 - or 12- thread pitch. Stay threads shall have good close fit in the sheet. Changing the thread pitch from 1 1 to 12 or the reverse shall be considered a repair.

h) Installation of expansion stays that have a different diameter in the firebox sheet shall be considered a repair.

i) Installation of expansion stays that have a different diameter in the bracket shall be considered a repair provided the changes are within the stress limits of the original code of construction.

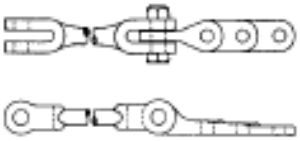
j) When driving expansion stay heads the opposite end shall be bucked or braced to prevent damaging the threads. Bracing can be done several ways such as using a pneumatic holder-on or heavy steel bucking bar. The stay head is to be driven in such a manner as to expand radially the stay body and threads into the sheet prior to forming the head. Merely driving over the head is not acceptable.

k) Telltale holes shall be reopened after driving.

FIGURE S1.2.6-a

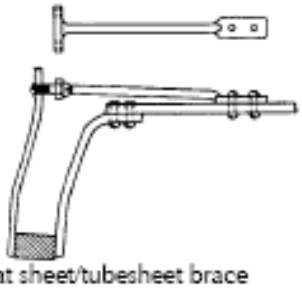
Diagonal Braces, Gusset Braces, and Throat Sheet/Tubesheet Braces

diagonal brace

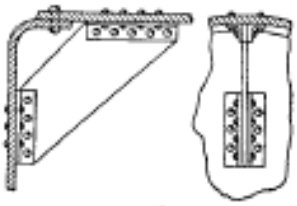


pin-type diagonal brace

solid-type brac



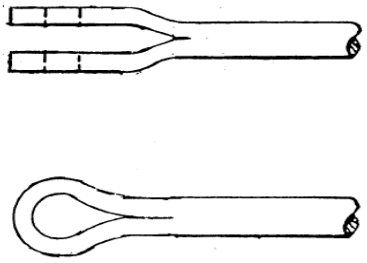
throat sheet/tubesheet brace



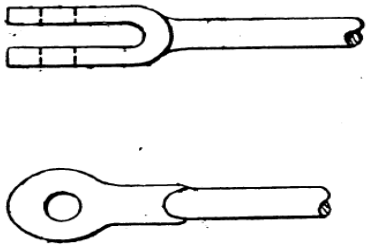
gusset brace

DIAGONAL BRACE ENDS

Figure S1.2.6-b



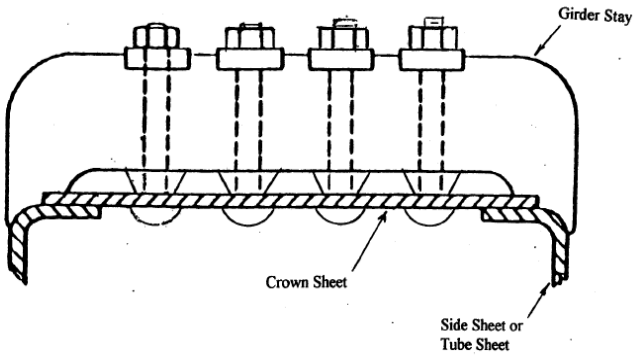
Loop-Type End

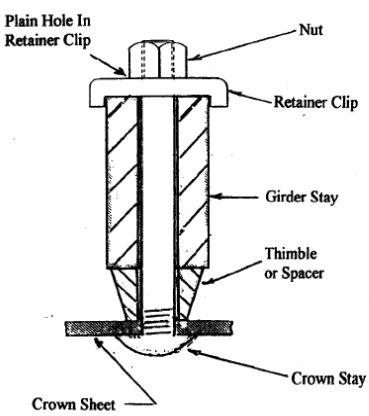


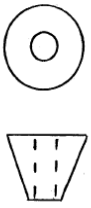
One-Piece End

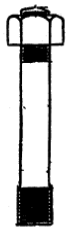
GIRDER STAY

Figure S.1.2.6.1-a



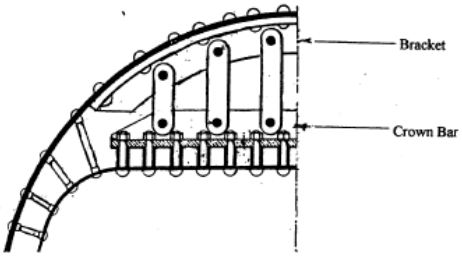






CROWN BAR WITH SLING STAYS

S1.2.6.1 b



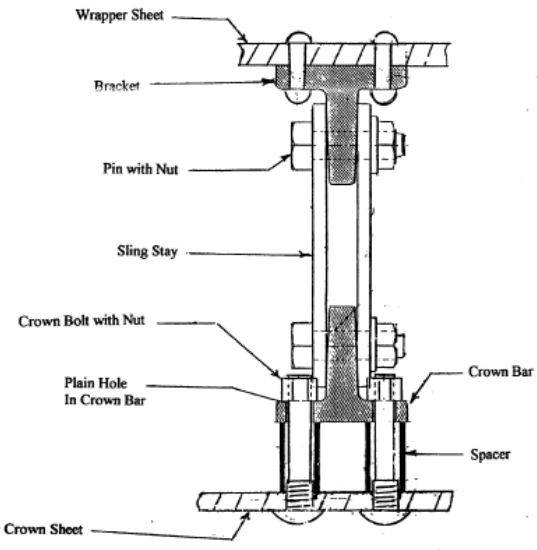
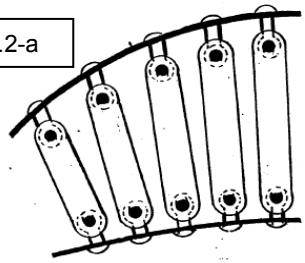


Figure S1.2.6.2-a

EYE-TYPE SLING STAY



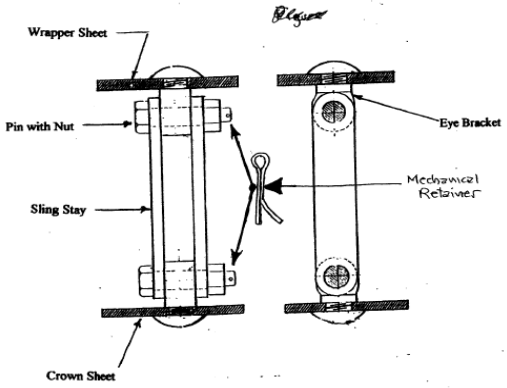
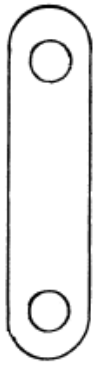


Figure S1.2.6.2-b

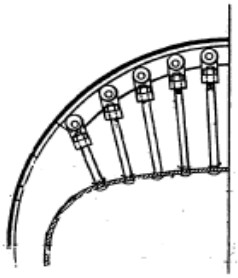


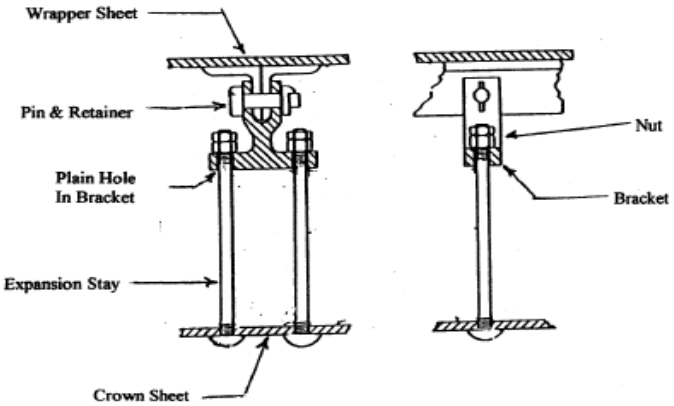
Sling Stay With
Round Pin Holes

Sling Stay With
Expansion Slot For Pin

Figure S1.2.6.3-a

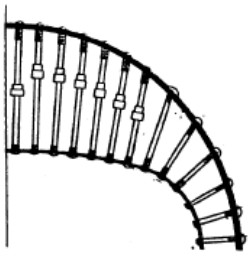
EXPANSION STAY

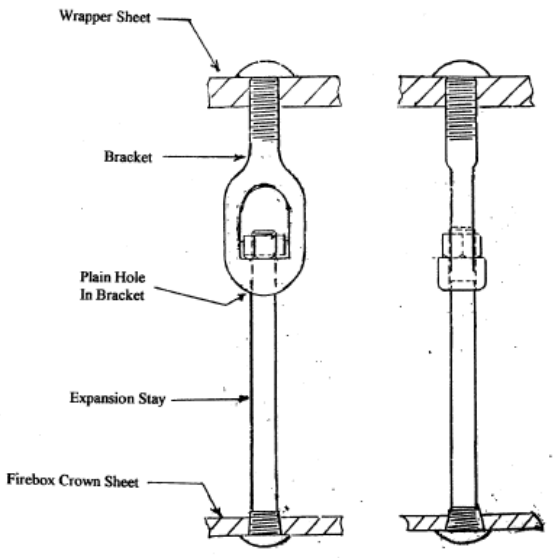




S1.2.6.3-b

BALDWIN-TYPE EXPANSION STAY





NB07-1009
S1.2.8

c) Patch bolts shall have either 11 or 12 thread pitch. Patch bolt threads shall be fit to support the structure to which the bolt is applied. Changing the patch bolt thread from 11 to 12 or the reverse shall be considered a repair.

NB06-0502
S1.2.8
d) A patch bolt applied in place of a rivet shall be considered an alteration.

NB08-1602
S1.2.9.7 FERRULES
a) Ferrous or non-ferrous ferrules may be used on either or both ends of flues and arch tubes.
b) The application of ferrules where none were used before shall be considered a repair.
c) The application without ferrules where they were used before shall be considered a repair.

NB07-1005

S1.2.11.5 REPAIR OF FIREBOX AND TUBESHEET KNUCKLES
a) Welds within the points of tangency of a knuckle are permitted. Welds with angles of less than 45 degrees to the longitudinal axis of the knuckle shall be radiographically examined. See Figures S1.2.11.5-a through S1.2.11.5-f.

b) Any patch not supported by means other than the weld, such as rivets, staybolts, tubes, or other forms of construction, shall have all weld seams radiographically examined.

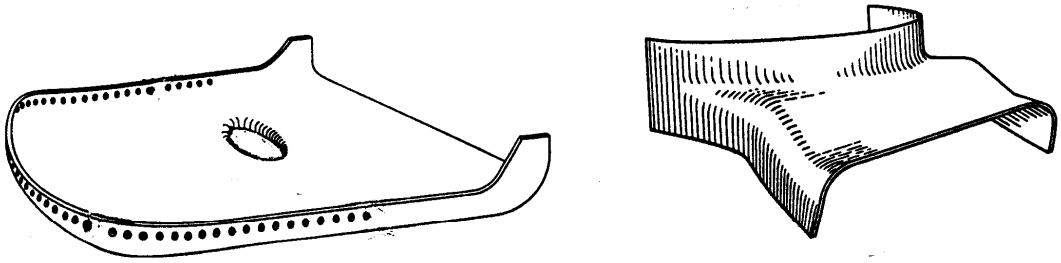
c) Patches shall be formed to proper shape and curvature.

d) Wasted sections of knuckles that have not wasted below 60% of the minimum required thickness may be repaired by weld buildup provided the strength of the structure will not be impaired. Where weld buildup is employed, the Inspector may require an appropriate method of NDE for the repair.

e) Wasted sections of knuckles that have wasted below 60% of the minimum required thickness shall be replaced.

f) Flanges shall be made so as to avoid stress intensifiers such as abrupt ridges and grooves

Figure S1.2.11.5-g



Flanged Sheets and Formed Flanges

1. Flanges shall be made smooth and free of ridges, valleys and grooves
2. Flanges may be welded in accordance with this section and all applicable sections of this code.

Comments must be submitted on the attached Public Review Comment Form. Comments should only be on altered language.

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

Draft 2009 Addendum Cycle B

Deleted items are designated by strikethrough.
Additions are designated by double underline.

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614) 888-8320
FAX: (614) 847-1828

DIRECTORY OF REVISIONS

Part 1 Installation

2.3
- **Added metric units to table**

2.7.5
- **Revised wording for clarity**

3.7.5.1
- **Revised wording for clarity**

3.7.9.1
- **Revised wording to exclude potable water heaters**

3.7.9.2
- **Added wording to address potable water heaters**

3.8.1.5
- **Deleted wording**

3.8.2.3
- **Revised wording for clarity**

3.8.2.4
- **Revised wording for clarity**

3.9.1.5
- **Added wording for clarity**

5.3.6
- **Added wording for design consideration**

Part 2 Inspection

2.2.12.3
- **Added text**

2.5.6
- **Added text**

S1.4.2.1 l)
- **Added diagram and text**

Part 3 Repairs and Alterations

2.3
- **Added note to SWPS**

2.5.3.2
- **Added wording**

2.5.3
- **Deleted table**

2.5.3.3
- **Added wording**

2.5.3.4
- **Added wording**

3.3.3
- **Added wording to address repairs and alterations**

3.3.4.1
- **Added wording**

3.3.4.2

- **Added wording**

3.3.4.3

- **Added wording to figure**

3.3.4.8

- **Added new section to address temporary repairs**

3.3.5.2

- **Revised wording**

3.4.3

- **Added wording**

3.4.4.1

- **Revised wording**

5.2.2

- **Added wording**

S1.1.3.1

- **Added wording**

S4.6

- **Revised wording**

S4.16.3

- **Revised wording**

S4.17.3

- **Revised wording**

S4.17.4

- **Revised wording**

S10

- **Added new supplement**

Glossary of Terms (Will appear in all three parts)

9

- **Revised definition for Alteration**
- **Added a new definition for Confined Space**

The National Board of Boiler and Pressure Vessel Inspectors

Part 1 Installation

NB07-2203

2.3 CALCULATION RELIEVING CAPACITY

b) It is necessary therefore, to determine the flow under both circumstances ~~(a) and (b)~~in paragraph a) above and check that the size of the safety valve under either condition will be adequate. The following formula should be used:

1) steam flow, W in lbs/hr (kg/hr) through the pressure-reducing valve

$W = AKC$

where,

A = internal area in sq. in. (sq. mm) of the inlet pipe size of the pressure-reducing valve (~~ref.~~see S2.5)

K = flow coefficient for the pressure-reducing valve (see ~~S2~~S2.4)

C = flow of saturated steam through a 1 sq. in. (1 sq. mm) pipe at various pressure differentials from Tables S2.3-a, ~~Table~~ S2.3-b, or ~~Table~~ S2.3-c.(for U.S. Customary units) or Tables S2.3M-a, S2.3M-b, or S2.3M-c (for metric units)

2) steam flow, W in lbs/hr (kg/hr) through the by-pass valve

$W = A_1 K_1 C_1$

where,

A_1 = internal area in sq. in. (sq. mm) of the pipe size of the by-pass around the pressure-reducing valve

K_1 = flow coefficient for the by-pass valves (see S2.4)

C_1 = flow of saturated steam through a 1 sq. in. (1 sq. mm) pipe at various pressure differentials from Tables S2.3-a, ~~Table~~ S2.3-b, ~~and~~ or ~~Table~~ S2.3-c (for U.S. Customary units) or Tables S2.3M-a, S2.3M-b or S2.3M-c (for metric).

NB09-0201

2.7.5 BLOWOFF

~~c) One of the blowoff valves shall be a slow-opening valve. When a second valve is required, the second valve may be a quick-opening or slow-opening valve.~~

c) When two valves are required, each bottom blowoff pipe shall have two slow-opening valves, or one quick-opening valve, at the boiler nozzle followed by a slow-opening valve.

NB07-1205

3.7.5.1 STEAM HEATING, HOT-WATER HEATING, AND HOT-WATER SUPPLY BOILERS

~~a) For Single Installations~~

~~Stop valves shall be located at an accessible point in the supply and return pipe connections, as near the boiler as is convenient and practicable~~

~~b) For Multiple Boiler Installations~~

~~A stop valve shall be used in each supply and return pipe connection of two or more boilers connected to a common system. See Figures 3.7.5 a), 3.7.5 b), and 3.7.5 c).~~

~~c) Types of Stop Valves~~

a) For Single Steam Heating Boilers

When a stop valve is used in the supply pipe connection of a single steam boiler, there shall be one used in the return pipe connection.

b) For Single Hot Water Heating & Hot Water Supply Boilers

1) Stop valves shall be located at an accessible point in the supply and return pipe connections as near the boiler as is convenient and practicable, of a single hot water boiler installation to permit draining the boiler without emptying the system.

2) When the boiler is located above the system and can be drained without draining the system, stop valves required on paragraph 3.7.5.1 b 1) may be eliminated.

c) For Multiple Boiler Installations
A stop valve shall be used in each supply and return pipe connection of two or more boilers connected to a common system. See Figures 3.7.5 a), 3.7.5 b), and 3.7.5 c)

d) Types of Stop Valves

NB08-0319
3.7.9.1 EXPANSION TANKS AND PIPING FOR STEAM HEATING, HOT-WATER HEATING AND HOT WATER SUPPLY BOILERS, ~~AND POTABLE WATER HEATERS~~

3) Hot-water Supply Systems ~~and Potable Water Systems~~

3.7.9.2 EXPANSION TANKS AND PIPING FOR POTABLE WATER HEATERS
a) Expansion Tanks

If a system is equipped with a check valve or pressure-reducing valve in the cold water inlet line, consideration should be given to the installation of an airtight expansion tank or other suitable air cushion. Otherwise, due to the thermal expansion of the water, the safety relief valve may lift periodically. If an expansion tank is provided, it shall be constructed in accordance with an acceptable code of construction. The minimum capacity of the expansion tank may be determined from Table ~~3.7.9.1-c.~~3.7.9.2 See Figures 3.7.5-d and 3.7.5-e for a typical acceptable installation. Except for pre-pressurized diaphragm-type tanks, which should be installed on the cold water side, provisions shall be made for draining the tank without emptying the system.

Table ~~3.7.9.1-c~~3.7.9.2
Expansion Capacities for a Potable Water Heater (Note)

Capacities, gal. (l)

System Volume, gal. (l)	Prepressurized Diaphragm Type	Nonpressurized Type
50 (190)	1 (4)	3 (11)
100 (380)	2 (8)	6 (23)
200 (760)	3 (11)	12 (45)
300 (1140)	4 (15)	18 (68)
400 (1514)	5 (19)	24 (91)
500 (1890)	6 (23)	30 (114)
1,000 (3790)	12 (45)	60 (227)
2,000 (7570)	24 (91)	120 (454)

Note: Capacities in this table are given as a guide to reduce or eliminate relief valve weeping under conditions of partial water system demands or occasional water draw during recovery.
System volume includes water heater capacity plus all piping capacity for a recirculation system or potable water heater capacity only for a nonrecirculation system.
The capacities are based upon a water temperature rise from 40°F to 180°F (4°C to 80°C), 60 psig (414 kPa) fill pressure, maximum operating pressure of 125 psig (862 kPa) 20% water recovery, and an acceptance factor of 0.465 for prepressurized types, and 0.09156 for nonpressurized types. For other cases or metric calculations see Chapter 12 of the 1996 *HVAC Systems and Equipment* Volume of the ASHRAE Handbook.

b) Piping
Provisions shall be made for the expansion and contraction of hot water mains connected to potable water heater(s) so that there will be no undue stress transmitted to the potable water heater(s). See Figures 3.7.5-d and 3.7.5-e for typical schematic arrangements of piping incorporating strain absorbing joints.

NB09-0101
3.8.1.5 AUTOMATIC LOW-WATER FUEL CUTOFF AND/OR WATER FEEDING DEVICE

c) In addition to the requirements in a) and b) above, a secondary low water fuel cutoff with manual reset shall be provided on each automatically fired steam or vapor-system boiler. ~~with a combined fuel input of greater than 400,000 Btu/hr (117 kW).~~

NB09-0202
3.8.2.3 TEMPERATURE CONTROL
Each automatically fired hot-water heating of hot-water supply boiler shall be protected from over-temperature by two temperature-operated controls.
a) Each individual hot-water heating or hot-water supply boiler or each system of commonly connected boilers ~~without intervening valves~~ shall have a control that will cut off the fuel supply when the water temperature reaches an operating limit, which shall be less than the maximum allowable temperature.
b) In addition to a) above, each individual automatically fired hot-water heating or hot-water supply boiler ~~or each system or commonly connected boilers without intervening valves~~ shall have a safety limit control with manual reset that will cut off the fuel supply to prevent the water temperature at the boiler outlet.

NB09-0203
3.8.2.4 LOW-WATER FUEL CUTOFF
a) Each automatically fired hot-water boiler ~~with heat input greater than 400,000 Btu/hr (117 kW)~~ shall have an automatic low-water fuel cutoff with manual reset. The low-water fuel cutoff shall be designed for hot-water service, and it shall be so located as to automatically cut off the fuel supply when the surface of the water falls to the level established in (b) below.
c) ~~A coil-type boiler or a watertube boiler with heat input greater than 400,000 Btu/hr (117 kW) requiring forced circulation to prevent overheating of the coils or tubes shall have a safety control to prevent burner operation at a flow rate inadequate to protect the boiler unit against overheating, at all allowable firing rates. This safety control shall shut down the burner and prevent restarting until an adequate flow is restored.~~
c) In lieu of the requirements for low-water fuel cutoffs in paragraph a), boilers requiring forced circulation to prevent overheating of the tubes, coils, or vessel, shall have an accepted flow, and/or temperature sensing device to prevent burner operation at a flow rate inadequate to protect the boiler unit against overheating at all allowable firing rates. This safety control(s) shall shut down the burner and prevent restarting until an adequate flow is restored and shall be independent of all other controls.

NB07-2204
3.9.1.5 SAFETY AND RELIEF VALVE DISCHARGE PIPING
a) A discharge pipe shall be used. Its internal cross-sectional area shall be not less than the full area of the valve outlet or of the total of the valve outlets discharging thereinto, and shall be as short and

straight as possible and so arranged as to avoid undue stress on the valve or valves. A union may be installed in the discharge piping close to the valve outlet. When an elbow is placed on a safety or a safety relief valve discharge pipe, it shall be located close to the valve outlet downstream of the union to minimize reaction moment stress.

NB07-1207
5.3.6 INLET AND DISCHARGE PIPING REQUIREMENTS
Replace paragraph h) with the following and re-letter the remaining paragraph to i).

h)The reaction forces due to discharge of pressure relief devices shall be considered in the design of the inlet and discharge piping.

~~h)~~ i) Pressure relief devices shall be installed so they are accessible for inspection, repair, or replacement.

The National Board of Boiler and Pressure Vessel Inspectors

Part 2 Inspection

NB08-0901
2.2.12.3 THERMAL FLUID HEATERS
f) Pressure relief devices – Pressure relief valves shall be a closed bonnet design with no manual lift lever. The pressure relief discharge should be connected to a closed, vented storage tank or blowdown tank with solid piping (no drip pan elbow, or other air gap). When outdoor discharge is used, the following should be considered for discharge piping at the point of discharge.

NB09-0302
2.5.6 PACKAGING, SHIPPING AND TRANSPORTATION
b) The following practices are recommended:

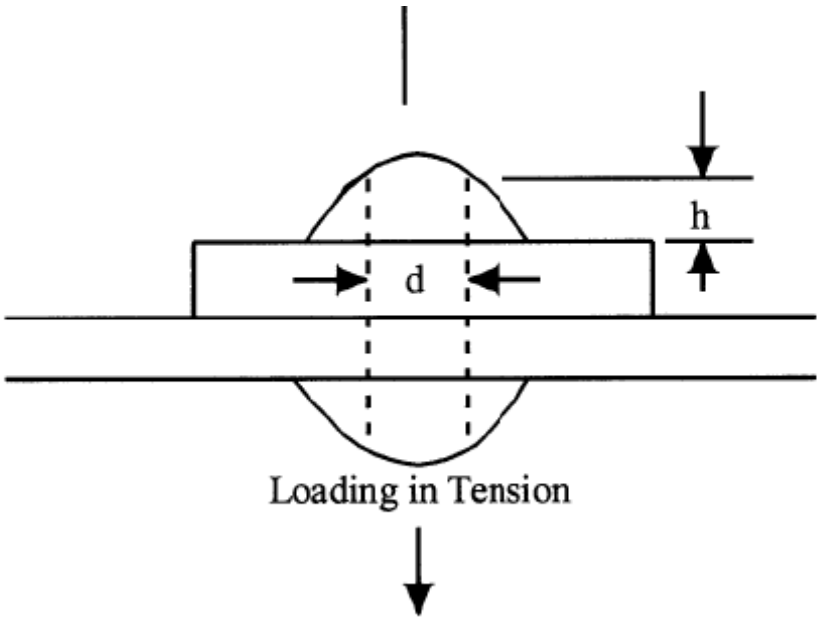
3) The valve should not be picked up or carried using the lifting lever. Lifting levers should be wired or secured so they cannot be moved while the valve is being shipped or stored. These wires shall be removed before the valve is placed in service.

NB07-1006

S1.4.2.1 l) Rivet Head Wastage for Rivet Joint in Tension
Rivet head wastage for riveted joints in tension shall not exceed 0.250d. In Fig. S1.4.2.1 l), h shall be equal to or greater than 0.250d where:

h = average height of rivet head on circumference of diameter d
d = shank diameter of driven rivet
Note: This calculation is independent of the type and style of the rivet head.

Figure S1.4.2.1 l)



THE NATIONAL BOARD
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Part 3 Repairs and Alteration

NB08-2001

2.3 STANDARD WELDING PROCEDURE SPECIFICATIONS (1)

(1) The AWS reaffirms SWPSs in accordance with ANSI procedures. When reaffirmation occurs without revision to the SWPS, the letter "R" is added to the SWPS designation following the year. Such designation is considered to be identical with previously published version and may be used pending incorporation herein, on the same basis as the version listed in Table 2.3.

NB09-0401

2.5.3.2 WELDING METHOD 2

f) The qualification thickness for the test plates and repair groove depths shall be in accordance with ~~Table 2.5.3.~~Section IX of the ASME Boiler and Pressure Vessel Code.

~~**Table 2.5.3**~~

~~**Base Metal Thickness**~~	~~**Repair Groove Depth**~~	~~**PQR Test Material Thickness**~~	~~**PQR Groove Depth (Note 2)**~~	~~**Thickness Qualified (Note 1)**~~
~~< 2 in. (50 mm)~~	~~< 1 in. (25 mm)~~	~~1 in. (25 mm)~~	~~< 1 in. (25 mm)~~	~~See PQR test material thickness column~~
~~2 in. (50 mm)~~	~~> 1 in. (25 mm)~~	~~Thickness of the base metal to be repaired~~	~~> 1 in. (25 mm)~~	~~PQR test material thickness~~
~~> 2 in. (50 mm)~~	~~1 in. (25 mm)~~	~~2 in. (50 mm)~~	~~1 in. (25 mm)~~	~~All base metal thickness and 1 in. (25 mm) repair groove depth~~
~~2 in. (50 mm)~~	~~> 1 in. (25 mm)~~	~~2 in. (50 mm)~~	~~> 1 in. (25 mm)~~	~~All base metal thickness and PQR groove depth~~
~~Note 1: Repair groove depth is limited to the maximum depth qualified.~~ ~~Note 2: The depth of the groove used for procedure qualification must be deep enough to remove test specimens.~~				

2.5.3.3 WELDING METHOD 3

f) The qualification thickness for the test plates and repair groove depths shall be in accordance with ~~Table 2.5.3.~~Section IX of the ASME Boiler and Pressure Vessel Code.

2.5.3.4 WELDING METHOD 4

f) The qualification thickness for the test plates and repair groove depths shall be in accordance with ~~Table 2.5.3~~Section IX of the ASME Boiler and Pressure Vessel Code..

NB05-1201

3.3.3 EXAMPLES OF REPAIRS

t) The replacement of a Pressure Relieving Device (PRD) attached by welding, provided the replacement device's relieving capacity is equal to or greater than the PRD-capacity required by the

original code of construction.
NB05-0122

3.3.4.1 SCOPE
Except as provided in 3.3.4.8 ~~A~~a repair of a defect in a welded joint or base material shall not be made until the defect has been removed.

3.3.4.2 DEFECT REPAIRS

a) Cracks

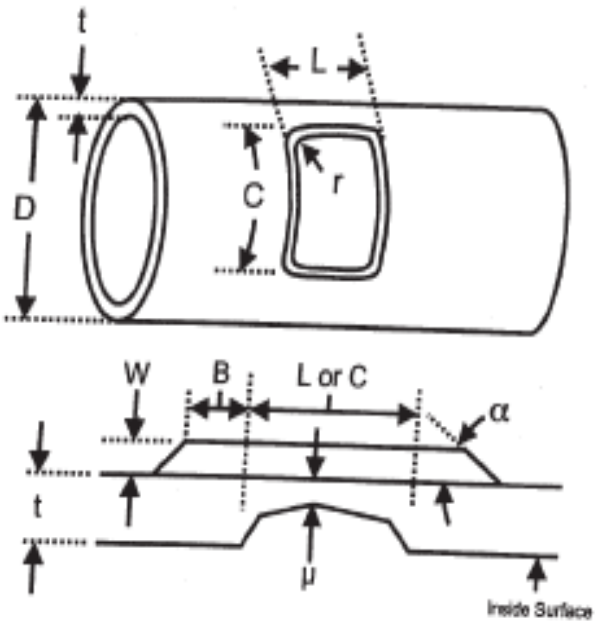
Except as provided in 3.3.4.8 a repair of a crack in a welded joint or base material shall not be made until the defect has been removed.

d) Minor Defects

Minor cracks, isolated pits, and small plate imperfections should be examined to determine the extent of the defect and whether repair by welding is required. Except as provided in 3.3.4.8 ~~P~~prior to repair by welding, the defects shall be removed to sound metal. Liquid penetrant or magnetic particle examination may be used before or after welding.

NB09-0701

FIGURE 3.3.4.3-c
External Overlay Terms and Definitions



L= length of area to be compared along the axis of the component
C= length of area to be repaired along outside circumference of the component
W = the completed thickness of the overlay
a = the angle between the component and the overlay (maximum 45°)
B = ¾ √ (R t) minimum
R = nominal outside radius of the component
D = the nominal outside diameter of the component
t =nominal wall thickness of the component
μ = remaining wall thickness of the component shall be 1/16 or greater
r = minimum radius, not less than the overlay thickness

3.3.4.8 REPAIR OF PRESSURE RETAINING ITEMS WITHOUT COMPLETE REMOVAL OF DEFECTS

(a) There may be cases where removal of a defect in a pressure retaining item is not practical at the time the defect is found. In such cases, with approval of the Inspector and, when required, the Jurisdiction, an engineering evaluation shall be performed to determine the scope of the repair and impact to safety prior to returning the pressure retaining item to service for a specified period of time. The engineering evaluation shall be performed by an organization with demonstrated competency in defect (and flaw) characterization of pressure retaining items. The method of defect evaluation and time interval for returning the pressure retaining item back to service shall be as agreed upon by the Inspector, and when required, the Jurisdiction. The specified period of time the defect can remain in service after weld repair shall be based on no measureable defect growth during subsequent inspections, or a period of time as specified by the Jurisdiction, if applicable. This repair method is not permitted for vessels used in lethal service, vessels designed for high-cycle operation or fatigue service, compressed air storage, and in cases where high stress concentration cannot be reduced by weld repair. This repair method is not permitted for DOT vessels.

(b) One or more fitness-for-service engineering evaluation methods as described in Part 2, Section 4, Paragraph 4.4 shall be used to determine whether the defect may remain, either in part or in whole, in the pressure retaining item. If it is determined that the defect can remain in the item, a risk-based inspection program shall be developed to assure inspection of the defect and monitoring of defect growth over time. This program shall be a controlled and documented inspection program that specifies inspection intervals as agreed upon with the Inspector and, when required, the Jurisdiction, and shall be maintained until the defect can be completely removed and the item repaired.

(c) The following requirements shall apply to the weld repair of pressure retaining items without complete removal of defects;

1)Engineering evaluation of the defect in the pressure retaining item shall be conducted using one or more fitness-for-service condition assessment method(s) as described in Part 2, Section 4, paragraph 4.4. Engineering evaluation of the condition assessment results shall be performed by an organization that has demonstrated industry experience in evaluating pressure retaining items as referenced in Part 2, Supplement 5.3.

2)If engineering evaluation indicates a defect can remain in the pressure retaining item, a risk-based inspection program shall be developed and implemented based on review and acceptance by the Inspector and, when required, the Jurisdiction. The risk-based inspection program shall be in accordance with the requirements in Part 2, Section 4.4.

3)The fitness-for-service condition assessment and risk-based inspection programs shall remain in effect for the pressure retaining item until such time that the defect can be completely removed and the item repaired. The fitness-for-service condition assessment method, results of

assessment, and method of weld repair shall be documented on a Report of Fitness for Service Assessment (FFSA) Form as described in Part 2, Section 4, Paragraph 4.4.1 (d) and shall be filed with the Jurisdiction, when required.

4)When weld repairs are performed without complete removal of the defect(s), this shall be noted on the Form R-1 in the description of the work. The R-Stamp holder performing the weld repairs shall provide detailed information on the Form R-1 describing the method and extent of repair and include the specific location of the repair on the item.

5)The interval to either re-inspect or remove the item from service for repair shall be determined based on a risk-based inspection program developed and implemented as required by Paragraph 3.3.4.8 (c) (2). The inspection interval shall not exceed the remaining life of the item, and shall be documented on the FFSA Form and in the remarks section of the Form R-1. The FFSA Form shall be affixed to the Form R-1 when weld repairs are performed in 3.3.4.8 (c) (4).

6) A copy of the completed Form R-1 with the completed FFSA Form attached may be registered with the National Board, and when required, filed with the Jurisdiction where the item was installed.

NB08-0313

3.3.5.2 REPAIR PLAN

The user shall prepare or cause to have prepared a detailed plan covering the scope of the repair.

a) ~~Professional~~ Engineer Review and Certification

The repair plan shall be reviewed and certified by ~~a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable~~ an engineer meeting the criteria of ASME Section VIII, Division 2 or 3, as applicable, for an Engineer signing and certifying a Manufacturer's Design Report ,. The review and certification shall be such as to ensure the work involved in the repair is compatible with the User's Design Specification and the Manufacturer's Design Report.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying Engineer.

NB05-1201(cont.)

3.4.3 EXAMPLES OF ALTERATIONS

e) In a boiler, an increase in the heating surface or steaming capacity as described on the original Manufacturer's Data Report. ~~such that an increase in the relieving capacity is required~~;

i) The replacement of a Pressure Relieving Device (PRD) as a result of work completed on a Pressure Retaining Item (PRI) that changes the resultant capacity to exceed the Minimum Required Relieving

Capacity (MRRC) required by the original code of construction as described on the original Manufacturer's Data Report.

NB08-0313 (cont.)

3.4.4.1 ALTERATION PLAN

a) ~~Professional~~ Engineer Review and Certification

The alteration plan shall be reviewed and certified by ~~a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable.~~ an engineer meeting the criteria of ASME Section VII, Division 2 or 3, as applicable, for an Engineer signing and certifying a Manufacturer's Design Report. The review and certification shall be such as to ensure the work involved in the alteration is compatible with the user's design specification and the Manufacturer's Design Report.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying Engineer.

b) User's Design Specification

If the alteration is such that the work is not compatible with or changes one or more requirement(s) of the original user's design specification, the user's design specification shall be revised by the user with the new parameters or changes. The revisions shall be certified by ~~a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable.~~an Engineer meeting the criteria of ASME Section VIII, Division 2 or 3, as applicable, for an Engineer signing and certifying a Manufacturer's Design Report.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying Engineer.

c) Manufacturer's Design Report

The "R" Certificate Holder shall prepare or cause to have prepared a supplement to the manufacturer's design report to reconcile the new parameters or changes with the user's design specification.
The supplement to the manufacturer's design report shall be certified by ~~a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable~~an Engineer meeting the criteria of ASME Section VIII, Division 2 or 3, as applicable, for an Engineer signing and certifying a Manufacturer's Design Report.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying Engineer.

NB05-1201 (cont.)

5.2.2 PREPARATION OF FORM R-2 (ALTERATIONS)

b) The information describing an alteration to a pressure-retaining item shall be identified on the Form R-2 with a complete description of the scope of work for physical or non-physical changes. When the scope of work represents a change that will increase the Minimum Required Relieving Capacity (MRRC) of a pressure retaining item, such as a change in heating surface, Maximum Designed Steaming Capacity (MDSC), or Btu/hr (W) heating capacity, the new MRRC shall be documented on the Form R-2 and indicated on the appropriate nameplate of Figure 5.9.6-b or Figure 5.9.6-c.

~~b~~c) Final preparation of Form R-2, including the gathering and attaching of supporting reports, shall be the responsibility of the "R" Certificate Holder that performed the construction portion of the alteration. The construction organization shall complete the Form R-2 provided by the design organization, including the "Construction Certificate" section. An Inspector shall indicate that the work complies with the applicable requirements of this code by completing and signing the "Certificate of Inspection" section of the form. When no construction work is performed (e.g., a re-rating with no physical changes), the "R" Certificate Holder responsible for the design shall prepare the Form R-2, including the gathering and attaching of supporting reports.

~~c~~d) The following shall be attached to and become a part of the completed Form R-2:

FIGURE 5.9.6-b
Required markings for alterations, with use of National Board Form R-2.

ALTERED BY _____

CERTIFICATE HOLDER

M.A.W.P _____ P.S.I

AT _____ F ____

_____

* Minimum Required Relieving Capacity

_____ _____

National Board "R" Certificate Number | Date Altered

FIGURE 5.9.6-c

Required markings for re-ratings, with use of National Board Form R-2.

RE-RATED BY _____

CERTIFICATE HOLDER

M.A.W.P _____ P.S.I

AT _____ F ____

_____

*Minimum Required Relieving Capacity

_____ _____

National Board "R" Certificate Number | Date Altered

*NOTE: a) Not required when the scope of work does not change the Minimum Required Relieving Capacity.

b) If the line identifying Minimum Required Relieving Capacity is represented on the nameplate and the scope of work does not affect the Minimum Required Relieving Capacity, the line shall be "X'd" to represent "no change".

c) Minimum Required Relieving Capacity may be abbreviated to M.R.C.C.

NB08-1601
S1.1.3.1

Application	**Specification**
Boiler Tubes & Flues, Arch Tubes Superheater Units	SA-178 Grade A, SA-192, SA-210
Boiler & Firebox Plate, Pressure Retaining Plate	SA-285 Grade C, SA-515, SA-516, SA-203, SA-204
Welded Staybolts	SA-675, SA-36, ~~ASTM A -31~~ SA-31 Grade B
Threaded Staybolts	SA-31 Grade A SA-675 with a tensile strength of 47,000 psi to 65,000 psi inclusive
Staybolt Sleeves and Caps	SA-105 Forging, SA-675
Boiler Braces	SA-675, SA-36
Rivets	SA-675, SA-31
Forged Parts & Fittings	SA-105, SA-181
Pressure-Retaining Steel Castings	SA-216, A-217
Hollow Cylindrical Pressure-Retaining Parts	SA-105 Forgings, SA-675 Bar Stock
Superheater Unit Bolts & Nuts	Bolts - SA-193, Nuts - SA-194
Pipe Flanges	SA-181, SA-105
Pipe	SA-106, SA-53 Seamless
Bronze Castings & Washout Plugs	SB-61, SB-62, SB-148

d) When staybolt material tensile strength is stronger than that of the firebox sheets, the firebox sheets deflect instead of the staybolts, which can result in the sheets developing cracks and leaking staybolts. In addition, high tensile strength steels are difficult to drive. Maximum allowable tensile strength shall be 7,500 psi (51.71 MPa).

NB08-0313 (cont.)

S4.6 VESSELS FABRICATED USING ELEVATED TEMPERATURE CURED RESIN SYSTEMS

1) ~~1)~~ Calculations must be submitted by ~~a Professional Engineer (P.E.) experienced in the field of FRP vessels. See S4.17.4.~~an Engineer meeting the ASME Section X criteria for an Engineer certifying ASME Section X compliance of the calculations contained in the Fabricator's Design Report.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying Engineer.

S4.16.3 REPAIR PLAN

When repairs other than those defined in S4.16.4 are being made to ASME Section X or RTP-1 stamped equipment, the user shall prepare or cause to have prepared a detailed plan covering the scope of the repair.

a) ~~Professional~~ Engineer Review and Certification

The repair plan shall be reviewed and certified by ~~a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada and is experienced in reinforced plastic vessel design.~~an Engineer meeting the ASME Section X criteria for an Engineer certifying ASME Section X compliance of the calculations contained in the Fabricator's Design Report. The review and certification shall be such to ensure that the work involved in the repair is compatible with the User's Design Specification or User's Basic Requirements Specification and the Manufacturer's Design Report. The certification shall also include any drawings and calculations prepared as part of the repair plan.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying Engineer.

S4.17.3 ALTERATION PLAN

The user shall prepare or cause to have prepared a detailed plan covering the scope of the alteration.

a) ~~Professional~~ Engineer Review and Certification

The alteration plan shall be reviewed and certified by ~~a Professional Engineer (P.E.) who is registered in one or more of the states of the United States of America or the provinces of Canada and is experienced in reinforced plastic vessel design.~~an Engineer meeting the ASME Section X criteria for an Engineer certifying ASME Section X compliance of the calculations contained in the Fabricator's Design Report. The review and certification shall be such as to ensure that the work involved in the alteration is compatible with the user's design specification and the Fabricator's Data Report.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying Engineer.

S4.17.4 CALCULATIONS

A set of calculations shall be completed prior to the start of any physical work. All design work shall be completed by an organization experienced in the design portion of the standard used for the construction of the item. All calculations for ASME Code Section X and RTP-1 alterations shall be certified by ~~a P.E. experienced in reinforced plastic vessel design.~~an Engineer meeting the ASME Section X criteria for an Engineer certifying ASME Section X compliance of the calculations contained in the Fabricator's Design Report. All calculations shall be made available for review by the Inspector.

NOTE: The Engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before the selecting the certifying Engineer.

NB07-1901

SUPPLEMENT 10 REPAIR AND ALTERATIONS OF PRESSURE VESSELS IN LIQUEFIED PETROLEUM GAS SERVICE

S10.1 SCOPE

This Supplement provides general and specific requirements that apply to the repairs or alterations to pressure vessels designed for storing Liquid Petroleum Gas (LPG) and fabricated in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquid and Gases. When the standard governing the original construction is not the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquid and Gases the requirements of paragraph 1.2 b), Part 3, Section 1 shall apply. In addition to this supplement, the applicable paragraphs of Part 3 of the NBIC shall be met. Vessels used for anhydrous ammonia service shall not be considered for repair or alteration in accordance with this Supplement.

S10.2 GENERAL AND ADMINISTRATIVE REQUIREMENTS

a) Refer to Section 1 of this Part for all applicable post construction activities pertaining to general and administrative requirements.
b) Repairs or alterations shall conform to the edition of the ASME Code or standard most applicable to the work.

S10.3 WELDING

Refer to Section 2 of this Part for all applicable post construction activities pertaining to welding requirements.

S10.4 REQUIREMENTS FOR REPAIRS AND ALTERATIONS

a) Refer to Section 3 of this Part for all applicable post construction activities pertaining to requirements for repairs and alterations.
    1) Excluded is Part 3, Section 3, Paragraph 3.3.4.8 Repair of Pressure Retaining Items without Complete Removal of Defects.

b) Radiographic or Ultrasonic Examinations are considered to be suitable alternative Nondestructive Examination methods to assure complete removal of the defect as described in paragraph 3.3.4.1 of this Part.

S10.5 EXAMINATION AND TESTING

Refer to Section 4 of this Part for all applicable post construction activities pertaining to examination and testing.

S10.6 CERTIFICATION / DOCUMENTATION AND STAMPING

a) Section 5 of this Part is applicable for all post construction activities pertaining to certification / documentation and stamping.

b) The “R” Certificate Holder shall assure all repairs or alterations involving a change to the following are recorded on the proper NBIC Form and marked on the NBIC nameplate or stamping without changing the required format of the NBIC markings.

1) Service for which the container is designed (for example, underground, aboveground, or both)
2) Dip tube length.
3) Maximum filling limit with liquid temperature reference.

S10.7 INSPECTION

Refer to Supplement 7 of Part 2 Inspection, for all applicable post construction activities pertaining to inspection.

S10.8 COATINGS

When coatings are reapplied the user should verify the coating is compatible with any coating that remains intact and is suited for the intended service application.

Glossary

Alteration — A~~ny~~ change in the item described on the original Manufacturer's Data Report ~~that~~ which affects the pressure retaining capability of the pressure-retaining item. (See sub-section 3.4.3, EXAMPLES OF ALTERATIONS)Nonphysical changes such as an increase in the maximum allowable working pressure (internal or external), increase in the design temperature, or a reduction in minimum temperature of a pressure-retaining item shall be considered an alteration.

Confined Space- Work locations considered "confined" because their configurations hinder the activities of employees who must enter, work in and exit them. A confined space has limited or restricted means for entry or exit, and it is not designed for continuous employee occupancy. Confined spaces include, but are not limited to underground vaults, tanks, storage bins, manholes, pits, silos, process vessels, and pipelines. Regulatory Organizations often use the term "permit-required confined space" (permit space) to describe a confined space that has one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress. Confined space entry requirements may differ in many locations and the Inspector is cautioned of the need to comply with local or site specific confined space entry requirements.

The proposed new text is not completely accurate. The inclusion of "fuel and ash" is only correct for solid fuel fired boilers, some heavy oil fired boilers, and chemical recovery boilers. Typically at the high point of the boiler where the described nipples are located, it is flyash, slag, or unburned carbon that is deposited on the tubes. The only "fuel" is the unburned char or carbon that is not consumed in combustion.

Based on this, I suggest the change shown below with a single underline and deletions with strikethrough. In addition, there appears to be an extra space between "join" and "drums" in the first line.

Part 2 Section 2.2.12.3 e)
e) In restricted fireside spaces, such as where short tubes or nipples are used to join drums or headers, in solid fuel fired, heavy oil fired, chemical recovery boilers there is a tendency for ~~fuel~~ unburned carbon, slag, and ~~flyash~~ to lodge at junction points. Such deposits are likely to cause under deposit corrosion if moisture is present, ~~and the~~ The area should be thoroughly cleaned and examined.