



**THE
NATIONAL
BOARD**
OF BOILER AND
PRESSURE VESSEL
INSPECTORS

NATIONAL BOARD SUBCOMMITTEE INSPECTION

MINUTES

Meeting of January 10th, 2018
New Orleans, LA

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The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614)888-8320
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1. Call to Order

Secretary, Jodi Metzmaier, called the meeting to order at 8:03 am.

2. Alternate Chair

The Chairman, Mark Mooney, was not present for the SC Inspection meeting; therefore, a motion was made for Jim Getting to stand in as Chair for the SC Inspection meeting. The motion was unanimously approved.

3. Introduction of Members and Visitors

Joey Burgess sat in on the SC Inspection meeting as an alternate for M. Mooney.

The attendees are identified on the attendance sign in sheet (**Attachment Pages 1-2**). With the attached attendance listing, a quorum was established.

4. Announcements

Secretary, Jodi Metzmaier and Chairman, Jim Getter, made announcements to the subgroup.

5. Adoption of the Agenda

- Add Matt Sansone as a nomination to the SG & SC Inspection
- Add Officer Nomination for Vice Chair of SC Inspection
- Add Task Group to 17-162
- Add item 18-7)Inspection Requirements for PVHOs)
- Add item 18-27 (CO₂ Detector Placement)

The above items were added to the agenda. The revised agenda was adopted unanimously by the subcommittee.

6. Approval of the Minutes of July 19th, 2017 Meeting

The minutes are available for review on the National Board website, www.nationalboard.org.

7. Review of Rosters

a. Membership Nominations

- Matt Sansone would like to become a member of the SG & SC Inspection.

M. Sansone addressed the SC stating why he would be an asset as members of the SC Inspection. A motion was made to recommend he become a member of the SC. The motion was unanimously approved.

b. Membership Reappointments

- Timothy Barker – SC Inspection
- Timothy Barker – SG Inspection

The SC Inspection unanimously voted to reappoint T. Barker as a member of the SG & SC Inspection.

c. Officer Nominations

- Vice Chair Stan Staniszewski has retired. A new Vice Chair needs to be recommended to the Main Committee (must have 2 years on SC).

A motion was made to appoint Mark Horbaczewski as the Vice Chair of the SC Inspection. The motion was unanimously approved.

8. Open PRD Items Related to Inspection

- NB14-0602B – Improve index in Part 2 relating to pressure relief devices – D. Marek (PM)
- NB15-0321 – Review testing requirements for inservice testing of pressure relief devices – A. Renaldo (PM)
- NB15-0324 – guidelines for storage/shelf life in regard to inspection and testing frequencies – A. Renaldo (PM)
- 17-132 – Paragraph 3.2.6 in Part 4 can be put into tabular format – No task group

9. Interpretations

Item Number: IN16-0501	NBIC Location: Part 2	No Attachment
General Description: Change of service from Ammonia to LP gas		
Subgroup: Inspection		
Task Group: None assigned.		
January 2018 Meeting Action: A progress report was initially given stating the NBIC secretary was unable to contact the inquirer. M. Horbaczewski then reached out to the inquirer and was able to make contact. M. Horbaczewski let him know that wording in the 2017 edition of the NBIC should address his concerns. The inquirer agreed and has withdrawn his inquiry. A motion was made to close this item with no further action. The motion was unanimously approved.		

Item Number: 17-174	NBIC Location: Part 2	Attachment Page 3-6
General Description: Use of API-510 for establishing maximum allowable operating conditions for equipment without nameplates, records, or stampings		
Subgroup: Inspection		
Task Group: None Assigned.		
January 2018 Meeting Action: V. Newton reported to the SC that the SG unanimously approved a response of “No”. A motion was made to accept this response. The motion was unanimously approved.		

10. Action Items

Item Number: NB13-0903	NBIC Location: Part 2, S2.14	Attachment Page 6
General Description: Add safety requirements for use of liquid or gaseous fuels to fire a historical boiler		
Subgroup: Historical		
Task Group: D. Rupert (PM), T. Dillon, J. Larson, R. Bryce		
January 2018 Meeting Action: The disapproval comments made by B. Wielgoszinski were reviewed, and after discussion during the SG Historical meeting, there were changes made to address his concerns. J. Getter presented and reviewed the document unanimously approved at the SG Historical Boilers meeting. A motion was made to accept the document. The motion was unanimously approved.		

Item Number: NB13-1409	NBIC Location: Part 2, S1	No Attachment
General Description: Address method for analyzing bulges created by overheating in stayed boiler surfaces		
Subgroup: Locomotive		
Task Group: P. Welch (PM), M. Mooney, R. Stone		
January 2018 Meeting Action: Progress Report. P. Welch has noted, there has been no progress. Joey Burgess has been added to the Task Group replacing M. Mooney.		

Item Number: NB14-0901	NBIC Location: Part 2	Attachment Pages 7-11
General Description: Review inspection requirements for pressure vessels designed for high pressures		
Subgroup: Inspection		
Task Group: M. Horbaczewski (PM), M. Schwartzwalder, D. Graf, G. Scribner, B. Wilson		
January 2018 Meeting Action: M. Horbaczewski presented the reviewed the document with the new wording to the SC. There were a few changes made to the document and a motion was made to accept the revised document. The motion passed with one disapproval vote.		

Item Number: NB14-1101	NBIC Location: Part 2	No Attachment
General Description: Diaphragm weld inspection.		
Subgroup: Locomotive		
Task Group: P. Welch (PM), D. Graf, R. Stone		
January 2018 Meeting Action: Progress Report. P. Welch has noted, there has been no progress.		

Item Number: NB16-0502	NBIC Location: Part 2	No Attachment
General Description: Gage glass and water level over historical boiler crown sheets		
Subgroup: Historical		
Task Group: D. Rupert (PM), T. Dillon, R. Underwood & R. Troutt		
January 2018 Meeting Action: Progress Report. J. Getter has noted, there has been no progress. The SG Historical decided the task group needs to work with SG Locomotive before proposing anything further to SG historical.		

Item Number: NB16-1001	NBIC Location: Part 2, CO2 Supp.	No Attachment
General Description: Edit CO2 supplement based on AIA proposed revision		
Subgroup: Inspection		
Task Group: M. Mooney (PM), D. Buechel, T. Barker, V. Newton		
January 2018 Meeting Action: Progress Report. V. Newton reported that he is still looking for further information.		

Item Number: NB16-1401	NBIC Location: Part 2, S10	No Attachment
General Description: Revise and update Supplement 10 on Inspection of CRPVs		
Subgroup: FRP		
Task Group: N. Newhouse (PM)		
January 2018 Meeting Action: Progress Report. A proposal has been developed and is being distributed to SG FRP for review and comment.		

Item Number: NB17-0203	NBIC Location: Part 2, S12.5	Attachment Page 12
General Description: Clarification on calibration of gas detectors		
Subgroup: Inspection		
Task Group: D. Buechel (PM), D. Graf, B. Hart		
January 2018 Meeting Action:		
The document presented to the SG by D. Buechel and unanimously approved, was reviewed by the SC. A motion was made to approve this document as presented. The motion was unanimously approved.		

Item Number: 17-136	NBIC Location: Part 2, S2	Attachment Pages 13-14
General Description: Update tables in Part 2, S2 with correct values		
Subgroup: Historical		
Task Group: J. Amato		
January 2018 Meeting Action:		
D. Rose presented the revised/corrected table, and showed changes to the wording attached to the table, to the SC. A motion was made to approve the changes. The motion was unanimously approved.		

Item Number: 17-140	NBIC Location: Part 2, 5.2.2	Attachment Pages 15-20
General Description: Updates to Part 2, 5.2.2 and NB-136 Form		
Subgroup: Inspection		
Task Group: None Assigned.		
January 2018 Meeting Action:		
The SG Inspection has decided to combine item 17-162 (Create a guide for NB-136) with this item. J. Getter reviewed the revised wording to 5.2, Rev. 9 of the NB-136 and the guide for NB-136 to the SC. All 3 were unanimously approved by the SG Inspection. A motion was made to approve the documents. The motion was unanimously approved.		

Item Number: 17-153	NBIC Location: Part 2, 2.3.6.4	Attachment Pages 21-22
General Description: Clarify acceptable conditions for UT thickness readings on air tanks		
Subgroup: Inspection		
Task Group: T. Barker (PM), J. Roberts, J. Burgess, T. Shernisky, J. Mangus		
January 2018 Meeting Action:		
T. Barker reviewed the new wording to 2.3.6.4 with the SC. This wording was unanimously approved at the SG Inspection meeting. A motion was made to approve the wording. The motion was unanimously approved.		

Item Number: 17-162	NBIC Location: Part 2	No Attachment
General Description: Create a guide for NB-136		
Subgroup: Inspection		
Task Group: J. Roberts (PM), D. LeSage, T. Shernisky, J. Castle, J. Burgess, B. Wielgoszinski		
January 2018 Meeting Action:		
The SG Inspection unanimously decided to close this item and combine it with item 17-140. A motion was made, and unanimously approved.		

Item Number: 17-164	NBIC Location: Part 2	Attachment Page 23
General Description: Update Part 2 for consistency with changes from Part 3 item NB16-2603		
Subgroup: Inspection		
Task Group: D. Graff (PM), E. Brantley & D. LaSage		
January 2018 Meeting Action:		
IT was noted by the SC that the action taken at the SG Inspection meeting was done with a misunderstanding of the action item. A task group of D. Graff (PM), E. Brantley & D. LaSage was created to review this item further. After a breakout session, D. LaSage presented proposed wording based on the changes made by part 3. A motion was made to approve the changes. The motion was unanimously approved.		

11. New Business

Item Number: 18-7	NBIC Location: Part 2, 2.3.6.8	Attachment Pages 24-26
General Description:		
Subgroup: Inspection		
Task Group: None Assigned.		
January 2018 Meeting Action:		
The document, unanimously approved at SG, showing the addition of inspection requirements for PVHOs was reviewed by the SC. After much discussion, a few changes were made and a motion was made to approve the changes as revised. The motion was unanimously approved.		
Task group created at SG: J. Byrum (PM), J. Wolfe and T. Shernisky		

Item Number: 18-27	NBIC Location: Part 2, S12.5	No Attachment
General Description: CO ₂ Detector Placement		
Subgroup: Inspection		
Task Group: None Assigned.		
January 2018 Meeting Action:		
Progress Report. A task group was assigned at the SG Inspection meeting, and they will work with the task group assigned in SG Installation to create a proposal.		
Task group assigned at SG: V. Newton (PM), D. Graff, E. Brantly, M. Horbaczewski, T. Shernisky and D. Buechel		

12. Future Meetings

- July 16th-19th, 2018 – Columbus, Ohio
- January 14th-17th – Location TBD

13. Adjournment

Respectfully submitted,



Jodi Metzmaier
SG Historical Secretary

SC Inspection Attendance Sheet - 1/10/18

Name	Company	Phone Number	Email	Signature
Mark Mooney	Liberty Mutual	(781) 891-8900	mark.mooney@libertymutual.com	Alternate for Mark Mooney Joey Byers
Jodi Metzmaier	National Board	(614) 888-8320	jmetzmaier@nationalboard.org	
Timothy Barker	Factory Mutual	360 801 3790 (781) 255-4704	timothy.barker@fmglobal.com	
Ernest Brantley	XL Insurance	(337) 842-7044	ernest.brantley@rpcllga.com	
David Buechel	Hartford Steam Boiler	(412) 310-7740	david_buechel@hsb.com	
Jim Getter	Worthington Industries	(614) 840-3087	jim.getter@worthingtonindustries.com	
Darrel Graf	Air Products and Chemicals Inc.		grafdr@airproducts.com	
Mark Horbaczewski	Diamond Technical Services	815 634 2727 (630) 799-8182	mhorbaczewski@diamondtechnicalservices.com	
Donnie LeSage	State of Louisiana	(225) 925-4572	donnie.lesage@la.gov	
Greg McRae	Trinity Industries	(214) 589-8559	greg.mcrae@trin.net	
Venus Newton	Boiler & Property Insurance	(770) 614-3111	venus.newton@boilerproperty.com	
James Roberts	Trinity Containers, LLC	(214) 589-8344	james.roberts@trin.net	
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Mike Schwartzwalder	AEP	(614) 581-6456	mschwartzwalder@aep.com	
Thomas Vandini	Quality Steel Corporation	(419) 334-2664	tvandini@propanetank.com	
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JOEY BURGESS	Liberty Mutual	940 475-1033	joey.burgess@libertymutual.com	
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John Mangas	AIR PRODUCTS	925-997-5633	mangasjc@airproducts.com	

5633

SC Inspection

Name	Company	Phone Number	Email	Signature
Brandon Wilson	DTS	724-599 4089	bwilson@diamondtechnicalservices.com	
James Lucas Calvert	Eli Lilly	317-760-5585	jcalvert@lilly.com	
Jon Wolf	ZURICH	920-253 8781	jon.wolf@zurichna.com	
Jim Clark	WORTHINGTON INDUSTRIES	781-718-9986	James.Clark@worthingtonindustries.com	
Marvin Byrum	ALABAMA	334-956-7411	MARVIN.Byrum@LABOR.ALABAMA.GOV	
David Rose	T+T INSPECTION	780 217 8175	DR3747@Telos.net	
Stephen Reimers	PCCZ	703-863 3871	sreimers@reimerssystems.com	
Daniel Harris	LA State Fire Marshal	225-268 5535	daniel.harris@la.gov	

Action Item 17-174 Part 2

Subject: Evaluation of existing equipment with minimal documentation

Edition 2017

NBIC Interpretation Inquiry Request

Inquiry: Does NBIC recognize API-510's procedure "Evaluation of Existing Equipment with Minimal Documentation" (Paragraph 7.7) for establishing maximum allowable operating conditions for equipment without nameplates, records, or stamping?

Response to Inquirer: No

8/11/2017

NBIC Interpretation Inquiry Request

Inquiry: Does NBIC recognize API-510's procedure "Evaluation of Existing Equipment with Minimal Documentation" (Paragraph 7.7) for establishing maximum allowable operating conditions for equipment without nameplates, records, or stamping?

Inquiry pertains to the guidance provided in NBIC Part 2, Section 5 "Stamping, Documentation, and Forms". Guidance for non-traceable equipment items not provided.

Background:

Please reference the following OSHA interpretation regarding direction when traceability is not possible:

OSHA Interpretation: 7/17/2006

Reference:

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=25498

Scenario: Even though a pressure vessel does not display any NRS information, the employer believes the pressure vessel meets all other requirements under OSHA standards.

Question 5: To determine and document that such vessels are suitable for their intended use, and in doing so, bring the vessels into full compliance with applicable OSHA standards, is it acceptable to conduct an evaluation that would include: 1) appropriate nondestructive testing (for example, radiography, ultrasonic thickness testing, hardness testing, pressure testing, etc.) to ascertain the current condition of the vessel; and 2) detailed code calculations (using appropriately conservative safety factors) for each vessel component to establish the allowable operating parameters for the vessel (specifically, the maximum allowable working pressure and maximum allowable operating temperature)?

Response 5: Pressure vessels which are required by a specific OSHA standard, such as 1910.106(b)(1)(v) or 1910.106(i)(3)(i) and (ii), to be constructed in accordance with the *Code* must meet all requirements, including NRS requirements of the 1968 version of the *Code*, as stated in Response 3. Consequently, the employer would not be in compliance with specific OSHA "*Code construction*" standards when the *Code*-required NRS is not available.

OSHA recognizes that there are pressure vessels in use, especially older vessels, that do not have the *Code*-required NRS. We understand that there are some requirements of the *Code* that cannot be satisfied when the NRS is not available to the employer. For example, it may not be possible to retroactively obtain design and construction aspects such as welding procedures and use of certified welders.

However, an employer may still come into compliance with applicable OSHA standards requiring *Code* construction where the stamping on a pressure vessel becomes indistinct or the nameplate is lost, illegible, or detached, but traceability to the original data is still possible. Where there is traceability, the owner/employer must have the stamped data replaced. The National Board of Boiler and Pressure Vessel Inspectors provides a procedure² to restamp pressure retaining items/vessels where stamping or nameplate problems exist.

In cases where traceability is not possible, OSHA will treat as a *de minimis* violation any pressure vessel that is

required by a specific OSHA standard, such as 1910.106(b)(1)(v), 1910.106(i)(3)(i) and (ii) to be built in accordance with the *Code*, but that does not have the *Code*-required NRS, provided that the criteria below are met:

1. The employer can demonstrate that it has taken reasonable steps to obtain or retain the required NRS. For example, did the employer contact the previous owner in an attempt to obtain the pressure vessel's NRS; if the employer has the pressure vessel number, did it contact ASME or the National Board of Boiler and Pressure Vessel Inspectors to obtain the required records; does the employer have a procedure in place to assure that any new or used pressure vessel it purchases or takes control of has the required *Code* NRS; does the employer routinely purchase used pressure vessels without the NRS; and
2. The employer verifies the fitness-for-operations integrity of the vessels by utilizing the procedure contained in API 510, Section 6.7. This procedure is for pressure vessels with no "traceability," such as those with no nameplate and minimal or no design or construction documentation. This procedure includes items such as: performing inspections and making necessary repairs; defining design parameters, and preparing drawings and calculations; basing calculations on applicable codes/standards; evaluating unidentified materials; use of radiography; marking with nameplate or stamping; and performing pressure testing.

Thank you for your interest in occupational safety and health. We hope you find this information helpful. OSHA requirements are set by statute, standards, and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at <http://www.osha.gov>. If you have any further questions, please feel free to contact the Office of General Industry Enforcement at (202) 693-1850.

Sincerely,

Richard E. Fairfax, Director
Directorate of Enforcement Programs

Regards,

Matt Schaser, P.E.
The Equity Engineering Group, Inc.
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Action Item Request

Code Revision or Addition: NB13-0903 to Part 2, S2.14

The requestor, Mr Don Cook, Chief Inspector, State of California has been seeing occasions in his state where historical boilers are being fired with liquid or gaseous fuels and is asking the Committee to provide some cautionary guidance in NBIC to address these important safety issues related to that activity.

PROPOSE:

New paragraph, Part 2, Supplement S2.14.16:

FIRING OF HISTORICAL BOILERS WITH LIQUID OR GASEOUS FUELS.

Hand firing of historical boilers with liquid or gaseous fuels poses significant additional safety concerns beyond those encountered when firing with solid fuels for which these boilers were originally designed, such as coal, straw or wood. The cautionary notes listed below are provided as examples to remind the owner or user that additional safety concerns do exist when firing historical boilers with these alternate fuels. These notes are not meant to be all-inclusive so each boiler's fuel system should be designed appropriately.

- a) JURISDICTIONAL ACCEPTANCE: The owner or user ~~should~~ shall check with the Jurisdiction as applicable to determine if this alternative firing method is allowed.
- b) OWNER OR USER KNOWLEDGE: The owner or user shall have an extensive knowledge of the fuel used, fuel transfer system, on board fuel storage, burner, firing controls, emergency shut off devices and procedures.
- c) PURGING: To prevent a firebox explosion, ~~it is essential to ensure that~~ the furnace ~~is~~ shall be purged of combustible gasses prior to applying the fuel ignition source, ~~to prevent flame outs.~~
- d) FLAME IMPINGEMENT: Direct flame impingement of the metal surfaces within the furnace can damage the boiler. Installation of refractory or fire brick in the firebox is a common practice to prevent this potential damage.
- e) LOW WATER: The owner or user ~~must~~ shall have a ~~plan and method~~ procedure in place to immediately shut off the fuel supply to the burner when a boiler low water condition occurs.
- f) FUEL CONTAINMENT: The fuel storage system ~~must~~ shall be suitably designed with the appropriate shut off devices for the specific fuel product. The mounting method and proximity of the fuel storage container to the furnace ~~must~~ shall be considered to prevent the fuel from accidental ignition.
- g) FUEL SYSTEM: The fuel delivery system and routing from fuel source to the burner shall be suitably designed for the specific fuel product including appropriate emergency shut off devices. ~~The routing of the fuel delivery system should be a consideration as well.~~
- h) FUEL AIR MIXTURE: The burner utilized shall be designed to operate within the confines of the boiler furnace and provide the proper fuel/air mixture.
- i) SAFETY VALVE: The boilers minimum relieving capacity shall be computed for the type of fuel used.
- j) COMPRESSED NATURAL GAS (CNG) vs LIQUID PETROLEUM GAS (LPG): CNG is lighter than air and LPG is heavier than air. The owner or user should understand the properties of the fuels to ensure the gas will not accumulate in the boiler (see Purging above).

NBIC Item NB14-901 draft Revisionx.x.x.x INSPECTION GUIDELINES FOR METALLIC PRESSURE VESSELS**Introduction**

This section provides guidelines for inspection of metallic pressure vessels typically designed for 15 psi or greater service. The scope of inspection of these vessels should be performed to verify the integrity of the vessel for ongoing use.

Scope

These inspection guidelines are for the inspection of metallic pressure vessels that are designed for 15 Psi or greater and would include, for example, process vessels, deaerators, air receivers and any vessel manufactured with metallic materials.

Inspection Frequency

1. External visual inspection should be conducted annually.
2. External thickness measurements should be conducted every 3 years.
3. Internal inspection of a pressure vessel, with a manhole, should be conducted every 3 years, if operated in corrosive service. If not operated in corrosive service, every 10 years, not to exceed Jurisdictional inspection requirements.
4. Review of operations and maintenance history should be conducted every 3 years or when a pressure excursion or an unusual event occurs.

Note: A thorough assessment of a pressure vessel is performed in order to determine its actual condition and the period of time it may be safely used until the next thorough inspection. It shall include the following:

1. Internal inspection includes but not limited to surface exam of all welds, including attachments welds, surface examination of all girth and longitudinal welds and a UT thickness check using a grid pattern.
2. Assessment of the equipment's maintenance and operating history.
3. When available, review operation history process, deviations, incidents, design and process changes, and other issues that could affect the integrity of the pressure equipment.
4. For vessels with an MAWP at and above 10,000 psi, designed and constructed per ASME Section VIII, Div. 3, refer to ASME High Pressure Systems.

Pre-Inspection Activities

A review of the known history of the pressure vessel should be performed. This should include a review of information such as:

1. Operating conditions
2. Normal contents of the vessel
3. Date of last inspection
4. ASME Code Symbol stamping or mark of code of construction.
5. The type of connections used during fabrication of the vessel to determine the proper joint efficiency to be used during stress analysis of the pressure vessel.
6. Serial number and materials of construction.
7. Records of wall thickness surveys, especially on vessels where corrosion is a consideration.

The following activities should be performed if required to support the inspection:

1. Remove inspection manhole covers
2. Clean vessel sufficiently to allow for visual inspection of internal and external surfaces.
3. Remove insulation as needed to allow access to the vessels surface.

General External Inspection Procedure

The type of installation given to pressure vessels should take into consideration the condition of the vessel and the environment in which it operates. This inspection may be external, internal, or both and use a variety of non-destructive examination techniques. The inspection may be performed with the vessel in service or depressurized, but should provide the necessary information that allows an adequate assessment of the pressure vessel.

A thorough inspection of a pressure vessel should include the following items:

1. External examination of the pressure vessel and associated equipment.
2. An ultrasonic thickness examination of the pressure vessel wall and dished heads and documentation for permanent record keeping.
3. An internal examination of the pressure vessel, if required. An internal examination may not be required if the pressure vessel is stamped with the original wall thickness and the thickness survey shows no loss of material. Pressure vessels in which the original wall thickness is unknown should have an initial internal examination performed to determine the baseline condition of the vessel.
4. Ultrasonic measurement, or other NDE technique, to determine the shell and dished head wall thicknesses for each pressure vessel. Other types of non-destructive examinations should be performed as required for any suspect areas identified during the external or internal examination.
5. Actual wall thickness data acquired during the ultrasonic thickness survey. These results should be compared with the manufacturer's data report.
6. A thorough inspection of the pressure relief valves and other safety devices to ensure the vessel is operating within its specified pressure range and is being adequately protected. Functional testing of the relief valves should be performed by a qualified repair organization.

7. Vessel connections, Manholes, reinforcing plates, nozzles, or other connections should be examined for cracks, deformation, or other defects. Bolts and nuts should be checked for corrosion or defects. Weep holes in reinforcing plates should remain open to provide visual evidence of leakage as well as to prevent pressure buildup between the vessel and the reinforcing plate. Accessible flange faces should be examined for distortion and to determine the condition of gasket seating surfaces.

8. The surfaces of the vessel should be checked for:

- a. Dents in a vessel are deformations caused by contact with a blunt object in such a way that the thickness of the metal is not materially impaired. In some cases, a dent can be repaired by mechanically pushing out the indentation.
- b. If any distortion is suspected or observed, the overall dimensions of the vessel should be checked to determine the extent and seriousness of the distortion.
- c. Local or general wastage from corrosion and erosion.
- d. Cuts or gouges can cause high stress concentrations and decrease the wall thickness. Depending on the extent of the defect, it may be necessary to repair the area by welding or patching. Blend grinding may be a useful method of eliminating some minor types of cuts or gouges if sufficient wall is determined to exist.
- e. The surfaces of shells and heads should be examined for possible cracks, blisters, bulges, and other evidence of deterioration, giving particular attention to the skirt and to the support attachment and knuckle regions of the heads.
- f. Welded joints and the adjacent heat affected zones should be examined for cracks or other defects. Magnetic particle and liquid penetrant examination are useful methods of examining suspect areas.

Thickness Survey

A thickness survey of the pressure vessels wall and dished heads should be performed and documented by a qualified NDT examiner using ultrasonic testing equipment. The ultrasonic testing equipment should be properly calibrated. The wall thickness data for each subsequent inspection should be used for comparisons to determine if any wall thinning may be taking place and compromising the factor of safety for the pressure vessel.

Internal Inspection

An internal inspection may be required only if the ultrasonic wall thickness data indicate that there is some wall thinning occurring or if the pressure vessel does not have a stamp indicating the original wall thickness of the shell and dished heads.

A general visual inspection is the first step in making an internal inspection. A borescope may also be used to facilitate the internal inspection of a pressure vessel. All parts of the vessel should be inspected for corrosion, erosion, hydrogen blistering, deformation, cracking, and laminations.

The following items should be reviewed:

- a. Threaded connections should be inspected to ensure that an adequate number of threads are engaged. All openings leading to any external fittings or controls should be examined as thoroughly as possible to ensure they are free from obstructions.
- b. Any special closures including those on autoclaves, normally termed quick actuating (quick opening) closures which are used frequently in the operation of a pressure vessel, should be checked for adequacy and wear. A check should also be made for cracks at areas of high stress concentration.
- c. Where pressure vessels are equipped with removable internals, these internals need not be completely removed, provided evidence exists that deterioration in regions rendered inaccessible by the internals is not occurring to an extent that might constitute a hazard or to an extent beyond that found in more readily accessible parts of the vessel.
- d. The type of corrosion (pitted or uniform), its location, and any obvious conditions should be established. Data collected for vessels in similar service will aid in locating and analyzing corrosion in the vessel being inspected. The liquid level lines, the bottom, and the shell area adjacent to and opposite inlet nozzles are often locations of most severe corrosion. Welded seams and nozzles and areas adjacent to welds are often subjected to accelerated corrosion.

Non Destructive Testing

Several different methods of non-destructive testing may be used to properly assess the condition of a pressure vessel. These examination techniques should be performed by experienced and qualified individuals. The type and amount of nondestructive examination should be acceptable to the inspector. Generally, some type of surface preparation will be required prior to the use of these examination methods. These examination methods include: magnetic particle examination, liquid penetrant examination, ultrasonic examination, radiography, eddy current examination, visual examination, metallographic examination, and acoustic emission.

Inspection of Safety Device(s)

See NBIC Part 2, 2.5 for information on the inspection of pressure-relieving devices.

NB17-0203**S12.5 GAS DETECTION SYSTEMS**

A continuous gas detection system shall be provided in the room or area where container systems are filled and used, in areas where the heavier ~~that~~ than air gas can congregate and in below grade outdoor locations. Carbon dioxide (CO₂) sensors shall be provided within 12 in. (305 mm) of the floor in the area where the gas is most likely to accumulate or leaks are most likely to occur. The system shall be designed to detect and notify at a low level alarm and high level alarm.

- a) The threshold for activation of the low level alarm shall not exceed a carbon dioxide concentration of 5,000 ppm (9,000 mg/m³) Time Weighted Average (TWA) over 8 hours. When carbon dioxide is detected at the low level alarm, the system shall activate a signal at a normally attended location within the building.
- b) The threshold for activation of the high level alarm shall not exceed a carbon dioxide concentration 30,000 ppm (54,000 mg/m³). When carbon dioxide is detected at the high level alarm, the system shall activate an audible and visual alarm at a location approved by the jurisdiction having authority.

Inspection should consist of verification that system has been calibrated by observing that there is a calibration sticker showing date of last calibration and next due date.

The inspection should verify that the gas detection system and audible alarm is operational and tested in accordance with manufacturer's guidelines.

The inspection should verify that audible alarms are placed at the entrance(s) to the room or area where the carbon dioxide storage vessel and/ or fill box is located to notify anyone who might try to enter the area of a potential problem.

Staybolt Spacing, in.	Actual Diameter of Corroded Iron Staybolts, in.																						
	0.35	0.375	0.4	0.425	0.45	0.475	0.5	1.525	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	81	93	105	119	133	149	165	182	199	218	237	257	278	300	323	346	370	396	422	448	476	504	533
3.625	75	86	98	111	124	139	153	169	186	203	221	240	259	280	301	323	345	369	393	418	444	470	497
3.75	70	81	92	104	116	129	143	158	174	190	207	224	242	261	281	302	323	345	367	390	415	439	465
3.875	66	76	86	97	109	121	134	148	163	178	193	210	227	245	263	282	302	323	344	366	388	411	435
4	62	71	81	91	102	114	126	139	153	167	182	197	213	230	247	265	284	303	323	343	364	386	408
4.125	58	67	76	86	96	107	119	131	143	157	171	185	200	216	232	249	267	285	303	323	343	363	384
4.25	55	63	71	81	90	101	112	123	135	148	161	174	189	204	219	235	251	268	286	304	323	342	362
4.375	52	59	67	76	85	95	105	116	128	139	152	165	178	192	207	222	237	253	270	287	305	323	341
4.5	49	56	64	72	81	90	100	110	121	132	143	156	168	182	195	209	224	239	255	271	288	305	323
4.625	46	53	60	68	76	85	94	104	114	125	136	147	159	172	185	198	212	227	241	257	273	289	306
4.75	32	37	42	47	53	59	65	72	79	86	94	102	110	119	128	137	147	157	167	178	189	200	211
4.875	30	35	40	45	50	56	62	68	75	82	89	97	105	113	121	130	139	149	159	169	179	190	201
5	29	33	38	43	48	53	59	65	71	78	85	92	100	107	115	124	133	142	151	160	170	180	191
5.125	27	32	36	41	45	51	56	62	68	74	81	88	95	102	110	118	126	135	144	153	162	172	182
5.25	26	30	34	39	43	48	53	59	65	71	77	83	90	97	105	112	120	128	137	145	154	164	173
5.375	25	29	33	37	41	46	51	56	62	67	73	80	86	93	100	107	115	122	130	139	147	156	165
5.5	24	27	31	35	39	44	49	54	60	65	71	77	83	90	97	104	111	117	125	133	141	149	158
5.625	23	26	30	34	38	43	48	53	59	64	70	76	82	88	95	102	109	117	125	133	141	149	158
5.75	22	25	29	32	36	41	46	51	56	62	67	73	79	85	92	99	106	114	121	129	136	144	151
5.875	21	24	27	31	34	39	44	49	54	60	65	71	77	83	90	97	104	111	119	127	135	143	151
6	20	23	26	30	33	38	43	48	53	59	64	70	76	82	88	95	102	109	116	123	131	138	144
6.125	19	22	25	28	32	36	41	46	51	56	62	67	73	79	85	91	97	103	109	115	122	129	133
6.25	18	21	23	27	30	34	39	44	49	54	60	65	71	77	83	89	95	101	107	113	120	127	133
6.375	18	20	23	26	29	33	37	42	47	52	57	63	69	75	81	87	93	99	105	111	117	124	131
6.5	17	20	22	25	28	32	36	40	45	50	55	61	67	73	79	84	89	95	101	107	113	120	127
6.625	16	19	21	24	27	31	35	39	44	49	54	60	66	72	78	84	89	95	101	107	113	120	127
6.75	16	18	21	23	26	29	33	37	41	46	51	56	62	68	74	80	86	91	97	103	109	115	122
6.875	15	18	20	23	26	29	33	37	41	46	51	56	62	68	74	80	86	91	97	103	109	115	122
7	15	17	19	22	24	27	30	33	37	41	46	51	56	62	68	74	80	86	91	97	103	109	115

This section of the table has incorrect data. From 3.5" to 4.625" staybolt spacing and diameters of .35 to .9. The correct data for this section of the table is listed on the attached Word document.

$$P = \frac{\pi \left[\frac{d}{2} \right]^2 \cdot S}{P^2}$$

S = 7,500 psi

P = MAWP psi

p = staybolt spacing, in.

d = Minimum diameter of corroded staybolt, in.

Table S2.10.4.La [US Customary Units]
Maximum Allowable Working Pressure on the Load Carrying Capacity of a Single Corroded Staybolt

Add the word "Iron" between corroded and staybolt

Corrected Table

Staybolt Spacing, in.	Actual Diameter of Corroded Iron 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	59	68	77	87	97	108	120	133	145	159	173	188	203	219	236	253	270	289	308	327	347	368	389
3.625	55	63	72	81	91	101	112	124	136	148	161	175	189	204	220	236	252	269	287	305	324	343	363
3.75	51	59	67	76	85	95	105	115	127	138	151	164	177	191	205	220	236	252	268	285	303	321	339
3.875	48	55	63	71	79	89	98	108	119	130	141	153	166	179	192	206	221	236	251	267	283	300	318
4	45	52	59	66	75	83	92	101	111	122	133	144	156	168	180	194	207	221	236	251	266	282	298
4.125	42	49	55	63	70	78	87	95	105	114	125	135	146	158	170	182	195	208	222	236	250	265	280
4.25	40	46	52	59	66	74	82	90	99	108	117	127	138	149	160	171	183	196	209	222	236	250	264
4.375	38	43	49	56	62	69	77	85	93	102	111	120	130	140	151	162	173	185	197	209	222	236	249
4.5	36	41	47	53	59	66	73	80	88	96	105	114	123	133	143	153	164	175	186	198	210	223	236
4.625	34	39	44	50	56	62	69	76	83	91	99	108	116	125	135	145	155	165	176	187	199	211	223
4.75	32	37	42	47	53	59	65	72	79	86	94	102	110	119	128	137	147	157	167	178	189	200	211
4.875	30	35	40	45	50	56	62	68	75	82	89	97	105	113	121	130	139	149	159	169	179	190	201
5	29	33	38	43	48	53	59	65	71	78	85	92	100	107	115	124	133	142	151	160	170	180	191
5.125	27	32	36	41	45	51	56	62	68	74	81	88	95	102	110	118	126	135	144	153	162	172	182
5.25	26	30	34	39	43	48	53	59	65	71	77	83	90	97	105	112	120	128	137	145	154	164	173
5.375	25	29	33	37	41	46	51	56	62	67	73	80	86	93	100	107	115	122	130	139	147	156	165
5.5	24	27	31	35	39	44	49	54	59	64	70	76	82	89	95	102	110	117	125	133	141	149	158
5.625	23	26	30	34	38	42	47	51	56	62	67	73	79	85	91	98	105	112	119	127	135	143	151
5.75	22	25	29	32	36	40	45	49	54	59	64	70	75	81	87	94	100	107	114	121	129	136	144
5.875	21	24	27	31	35	39	43	47	52	56	61	67	72	78	84	90	96	103	109	116	123	131	138
6	20	23	26	30	33	37	41	45	49	54	59	64	69	75	80	86	92	98	105	111	118	125	133
6.125	19	22	25	28	32	35	39	43	47	52	57	61	66	72	77	83	88	94	100	107	113	120	127
6.25	18	21	24	27	31	34	38	42	46	50	54	59	64	69	74	79	85	91	97	103	109	115	122
6.375	18	20	23	26	29	33	36	40	44	48	52	57	61	66	71	76	82	87	93	99	105	111	117
6.5	17	20	22	25	28	31	35	38	42	46	50	54	59	64	68	73	78	84	89	95	101	107	113
6.625	16	19	21	24	27	30	34	37	41	44	48	52	57	61	66	71	75	81	86	91	97	103	109
6.75	16	18	21	23	26	29	32	36	39	43	47	51	55	59	63	68	73	78	83	88	93	99	105
6.875	15	18	20	23	25	28	31	34	38	41	45	49	53	57	61	66	70	75	80	85	90	95	101
7	15	17	19	22	24	27	30	33	36	40	43	47	51	55	59	63	68	72	77	82	87	92	97

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5.2 Replacement of Stamping or Nameplate

5.2.1 Indistinct Stampings or nameplate is lost, illegible, or detached.

- a) When the stamping on a pressure –retaining item becomes indistinct or the nameplate is lost, illegible or detached, but traceability to the original pressure-retaining item is still possible the Inspector shall instruct the owner or user to have the nameplate or stamped data replaced. All re-stamping shall be done in accordance with the original code of construction, except as modified herein. Request for permission to re-stamp data or replace nameplates shall be made to the Jurisdiction in which the nameplate or stamping is reapplied for approval. Application shall be made on the *Replacement of Stamped Data Form*, NB-136 (see 5.3.2) which is available on the National Board website (www.nationalboard.org). Proof of traceability to the original nameplate or stamping and other such data, as is available, shall be furnished with the request. The manufacturer of the pressure-retaining item, if available, shall be contacted prior to replacing a nameplate or stamped data in order to verify applicable code requirements.
- b) When there is no Jurisdiction, documentation used to verify traceability, and the *Replacement of Stamped Data Form*, NB-136 shall be submitted to a National Board Commissioned Inspector for approval.
- c) All re-stamping or replacement of nameplates shall be witnessed by a National Board Commissioned Inspector.
- d) When the nameplate is welded to the pressure retaining boundary, the welding must be done by a National Board "R" Stamp Holder.
- e) Permission from the Jurisdiction or National Board Commissioned Inspector is not required for the reattachment of nameplates that are partially attached.
- f) The re-stamping or replacement of a code symbol stamp shall be performed only as permitted by the governing code of construction.
- g) Replacement nameplates or stamped data shall be clearly marked "Replacement".
- h) When traceability cannot be established, the Jurisdiction where the pressure retaining item is installed shall be contacted for approval prior to replacing a nameplate or re-applying stamping.

5.2.2 Reporting

a) The completed Form NB-136 with a facsimile of the replacement stamping or nameplate applied and appropriate signatures shall be filed with the Jurisdiction, if applicable and the National Board by the owner, user or "R" Stamp Holder.

b) The owner or user shall retain all documentation provided for traceability with the completed form NB-136 for as long as the pressure-retaining item is in their ownership or use. If the pressure-retaining item is sold, Form NB-136 along with the supporting documentation shall be provided to the new owner.

Delete 5.2.3

REPLACEMENT OF STAMPED DATA FORM, NB-136
in accordance with provisions of the *National Board Inspection Code*

1. _____
(P.O. no., job no., etc.)

2. SUBMITTED TO: _____
(Name of jurisdiction)

(Address)

(Telephone no.)

3. SUBMITTED BY: _____
(Name of owner, user, or certificate holder)

(Address)

4. _____
(Name of contact) (Email) (Telephone no.)

5. LOCATION OF INSTALLATION: SAME AS #3 STOCK ITEM – UNKNOWN

(Name)

(Address)

6. DATE INSTALLED: _____ UNKNOWN

7. MANUFACTURER: _____
(Name)

8. MANUFACTURER'S DATA REPORT ATTACHED: NO YES

9. ITEM REGISTERED WITH NATIONAL BOARD: NO YES, NB NUMBER: _____

10. ITEM IDENTIFICATION: _____
(Type) (Mfg. serial no.) (Jurisdiction no.) (Year built)

(Dimensions) (MAWP psi) SAFETY RELIEF VALVE SET AT: _____ (psi)

11. PROVIDE A TRUE FACSIMILE OF THE LEGIBLE PORTION OF THE NAMEPLATE. ATTACHED

THE FOLLOWING IS A TRUE FACSIMILE OF THE LEGIBLE PORTION OF THE ITEM'S ORIGINAL NAMEPLATE (IF AVAILABLE). PLEASE PRINT. WHERE POSSIBLE, ALSO ATTACH A RUBBING OR PICTURE OF THE NAMEPLATE.

12. TRACEABILITY DOCUMENTATION – PROVIDE ANY DOCUMENTATION THAT WILL HELP THE JURISDICTION OR INSPECTOR VERIFY THE REQUESTED RE-STAMPING OR REPLACEMENT NAMEPLATE IS IN ACCORDANCE WITH THE ORIGINAL CODE OF CONSTRUCTION FOR THIS PRESSURE-RETAINING ITEM. ATTACHED

1. _____
(P.O. no., job no., etc.)

13. I REQUEST AUTHORIZATION TO REPLACE THE STAMPED DATA OR NAMEPLATE ON THE ABOVE DESCRIBED PRESSURE-RETAINING ITEM IN ACCORDANCE WITH THE RULES OF THE NATIONAL BOARD INSPECTION CODE (NBIC).

NAME: _____ NUMBER: _____
(Owner/Users or "R" Certificate Holder) (R Certificate Holder only)

SIGNATURE: _____ DATE: _____
(Authorized Representative)

14. BASED ON THE TRACEABILITY PROVIDED, AUTHORIZATION IS GRANTED TO REPLACE THE STAMPED DATA OR TO REPLACE THE NAMEPLATE OF THE ABOVE DESCRIBED PRESSURE-RETAINING ITEM.

SIGNATURE: _____ DATE: _____
(Authorized jurisdictional representative or inspector)

NATIONAL BOARD COMMISSION NO.: _____ JURISDICTIONAL NUMBER: _____
(if available)

15. THE FOLLOWING IS A TRUE FACSIMILE OF THE ITEM'S REPLACEMENT STAMPING OR NAMEPLATE (must clearly state "replacement")

16. I CERTIFY THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF, THE STATEMENTS IN THIS REPORT ARE CORRECT, AND THAT THE REPLACEMENT INFORMATION, DATA, AND IDENTIFICATION NUMBERS ARE CORRECT AND IN ACCORDANCE WITH THE PREVISIONS OF THE NATIONAL BOARD INSPECTION CODE (NBIC).

NAME: _____ NUMBER: _____
(Owner/Users or "R" Certificate Holder) (R Certificate Holder only)

SIGNATURE: _____ DATE: _____
(Authorized Representative)

17. WITNESSED BY: _____ EMPLOYER: _____
(Name of Inspector)

SIGNATURE: _____ DATE: _____ NB COMMISSION: _____
(Name of Inspector)

Instructions for Completing the Form NB-136, Replacement of Stamped Data Form

Items 1-12 shall be completed by the owner, user, or "R" Stamp holder making the request.

1. Enter purchase order, job, or other identifying number used by your company if applicable.
2. The name address and phone number of the Jurisdiction, Authorized Inspection Agency (when there is no Jurisdiction) the form is being submitted to for approval.
3. Enter the name and address of your company or organization.
4. Enter the name, email, and phone number of the person who can be contacted if there are any questions concerning this request within your company or organization.
5. Enter the name and address of the location where the pressure retaining item is installed. If this is the same as number 3, check the box "same as # 3). If the pressure retaining item is being refurbished and the final installation location is unknown, check the box "Stock item, unknown".
6. Enter the date the pressure retaining item was installed. If unknown check the box "Unknown".
7. Enter the name of the manufacturer of the pressure retaining item the request is being submitted for.
8. Manufactures Data Report Attached, check the appropriate box.
9. Is the pressure retaining item registered with the National Board? Check the appropriate block. If yes provide the National Board Registration Number.
10. Provide as much information as known to help identify the pressure retaining item.
11. Provide a true facsimile of the legible part of the nameplate or stamping.
12. Attach any other documentation that helps provide tractability of the vessels to the original stamping, such as purchase orders, blueprints, inspection reports, etc.
13. Provide the name of owner or user of the pressure retaining item or "R" Stamp holder making the request. If an "R" Stamp holder, provide the "R" Stamp number. Signature of the requester and date requested.
14. To be completed by the Jurisdiction or Authorized Inspection Agencies authorized representation.

If the original manufacturer is currently in business, concurrence shall be obtained by the owner/user.

The requester shall submit the form along with any attachments to the jurisdiction where the pressure retaining item is installed for approval. If there is no jurisdiction or the pressure retaining item is a stock item, the requester shall submit the form to a National Board Commissioned inspector for approval.

After authorization, the form will be returned to the owner, user, or "R" Stamp holder who made the request. The requester is required to contact the Jurisdiction or an Authorized Inspection Agency to provide a National Board Commissioned inspector to witness the re-stamping or installation of the new name plate. If the name plate is being welded to the pressure retaining boundary of the vessel, the welding shall be done by a "R" Stamp holder. The requester will provide the new name plate or have the tools on hand to do the re-stamping in accordance with the original code of construction.

15. Once the re-stamping is completed or the new nameplate is attached the requester shall provide a true facsimile of the replacement stamping.
16. The owner, user, or "R" Stamp holder shall then complete fill in their name (and number if a "R" Stamp holder) and sign and date.
17. To be completed by the National Board Commissioned Inspector who witnessed by re-stamping or installation of the new nameplate.

Note: Once completed the requester shall file a copy with the Jurisdiction where the pressure retaining item is installed, the National Board, and the owner or user of the vessel if the request was made by and "R" Stamp holder, and upon request to the Authorized Inspection Agency who witnessed the re-stamping or attachment of the new name plate.

17-153 Acceptance Criteria for UT Thickness

2.3.6.2 COMPRESSED AIR VESSELS

a) Compressed air vessels include receivers, separators, filters, and coolers. Considerations of concern include temperature variances, pressure limitations, vibration, and condensation. Drain connections should be verified to be free of any foreign material that may cause plugging.

b) Inspection shall consist of the following:

1) Welds — Inspect all welds for cracking or gouging, corrosion, and erosion. Particular attention should be given to the welds that attach brackets supporting the compressor. These welds may fail due to vibration;

2) Shells/~~H~~heads — Externally, inspect the base material for environmental deterioration and impacts from objects. Hot spots and bulges are signs of overheating and should be noted and evaluated for acceptability. Particular attention should be paid to the lower half of the vessel for corrosion and leakage. For vessels with manways or inspection openings, an internal inspection should be performed for corrosion, erosion, pitting, excessive deposit buildup, and leakage around inspection openings. UT thickness testing may be used where internal inspection access is limited or to determine actual thickness when corrosion is suspected;

a. UT Acceptance Criteria

1. For line or crevice corrosion, the depth of the corrosion shall not exceed 25% of the required wall thickness.

2. Isolated pits may be disregarded provided that their depth is not more than 50% of the required thickness of the pressure vessel wall (exclusive of any corrosion allowance), provided the total area of the pits does not exceed 7 sq. in. (4,500 sq. mm) within any 8 in. (200 mm) diameter circle, and provided the sum of their dimensions along any straight line within that circle does not exceed 2 in. (50 mm).

3. For a corroded area of considerable size, the thickness along the most critical plane of such area may be averaged over a length not exceeding 10 in. (250 mm). The thickness at the thinnest point shall not be less than 75% of the required wall thickness.

b. If the corrosion exceeds any of the above criteria, the following options are available to the owner/user.

1. The owner/user may contract with a qualified NDE organization to conduct a complete UT survey of the vessel to verify remaining vessel wall thickness.

2. The vessel shall be removed from service until the vessel is repaired by a "R" stamp holder.

3. The vessel shall be removed from service until it is rerated (alteration) to a lower MAWP by a "R" stamp holder.

4. A fitness-for service analysis is performed by a qualified organization.

5. The vessel is permanently removed from service.

- 3) Fittings and attachments — Inspect all fittings and attachments for alignment, support, deterioration, damage, and leakage around threaded joints. Any internal attachments such as supports, brackets, or rings shall be visually examined for wear, corrosion, erosion, and cracks;
- 4) Operation — Check the vessel nameplate to determine the maximum allowed working pressure and temperature of the vessel. Ensure the set pressure of the safety valve does not exceed that allowed on the vessel nameplate and determine that the capacity of the safety valve is greater than the capacity of the compressor. Ensure there is a functioning manual or automatic condensate drain; and
- 5) Quick-Closure Attachments — Filter-type vessels usually have one quick-type closure head for making filter changes, see NBIC Part 2, 2.3.6.5.

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Part 2

4.3.1.2 LIQUID PRESSURE TESTING

Test pressure should be selected or adjusted in agreement between the Inspector and owner or user.

~~The liquid test pressure shall not exceed the lesser of 150% of MAWP or test pressure established by the original code of construction.~~ The test pressure shall not exceed the liquid test pressure of the original code of construction.

When a pressure relief device is left in place, test pressure should not exceed 90% of set pressure of the lowest setting pressure relief device on the pressure-retaining item to avoid damage to pressure relief devices.

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2.3.6.8 INSPECTION OF PRESSURE VESSELS FOR HUMAN OCCUPANCY (PVHO's)

A pressure vessel for human occupancy (PVHO), as defined by ASME PVHO-1 is a pressure vessel that encloses a human being or animal within its pressure boundary while it is subject to internal or external pressure that exceeds a 2 psi (14 kPa) differential pressure. PVHOs include, but are not limited to submersibles, diving bells, personal transfer capsules, decompression chambers, recompression chambers, hyperbaric chambers, high altitude chambers and medical hyperbaric oxygenation facilities.

This section provides guidelines for inspection of PVHOs. Due to the many different designs and applications of PVHOs, potential failures of components or safety concerns that are not specifically covered, such as rapid decompression or fire/sparking issues should be considered.

a) General/operational

- 1) PVHOs should be constructed in accordance with ASME PVHO-1. This code adopts Section VIII and therefore the vessels should bear a "U" or "U2" ASME designator. Inspections may be conducted using ASME PVHO-2 for reference. PVHO-1 also has several Code Cases that address PVHOs manufactured from non-traditional materials such as various fabrics. PVHOs built under such Code Cases shall have all the documentation required by the Code Case, but may not necessarily have any related Section VIII forms.
- 2) Cast and ductile iron fittings are not allowed.
- 3) Due to the human occupancy element, a person should be in attendance to monitor the PVHO when in operation, in the event there is an accident.
- 4) The installation should be such that there is adequate clearance to inspect it properly. In some applications, such as underground tunneling, it may be impossible to perform a complete external inspection.

b) Internal Inspection

- 1) Where existing openings permit, perform a visual internal inspection of the vessel. Look for any obvious cracks 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.
- 2) The vessel should be free of corrosion, dents, gouges, or other damage. Special attention should be paid to areas under chamber floors and the interiors of chamber drain fittings.
- 3) All openings leading to external fittings or controls should be free from obstruction.
- 4) All exhaust inlets should be checked for the presence of fittings that prevent a chamber occupant from inadvertently blocking the opening.
- 5) The inlets to all chamber pressure gauge lines should be located where they are either protected from possible blockage, or are fitted with multiple openings.
- 6) Chamber doors:
 - a. should operate freely and smoothly. However, doors should not move on their own when released;
 - b. that close/seal with pressure and which are fitted with "dogs" or other restraints to hold them in place until an initial seal is obtained, shall be fitted with features to prevent the door from maintaining a seal in the event the pressure differential on the door is reversed;
 - c. should have seals that are supple, free from flat spots, cracking, etc.; and
 - d. that close/seal against pressure shall have provisions as follows:
 1. Positive protection against pressurization of the vessel unless the restraint mechanism is fully engaged. This includes pressurization by back-up methods as well as primary methods; and
 2. Positive protection against release of the restraint mechanism unless pressure in the vessel is fully relieved.

c) External Inspection

- 1) The Inspector should closely examine the external condition of the pressure vessel for corrosion, damage, dents, gouges or other damage.
- 2) The lower half 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 or fireproofing such as saddle supports, sphere support legs, 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 vessel's insulated surfaces should be conducted once per year.
- 4) The most common and superior method to inspect for suspected corrosion under insulation (CUI) damage 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. Proper surface treatment (coating) of the vessel external shell and maintaining weather-tight external insulation are the keys to prevention of CUI damage.
- 6) Couplers and doors that open with pressure:
 - a. should operate freely and smoothly;
 - b. should have seals that are supple, free from flat spots, cracking, etc.; and
 - c. that close/seal against pressure shall have provisions as follows:
 1. Positive protection against pressurization of the vessel unless the restraint mechanism is fully engaged. This includes pressurization by back-up methods as well as primary methods; and
 2. Positive protection against release of the restraint mechanism unless pressure in the vessel is fully released.

d) Inspection of parts and appurtenances (e.g., piping systems, pressure gages, bottom drains, etc.)

- 1) As stated above, cast iron is not allowed on PVHOs and shall be replaced with parts fabricated with other suitable materials, in accordance with ASME Code Section II.
- 2) If valves or fittings are in place, check to ensure that these are complete and functional.
- 3) The Inspector shall 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. Lines leading to chamber primary depth gauges should connect only to the depth gauge.
- ~~4) The Inspector shall verify that the vessel is provided with a drain opening.~~
- 5)4) The system should have a pressure gage designed for at least the most severe condition of coincident pressure in normal operation. This gage should be clearly visible to the person adjusting the setting of the pressure control valve. The graduation on the pressure gage shall be graduated to not less than 1.5 times the MAWP of the vessel.
- 6)5) Provisions should be made to calibrate pressure gages or to have them checked against a standard test gage.
- 7)6) Any vents and exhausts should be piped at least 10 ft. (3.0 m) from any air intake.
- 8)7) Venting should be provided at all high points of the piping systems.

e) Inspection of view ports / windows

- 1) Each window should be individually identified and be marked in accordance with PVHO-1.
- 2) If there are any penetrations through windows, they must be circular and in accordance with PVHO-1 requirements.
- 3) Windows must be free of crazing, cracks and scratches that exceed "superficial" defects as defined by PVHO-2.
- 4) Windows and viewports have a maximum interval for seat/seal inspection and refurbishment. Documentation should be checked to ensure compliance with PVHO-2, Table 7.1.3 Section 2-4.4.

f) Inspection of pressure relief devices

- 1) Pressure relief devices for chambers only must have a quick opening manual shutoff valve installed between the chamber and the pressure relief device, with a frangible seal in place, within easy access to the operator.
- 2) The pressure relief device shall be constructed in accordance with ASME Code Section VIII.
- 3) The discharge from the chamber pressure relief device must shall be piped outside to a safe point of discharge as determined by the Authority having Jurisdiction.
- 4) Rupture disks may be used only if they are in series with a pressure relief valve, or when there is less than 2 ft³ (57 l) of water volume.
- 5) Verify that the safety valve is periodically tested either manually by raising the disk from the seat or by removing and testing the valve on a test stand.

g) Acceptance criteria

The following forms are required to be ~~completed~~ available for review:

- 1) ASME BPV Forms U-1, U-1A or U-2 as appropriate
- 1)2) PVHO-1 Form PVHO-1-GR-1 Manufacturer's Data Report for Pressure Vessels for Human Occupancy.
- 3) PVHO-1 Forms VP-1 PVHO-2 Fabrication Certification for Acrylic Windows (one for each window).
- 4) PVHO-1 Form VP-2 Design Certification for Acrylic Windows (one for each window).
- 5) PVHO-2 Form VP-1 Viewport Inspection (one for each window, current within PVHO-2 requirements).
- 2)6) For any repaired windows, PVHO-2 Form VP-2 Acrylic Window Repair Certificate for Windows. Repaired by the User (or his Authorized Agent) or PVHO-2 Form VP-3 Acrylic Window Repair Certificate for Severely Damaged Windows.

h) All PVHOs under the jurisdiction of the U.S. Coast Guard must also comply with 46 CFR Part 197.