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THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD SUBGROUP INSPECTION

MINUTES

Meeting of July 19th, 2016
Columbus, OH

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The National Board of Boiler & Pressure Vessel Inspectors
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1. **Call to Order**
   The meeting was called to order at 8:03 a.m. on January 19, 2016 by Mr. Jim Getter.

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

3. **Announcements**
   J. Getter (Chairman) and J. Metzmaier (Secretary) presented announcements for the remainder of the week.

4. **Adoption of the Agenda**
   New business items NB16-0807, NB16-0808, NB16-0809D and nomination for David Buechel and Bryce Hart for SG Inspection were added to the agenda. Motion was made to adopt the agenda as revised. The motion was unanimously approved.

5. **Approval of the Minutes of January 12th, 2016 Meeting**
   A motion was made to approve the subgroup Inspection minutes from January 12, 2016. The motion was unanimously approved.

6. **Review of Rosters**

   a. **Membership Nominations**
      The resume's for David Buechel and Bryce Hart were reviewed, and a motion was made to appointment them both to subgroup Inspection. The motion was unanimously approved.

   b. **Membership Reappointments**
      Mr. Jason Safarz and Mr. Ernest Brantley were both eligible for reappointment to Subgroup Inspection. A motion was made to reappoint E. Brantly to Subgroup Inspection. The motion was unanimously approved. There was no motion to reappoint J. Safarz.

7. **Interpretations**

Item Number: IN16-0501	**NBIC Location: Part 2**	**Attachment Pages 3-4**
General Description: Change of service from Ammonia to LP gas **Subgroup:** Inspection **Task Group:** None assigned. **July 2016 action:** The interpretation was discussed and a response was created. A motion was made to approve the response. The motion was unanimously approved.		

8. Action Items – Old Business

Item Number: NB13-1002	NBIC Location: Part 2	Attachment Page 5

General Description: Review inspection requirements against ASME B31.1 Power Piping code

Subgroup: Inspection
Task Group: M. Schwartzwalder (PM), J. Frey, V. Newton, M. Mooney, D. Canonico, M. Horbaczewski, B. Dobbins, C. Withers

July 2016 action:
M. Schwartzwalder presented an addition to the glossary, and discussed the new proposed section to be added to Part 2, Section 2.4. Revisions were made to the proposed new section. A motion was made to approve the addition to the glossary and to approve the new section as revised by the Subgroup Inspection. The motion was unanimously approved.

Item Number: NB13-1406	NBIC Location: Part 2, S1	No Attachment

General Description: Add requirements for inspection of superheater units

Subgroup: Inspection
Task Group: P. Welch (PM), R. Stone

July 2016 action:
P. Welch gave a progress report. They should have something to present in January 2017. Action Item has been moved to Subgroup Locomotive.

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: Inspection
Task Group: P. Welch (PM), M. Mooney, R. Stone

July 2016 action:
P. Welch gave a progress report. They should have something to present in January 2017. Action Item has been moved to Subgroup Locomotive.

Item Number: NB13-1701	NBIC Location: Part 2, 2.3.6.6	Attachment Pages 6-9

General Description: Review inspection requirements for wire wound pressure vessels

Subgroup: Inspection
Task Group: M. Horbaczewski (PM), M. Mooney, J. Riley, V. Scarcella, G. Galanes

July 2016 action:
M. Horbaczewski reviewed the Letter Ballot comments with the Subgroup and the changes that were made based on the LB comments. A motion was made to approve the document with addition changes made by the Subgroup Inspection. The motion was unanimously approved.

Item Number: NB14-0901	NBIC Location: Part 2	No Attachment

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

July 2016 action:
M. Horbaczewski gave a progress report. Work is being done but it is not complete.

Add Joe Frey to task group.

Item Number: NB14-1101	NBIC Location: Part 2	No Attachment

General Description: Diaphragm weld inspection.

Subgroup: Inspection
Task Group: P. Welch (PM), D. Graf, R. Stone

July 2016 action:
P. Welch gave a progress report. They should have something to present in January 2017. Action Item has been moved to Subgroup Locomotive.

Item Number: NB14-1801	NBIC Location: Part 2	No Attachment

General Description: Ferrules

Subgroup: Inspection
Task Group: P. Welch (PM), R. Stone

July 2016 action:
P. Welch gave a progress report. They should have something to present in January 2017. Action Item has been moved to Subgroup Locomotive.

Item Number: NB14-1802	NBIC Location: Part 2	No Attachment

General Description: Riveted staybolt head dimensions and Figure S1.2.2-c

Subgroup: Inspection
Task Group: P. Welch (PM), R. Stone

July 2016 action:
P. Welch gave a progress report. They should have something to present in January 2017. Action Item has been moved to Subgroup Locomotive.

Item Number: NB15-0201	NBIC Location: Part 2	Attachment Pages 10-11

General Description: Provide consistent language in all areas of the NBIC affected by the closure of NB13-0701

Subgroup: Inspection
Task Group: J. Riley (PM), M. Mooney, T. Vandini, M. Clark, G. McRae

July 2016 action:
J. Riley presented a proposed document. After discussion, changes were made and a motion was made to approve the document with the changes. The motion was unanimously approved.

Item Number: NB15-0504	NBIC Location: Part 2, CO2 Sup.	No Attachment
General Description: Result of PR15-0701, PR15-0702 and PR15-0703, clarify what the National Board Commissioned Inspector's specific duties are when inspecting high pressure composite vessels **Subgroup:** Inspection **Task Group:** E. Brantly (PM), M. Mooney, M. Horbaczewski, V. Newton **July 2016 action:** E. Brantly reviewed the item with the Subgroup, and made a motion to close this item and refer the commenter to Part 2, S10. The motion was unanimously approved.		

Item Number: NB16-0201	NBIC Location: Part 2, S7	Attachment Pages 12-17
General Description: Ensure common technology i.e. "pressure vessel", is used throughout S7 **Subgroup:** Inspection **Task Group:** S. Staniszewski (PM), T. Vandini, B. Hart **July 2016 action:** T. Vandini presented a new document showing proposed changes to S7. A motion was made to approve the changes. The motion was unanimously approved.		

9. Action Items – New Business

Item Number: NB16-0901	NBIC Location: Part 2, Section 3	Attachment Page 29
General Description: Update language to be consistent with new name for Section II, Part D Nonmandatory Appendix A **Subgroup:** Inspection **Task Group:** None assigned. **July 2016 action:** J. Getter presented the updated changes to the Subgroup. A motion was made to approve the change. The motion was unanimously approved.		

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:** None assigned. **July 2016 action:** V. Newton discussed the document revised by AIA with the Subgroup. After review, it was decided that the document was diluted to the point where is does not provide proper guidelines. A motion was made to move the document forward as originally presented in January 2016 (without the AIA changes). The motion was unanimously approved.		

Item Number: NB16-1601	NBIC Location: Part 2, S7 and S9	No Attachment
General Description: Address conflict between change of service from Ammonia to LP gas requirements **Subgroup:** Inspection **Task Group:** None assigned. **July 2016 action:** J. Getter discussed the item with the Subgroup. A motion was made to close with no action. 2017 NBIC Part 2, S7.8.6 resolves this issue. The motion was unanimously approved.		

Item Number: NB16-2201	NBIC Location: Part 2, S1	No Attachment
General Description: Based on NB15-2304, update footnote to reference new Part PL **Subgroup:** Inspection **Task Group:** M. Mooney (PM), J. Pillow **July 2016 action:** This item is for Subgroup Historical. A motion was made to close the item. The motion was unanimously approved.		

NB16-0807: G. Scribner presented proposed changes based on an International Working Group discussion. A few changes were made by the subgroup. A motion was made to approve the changes with the Subgroup revisions. The motion was unanimously approved. **Attachment Pages 19-24**

NB16-0808 (color photos in the 2017 NBIC): J. Getting explained to the Subgroup that there will be no color photos in the 2017 NBIC. A motion was made to remove the photos and add a statement saying "Color photo is available on the National Board Website, www.nationalboard.org". The motion was unanimously approved. **No Attachment.**

NB16-0809D (Scope consistency): G. Scribner presented a document showing changes to scopes throughout Part 2. These changes were reviewed and a motion was made to approve the changes. The motion was unanimously approved. **Attachment Pages 25-28**

NB16-0202: A motion was made to add "CGA – Compressed Gas Association" to the glossary. The motion was unanimously approved. **Attachment Page 29**

10. Future Meetings

January 9-12, 2017 – San Diego, California
July 17-20, 2017 – Location TBD

11. Adjournment

A motion was made and unanimously approved to adjourn the meeting at 2:25 p.m.

Respectfully submitted,

Brad Besserman
NBIC Secretary

SG Inspection Attendance Sheet -7/19/16

Name	Company	Phone Number	Email	Signature	Attend Rec.?	Guest?
Jim Getter	Worthington Industries	(614) 840-3087	jim.getter@worthingtonindustries.com	[signature]	X	X
Mike Schwartzwalder	AEP	(614) 581-6456	mschwartzwalder@aep.com	[signature]	✓	X
Jodi Metzmaier	National Board	(614) 888-8320	jmetzmaier@nationalboard.org	[signature]	✓	
Timothy Barker	~~Factory Mutual~~ FM GLOBAL	~~(781) 255-4784~~ 360 801 3790	timothy.barker@fmglobal.com	[signature]	✓	
Ernest Brantley	XL Insurance	(337) 842-7044	ernest.brantley@bpcllcga.com	[signature]	✓	
Domenic Canonico	Canonico & Assoc.	(423) 886-1008	canonicod@ebpfi.com			
David Ford	U.S. DOT	(202) 366-4545	david.ford@dot.gov	[signature]		
Darrell Graf	Air Products & Chemicals	(601) 799-2889	grafdr@airproducts.com	[signature]	X	
Mark Horbaczewski	Diamond Technical Services	(630) 799-8162	mhorbaczewski@diamondtechnicalservices.com	[signature]	✓	
Greg McRae	Trinity Industries	(214) 589-8559	greg.mcrae@trin.net	[signature]	✓	
Mark Mooney	Liberty Mutual	(781) 891-8900	mark.mooney@libertymutual.com	Mark Mooney	✓	
Venus Newton	Boiler & Property Insurance	(770) 614-3111	venus.newton@boilerproperty.com	[signature]	✓	
Jim Riley	Phillips 66	(510) 245-5895	jim.riley@p66.com	J Riley	✓	
Jason Safarz	CEC Combustion Safety	(216) 749-2992	jsafarz@combustionsafety.com			
Stanley Staniszewski	U.S. DOT	(202) 366-4545	stanley.staniszewski@dot.gov			
Thomas Vandini	Quality Steel Corporation	(419) 334-2664	tvandini@propanetank.com	[signature]		
Paul Welch	Arise	(678) 446-5290	paul.welch@ariseinc.com	Paul Welch	✓	
JAMES ROBERTS	TRINITY CONTAINERS	214-589-8344	JAMES.ROBERTS@TRIN.NET	James Roberts	X	
DAVE BUECHEL	HSB I&I	412-310-7740	DAVID_BUECHEL@HSB.COM	David Buechel	X	~~X~~
Brandon Wilson	DTS	724-599 4689	bwilson@diamondtechnicalservices.com	[signature]	X	~~X~~
BRYCE HART	ZURICH	212-859 2777	BRYCE.HART@ZURICHNA.COM	[signature]		
Joe Frey	Stress Engr & B31.1	713 2017861	joe.frey@stress.com	Joe Frey	✓	✓

Name	Company	Phone Number	Email	Signature	Attend Rec.?	Guest?
Kimberly Adkins	FMGlobal	310.965.6521	Kimberly.Adkins@FMGlobal.com		/	

LPG VENTURES

IN16-0501

1) **Inquiry:**
Can pressure vessels that were previously used in anhydrous ammonia service be converted to LPG service?

2) **Reply:**
Yes. With proper testing and evaluation they can be converted to LPG service.

3) **Background Information:**
We are seeking a formal interpretation of what appears to be conflicting standards as it relates to Change of Service of vessels larger than 3000 gallons that had been previously used in Anhydrous Ammonia service to LPG service. The conflict is as follows;

Part 2, Supplement 7: S7.8.6- "Containers that have been previously used in anhydrous ammonia service shall not be converted to LPG service".

Part 2, Supplement 9: Table S9.4- Examples of change of service conditions; Factors to consider when changing vessel from Ammonia to LP Gas.

NFPA 58 5.2.1.5- ASME containers of 3000 gallons WC or less shall not be converted to LPG service.

The one sentence in S7.8.6 appears to conflict with Table S9.4 Change of Service factors to consider and definitely conflicts with the governing installation code, NFPA 58. We are specifically seeking clarification as to whether or not a vessel larger than 3,000 gallons water capacity can be changed from Anhydrous Ammonia service to LPG Service.

Sincerely,

Chris Heichel
Quality Control Manager
LPG Ventures, Inc.
816-903-1806
chrish@lpgventures.com

Interpretation IN16-0501

Proposed Interpretation

Inquiry:	IN16-0501
Source:	Chris Heichel
Subject:	Change of service – LPG & ammonia
Edition:	2015 NBIC
Question 1:	Can pressure vessels that were previously used in anhydrous ammonia service be converted to LPG service?
Reply 1:	No, except for the following: *ASME containers of 3000 gal (11.4 m3) water capacity or less used to store anhydrous ammonia, except for containers used in cargo tank vehicle service, shall not be converted to LP-Gas service.* The above paragraph is proposed to be included in the 2017 NBIC (Part 2, S7.8.6)
SC Vote	Passed – Unanimous
NBIC Vote	

National Board Inspection Code Action item NB13-1002- Revision Dated 7/13/2016

NB13-1002 - Part 2, SG Insp. Spec. – Review inspection requirements for B31.1 Power Piping. A Task Group consisting of Mike Schwartzwalder (Lead), Joe Frey, Venus Newton, Mark Mooney, Marshall Clark, Domenic Canonico, Mark Horbaczewski, Robbie Dobbins and Chuck Withers were assigned.

For Discussion, I propose the following additions to the Part 2- Inspection, 2017 edition Section 1.3 add paragraph 1.3(v) ASME B31.1, Power Piping, Chapter VII, Operation and Maintenance.

Add to Part 2- Section 9 Inspection, Glossary of Terms Definitions; 9.1 Definitions**; Covered Piping Systems (CPS) (not to be confused with insulated piping) are ASME B31.1 pressure piping systems or other piping systems where safety risks to personnel and equipment may exist during facility operations.**

2.4.X –COVERED PIPING SYSTEMS

2.4.X.1 Covered Piping Systems (CPS) designed to B31.1 or other construction piping codes as deemed necessary by the owner may be subjected to the same damage mechanisms that "covered piping", such as boiler and boiler external piping, based on temperature, pressure and environmental conditions. Examples of CPS are main steam, hot and cold reheat, feedwater, drains and other piping systems where failure may occur as a result of creep, fatigue, erosion–corrosion, corrosion–fatigue, wall thinning, graphitization and other failure mechanisms. Based on these considerations a program should be established where CPS is periodically evaluated by an owner's assessment program using suitable NDE, metallurgical analysis or other methods to determine whether continued operation of this piping is justified. B31.1, Chapter VII -Operation and Maintenance provides guidance on how these systems should be evaluated, maintained and documented. It is recognized that all of the documentation, data and records for CPS, identified in B31.1, Chapter 7 may not be available for a specific plant, particularly for older plants and for piping systems identified as nonboiler external or similar piping. The rigor and detail of the owner's CPS assessment programs are the responsibility of the owner and should ensure the continued safe operation of this piping. The owner should ensure to the extent possible that CPS do not represent safety risks. The assessment program should be made available for review.

NBIC Item NB13-1701

2.3.6.6 INSPECTION OF WIRE WOUND PRESSURE VESSELS

(a) This section provides guidelines for inspection of wire wound pressure vessels typically designed for 10,000 psi or greater service. The scope of inspection of these vessels should include components affected by repeated opening and closing, such as the frame, yolk and cylinder inner diameter surface, or alignment of the yolk with the cylinder, lack of maintenance and a check for inoperable or bypassed safety and warning devices. Early detection of any damage to the cylinder, closures or frame is essential to avoid catastrophic failure. (Moved from paragraph c)

(b) These vessels consist of four parts, a wire wound cylinder, two end closures and a frame to retain the closures in the cylinder. The wire is one continuous piece and is wound in tension. On the cylinder, the wire can only carry circumferential or radial loading. The cylinder is typically not of sufficient thickness to carry axial load which requires the end closures have no threads or retaining grooves and requires a frame to retain the pressure vessel axial load imposed on the closures. The purpose for this design is to minimize weight of the containment cylinder using thinner wall materials and using external wound wire to induce a compressive preload. This design also provides increased resistance to damage from fatigue loading.

Note that some vessels may be monoblock cylinders (no winding) with wire wound frame and some vessels may be wire wound cylinder with a forged or welded plate frame (not wire wound). Use of a frame to retain the end closures removes the sharp transitions in shape (threads or grooves) associated with monoblock cylinder failures. The design of high pressure vessels is typically based on fatigue life criteria. The majority of operating wire wound vessels in North America ~~today~~ were manufactured to ASME BPVC Section VIII Division 3, Alternative Rules for Construction of High Pressure Vessels. Some inservice vessels may have been manufactured to ASME BPVC Section VIII Division 1 or Division 2, and others have been installed as “State Specials” that require fatigue life analysis to determine a safe operating life. The primary failure mode is fatigue cracking. Early detection of any damage to the cylinder, closures or frame is essential to avoid catastrophic failure

~~High pressure design requires use of high strength materials, which have relatively low ductility. The material thickness required for reasonable fatigue life is greatly reduced by the pre-tensioned wire wound design. Typical winding design provides compression sufficient that at vessel design conditions there is no circumferential stress in the cylinder. These vessels have been used in various industrial applications, including foods and drinks processing, ceramic or refractory processing and powdered metal processing utilizing a liquid compressing fluid at ambient or slightly elevated temperature. The most frequent of these are isostatic pressing and hydrostatic extrusion. Isostatic pressing can be performed at either cold temperatures, at room temperature, with liquid as the pressure medium, or hot, at temperatures of 2000 to 3300°F with gas as the pressure medium. In hot isostatic presses, the vessel wall is~~

~~separated from the hot space by insulation, which keeps the vessel wall operating at a low temperature of approximately 120 to 180°F.~~

~~Cold pressing is used for regular production at pressures up to 87,000 psi. Ceramic, refractory and metal processing is also performed at elevated temperature, up to 3632°F (2000°C). The "hot" processes utilize an inert gas fluid pressure up to 45,000 psi (310 MPa). Continuous cooling is necessary for the hot process and may contribute to corrosion damage of the cylinder of closures.~~

~~Hydrostatic extrusion is generally performed either cold, at room temperature, or warm, at temperatures up to 1110°F, in both cases with liquid as the pressure medium. Hydrostatic extrusion is used for regular production at pressures up to 200,000 psi. Both cold and hot processes are commonly found in research facilities and in universities.~~

(c) Record keeping

(1) Since these vessels have a finite fatigue life, it is essential a record be maintained of each operating cycle, recording both temperature and pressure. Deviation beyond design limits is cause for suspending operation and reevaluation of remaining fatigue life. Vessels having no operating record ~~should~~ shall be inspected and a fracture mechanics evaluation with a fatigue analysis test be performed to establish remaining life before resuming operation. Vessels having no operating record shall not be used for service until such time previous operating history can be determined.

(2) Operating data should be recorded and include the following whenever the vessel is operating:
   a. Number of cycles
   b. Maximum pressure
   c. Maximum temperature
   d. Any unusual conditions

(d) Any damage to the cylinder or closures can lead to premature failure. Frequent visual inspection should be made of internal and external surfaces of the cylinder, frame and closures. A thorough examination should be completed if any visually apparent damage is identified or if any excursion beyond design temperature or pressure occurs.

In addition, surfaces of the cylinder and closures should be examined by dye penetrant or magnetic particle method at intervals based on vessel remaining life. Closures may require ultrasonic examination of passageways.

~~Following is an example of what the results of such a study might reveal as allowable cycles for a particular wire wound vessel:~~

~~Columns~~	~~> 10^6 Cycles~~	~~"Columns" are beams on either side of frame, between the yokes.~~
~~Yokes~~	~~> 10^6 Cycles~~	~~"Yokes" are the circular ends of the frame.~~
~~Wires of frames~~	~~> 10^6Cycles~~	~~"Wires" place frame in compression~~
~~Cylinder~~	~~100 X 10^3 cycles~~	

~~Wires of Cylinder~~	~~60 X 10^3 cycles~~	~~"Wires" place cylinder in compression.~~
~~Closures~~	~~30 X 10^3 cycles~~	~~All connections to the vessel are through the closures. These passageways create stress raisers, as do grooves for sealing system.~~

~~The vessel design life in this example is thus limited by the closure. The calculated design life is 30,000 cycles at design pressure and temperature.~~

~~An acceptable factor of safety for vessel fatigue inspection interval varies between 0.25 and 0.5 of the remaining design life. The inspection interval for the above example is therefore 10,000 to 20,000 cycles, but should not exceed five years.~~

~~In addition to scope of frequent inspection, the fatigue inspection should include measurement of the cylinder inside diameter and frame inside length to detect reduced tension in the wire windings. Note that monoblock cylinders and plate frames require additional inspection due to differing construction.~~

~~If a crack or flaw is detected during any inspection, an immediate evaluation, repair and study of impact on remaining fatigue life should be completed by a National Board authorized repair agency. Using the results of this study, and application of safety factor 0.25 (due to known damage), the number of cycles of operation to the next fatigue inspection is established.~~

As part of this inspection guideline for wire wound pressure vessels ~~frequent inspection~~, the following items should be reviewed:

(1) Verify no change in the process, such as the processing fluid, that might adversely impact vessel integrity.

(2) Review the vessel manufacturer's inspection recommendations for vessel, closures and frame. If manufacturer's recommendations are not available, obtain recommendations from a recognized wire wound vessel service provider.

(3) Verify any repair to pressure retaining items has been completed by National Board authorized service provider having wire wound vessel expertise.

(4) Verify overpressure protection with appropriate set pressure and capacity is provided. Rupture discs are commonly used for pressures exceeding 14,500 psi (100 MPa) to avoid valve seat leakage. Overpressure protection devices are frequently replaced to avoid premature operation.

(5) If there are no manufacturer's recommendations available for the vessel, the following are additional recommended inspections that should be conducted to ensure vessel integrity and safety

   a. Conduct annual visual and dimensional vessel inspections with liquid penetrant examination of maximum stressed areas to ensure that the surfaces are free of defects. Conduct ultrasonic examination of the vessel after every 25% of the design cycle life or every five years, whichever comes first, to detect subsurface cracks. Special attention should be given to the roots of threads and closures using threaded head retention construction. Other geometric discontinuities that are inherent in the design or irregularities resulting from localized corrosion, erosion, or mechanical damage should be carefully examined. This is particularly important for units of monoblock construction.

b. The closure mechanism of the vessel end-closure is opened and closed frequently during operation. It should be closely inspected for freedom of movement and proper contact with its locking elements. Wire wound vessels must have yoke-type closures so the yoke frame will need to be closely inspected on a regular basis

c. ~~Should pitting, cracks, corrosion, or other defects are found during scheduled inspection, verify that an evaluation using fracture mechanics techniques is performed. This is to determine MAWP, cyclic life and extent of NDE frequency based on crack growth rate.~~

(6) Gages, Safety Devices, and Controls

a. Verify that the vessel is provided with control and monitoring of pressure, temperature, the electrical system, fluid flow, liquid levels and all variables that are essential for the safe operation of the system. If the vessel is automatically controlled, manual override should be available. Also, safety interlocks should be provided on the vessel closure to prevent vessel pressurization if the vessel closure is not complete and locked.

b. Verify that all safety device isolation valves are locked open if used.

c. Verify appropriate pressure relief device is installed with the setpoint at the lowest pressure possible, consistent with the normal operating pressure but in no case higher than the design operating pressure of the vessel. Rupture discs are normally considered more suitable for these types of applications since pressure relief devices operating at pressures above 14500 psi may tend to leak by their seat.

d. Verify that pressure and temperature of the vessel coolant and vessel wall is controlled and monitored. Interlock devices should be installed that will de-energize or depressurize the vessel at established setpoints.

e. Verify audible and visual alarms are installed to indicate unsafe conditions.

Ballot item NB15-0201 review wording in Part 2 on Pitting Corrosion

Current wording in NBIC sections

3.3.1 MACROSCOPIC CORROSION ENVIRONMENTS

Macroscopic corrosion types are among the most prevalent conditions found in pressure-retaining items causing deterioration. The following corrosion types are found.

e) Pitting Corrosion

Pitting corrosion is the formation of holes in an otherwise relatively un-attacked surface. Pitting is usually a slow process causing isolated, scattered pits over a small area that does not substantially weaken the vessel. It could, however, eventually cause leakage.

4.4.7.2 METHOD FOR ESTIMATING INSPECTION INTERVALS FOR EXPOSURE TO CORROSION

NB13-0701 4.4.8.7.2(J)(1)

Wording in 2015 NBIC

j) Local Metal Loss

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

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

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

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

4.4.8.7 EVALUATING PRESSURE·RETAINING ITEMS CONTAINING LOCAL THIN AREAS

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

d) Required measurements for evaluation of local thin areas shall include:
1) Thickness profiles within the local region;
2) Flaw dimensions;
3) Flaw to major structural discontinuity spacing;
4) Vessel geometry;
5) Material properties.

e) Required measurements for evaluation of pitting corrosion shall include:
1) Depth of the pit;
2) Diameter of the pit;
3) Shape of the pit;
4) Uniformity.

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

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

SUPPLEMENT 7
INSPECTION OF PRESSURE VESSELS IN LIQUEFIED PETROLEUM GAS (LPG) SERVICE NBIC 2015 Edition

S7.8.5 CORROSION

a) Line and Crevice Corrosion For line and crevice corrosion, the depth of the corrosion shall not exceed 25% of the original wall thickness.

b) Isolated Pitting Isolated pits may be disregarded provided that:

1) Their depth is not more than 25% the required thickness of the container wall;

2) 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

3) The sum of their dimensions along any straight line within this circle does not exceed 2 in. (50 mm).

c) General Corrosion

For a corroded area of considerable size, the thickness along the most damaged 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, and the average shall not be less than 90% of the required wall thickness. When general corrosion is identified that exceeds the limits set forth in this paragraph, the pressure vessel shall be removed from service until it is repaired by a qualified “R” Stamp holder or permanently removed from service unless an acceptable for service evaluation is performed in accordance with NBIC Part 2, 4.4.

Add d) to S7.8.5:

d) When general, localized or pitting corrosion exceeds the specified corrosion/erosion allowance, but meets the requirements of b) and c), the inspector should consider results from previous inspections. Patterns of corrosion and damage that are expected to occur over the future service life should determine a specific inspection plan. Potential repairs may be necessary to maintain a safe and satisfactory operating condition.

NB16-0201

Supplement 7 (below) uses alternate terminology for pressure vessel(s). The uses are highlighted in bold large red. The general terms container, vessel, or tank were used as alternates to pressure vessel.

If we want to standardize all uses to pressure vessel or pressure vessels, then the following edits just need to be made:

1) Replace "container" with "pressure vessel"
2) Replace "containers" with "pressure vessels"
3) Replace "tank" with "pressure vessel"
4) Replace "vessel" (when not preceded by "pressure") with "pressure vessel"
5) Replace "vessels" (when not preceded by "pressure") with "pressure vessels"

SUPPLEMENT 7
INSPECTION OF PRESSURE VESSELS IN LIQUEFIED PETROLEUM GAS SERVICE

S7.1 SCOPE

a) **~~Containers~~Pressure vessels** designed for storing liquefied petroleum gas (LPG) can be stationary or can be mounted on skids. LPG is generally considered to be non-corrosive to the interior of the **~~vessel~~pressure vessel**. NBIC Part 2, Supplement 7 is provided for guidance of a general nature for the owner, user, or jurisdictional authority. There may be occasions where more detailed procedures will be required such as changing from one service to another (e.g., above ground to underground; or **~~containers~~pressure vessels** that are commercially refurbished).

b) The application of this supplement to underground **~~containers~~pressure vessels** will only be necessary when evidence of structural damage to the **~~vessel~~pressure vessel** has been observed, leakage has been determined, or the **~~tank~~pressure vessel** has been dug up, and is to be reinstalled. Special consideration will be given to **~~containers~~pressure vessels** that are going to be commercially refurbished (see NBIC Part 2, S7.9).

S7.2 PRE-INSPECTION ACTIVITIES

a) A review of the known history of the **~~container~~pressure vessel** should be performed. This should include a review of information, such as:
1) Operating conditions;
2) Historical contents of the **~~vessel~~pressure vessel**;
3) Results of any previous inspection;
4) Current jurisdictional inspection certificate, if required;
5) ASME Code symbol stamping or mark of code of construction, if required; and 6) National Board and/or jurisdictional registration number, if required.

b) The **~~container~~pressure vessel** shall be sufficiently cleaned to allow for visual inspection. For commercially refurbished **~~containers~~pressure vessels** see NBIC Part 2, S7.9.

S7.3 INSERVICE INSPECTION FOR ~~VESSEL~~PRESSURE VESSELSS IN LP GAS SERVICE

The type of inspection given to pressure vessels should take into consideration the condition of the **~~vessel~~pressure vessel** and the environment in which it operates. The inspection may be external or internal, and use a variety of nondestructive examination methods. Where there is no reason to suspect an unsafe condition or where there are no inspection openings, internal inspections need not be performed. When service conditions change from one service to another, i.e. above ground to underground; or ~~containers~~pressure vessels that are commercially refurbished, an internal inspection may be required. The external inspection may be performed when the ~~container~~pressure vessel is pressurized or depressurized, but shall provide the necessary information that the essential sections of the ~~vessel~~pressure vessel are of a condition to operate.

S7.3.1 NONDESTRUCTIVE EXAMINATION (NDE)

Listed below are a variety of methods that may be employed to assess the condition of the pressure vessel. These examination methods should be implemented by experienced and qualified individuals. Generally, some form of surface preparation will be required prior to the use of these examination methods: visual, magnetic particle, liquid penetrant, ultrasonic, radiography, radioscopy, eddy current, metallographic examination, and acoustic emission. When there is doubt as to the extent of a defect or detrimental condition found in a ~~container~~pressure vessel, additional NDE may be required.

S7.4 EXTERNAL INSPECTION

The ~~container~~pressure vessel shall be inspected for corrosion, distortion, cracking, or other conditions as described in this section. In addition, the following should be reviewed, where applicable:

a) Insulation or Coating

If the insulation or coating is in good condition and there is no reason to suspect an unsafe condition behind it, then it is not necessary to remove the insulation or coating in order to inspect the ~~vessel~~pressure vessel. However, it may be advisable to remove a small portion of the insulation or coating in order to determine its condition and the condition of the ~~container~~pressure vessel surface. For commercially refurbished ~~containers~~pressure vessels see NBIC Part 2, S7.9.

b) Evidence of Leakage

Any leakage of vapor or liquid shall be investigated. Leakage coming from behind insulation or coating, supports, or evidence of past leakage shall be thoroughly investigated by removing any insulation necessary until the source is established.

c) Structural Attachments

The pressure vessel mountings should be checked for adequate allowance for expansion and contraction, such as provided by slotted bolt holes or unobstructed saddle mountings. Attachments of legs, saddles, skirts, or other supports should be examined for distortion or cracks at welds.

d) ~~Vessel~~Pressure Vessel Connections

Components that are exterior to the ~~vessel~~pressure vessel and are accessible without disassembly shall be inspected as described in this paragraph. Manholes, reinforcing plates, nozzles, couplings, or other connections shall be examined for cracks, deformation, or other defects. Bolts or nuts should be examined for corrosion or defects. Weep holes in reinforcing plates shall remain open to provide visual evidence of leakage as well as to prevent pressure buildup between the ~~vessel~~pressure vessel and the reinforcing plate. Accessible flange faces should be examined for distortion. It is not intended that flanges or other connections be opened unless there is evidence of corrosion to justify opening the connection.

e) Fire Damage

Pressure vessels shall be carefully inspected for evidence of fire damage. The extent of fire damage determines the repair that is necessary, if any. (See NBIC Part 2, S7.7).

S7.5 INTERNAL INSPECTION

When there is a reason to suspect an unsafe condition, the suspect parts of the ~~vessel~~pressure vessel shall be inspected and evaluated. The ~~vessel~~pressure vessel shall be prepared and determined to be gas-free and suitable for human entry prior to internal inspection. (See NBIC Part 2, 2.3.4).

S7.6 LEAKS

Leakage is unacceptable. When leaks are identified, the ~~vessel~~pressure vessel shall be removed from service until repaired by a qualified repair organization or permanently removed from service.

S7.7 FIRE DAMAGE

a) ~~Vessel~~Pressure vesselss in which bulging exceeds the limits of NBIC Part 2, S7.8.3 or distortion that exceeds the limits of the original code of construction (e.g., ASME Section VIII, Div. 1), shall be removed from service until repaired by a qualified repair organization or permanently removed from service.

b) Common evidence of exposure to fire is:
1) Charring or burning of the paint or other protective coat;
2) Burning or scarring of the metal;
3) Distortion; or
4) Burning or melting of the valves.

c) A pressure vessel that has been subjected to action of fire shall be removed from service until it has been properly evaluated. The general intent of this requirement is to remove from service pressure vessels which have been subject to action of fire that has changed the metallurgical structure or the strength properties of the steel. Visual examination with emphasis given to the condition of the protective coating can be used to evaluate exposure from a fire. This is normally determined by visual examination as described above with particular emphasis given to the condition of the protective coating. If there is evidence that the protective coating has been burned off any portion of the pressure vessel surface, or if the pressure vessel is burned, warped, or distorted, it is assumed that the pressure vessel has been overheated. If, however, the protective coating is only smudged, discolored, or blistered, and is found by examination to be intact underneath, the pressure vessel shall not be considered affected within the scope of this requirement. ~~Containers~~Pressure vessels that have been involved in a fire and show no distortion shall be requalified for continued service by retesting using the liquid pressure test procedure applicable at the time of original fabrication.

d) Subject to the acceptance of the Jurisdiction and the Inspector, alternate methods of pressure testing may be used.

S7.8 ACCEPTANCE CRITERIA

The acceptance criteria for LPG ~~vessel~~pressure vessels is based on successfully passing inspections without showing conditions beyond the limits shown below.

S7.8.1 CRACKS

Cracks in the pressure boundary (e.g., heads, shells, welds) are unacceptable. When a crack is identified, the ~~vessel~~pressure vessel shall be removed from service until the crack is repaired by a qualified repair organization or
permanently retired from service. (See NBIC Part 3, Repairs and Alterations).

S7.8.2 DENTS

a) Shells
The maximum mean dent diameter in shells shall not exceed 5% of the shell diameter, and the maximum depth of the dent shall not exceed 5% of the mean dent diameter. The mean dent diameter is defined as the average of the maximum dent diameter and the minimum dent diameter. If any portion of the dent is closer to a weld than 5% of the shell diameter, the dent shall be treated as a dent in a weld area, see b) below.

b) Welds
The maximum mean dent diameter on welds (i.e., part of the deformation includes a weld) shall not exceed 10% of the shell diameter. The maximum depth shall not exceed 5% of the mean dent diameter.

c) Head
The maximum mean dent diameter on heads shall not exceed 10% of the shell diameter. The maximum depth shall not exceed 5% of the mean dent diameter. The use of a template may be required to measure dents on heads.

d) When dents are identified which exceed the limits set forth in these paragraphs, the ~~vessel~~pressure vessel shall be removed from service until the dents are repaired by a qualified repair organization or permanently retired from service.

S7.8.3 BULGES

a) Shells
If a bulge is suspected, the circumference shall be measured at the suspect location and in several places remote from the suspect location. The variation between measurements shall not exceed 1%.

b) Heads
1) If a bulge is suspected, the radius of curvature shall be measured by the use of templates. At any point the radius of curvature shall not exceed 1.25% of the diameter for the specified shape of the head.
2) When bulges are identified that exceed the limits set forth in these paragraphs, the ~~vessel~~pressure vessel shall be removed from service until the bulges are repaired by a qualified repair organization or permanently retired from service.

S7.8.4 CUTS OR GOUGES

When a cut or a gouge exceeds 25% of the thickness of the ~~vessel~~pressure vessel, the ~~vessel~~pressure vessel shall be removed from service until it is repaired by a qualified repair organization or permanently removed from service.

S7.8.5 CORROSION

a) Line and Crevice Corrosion
For line and crevice corrosion, the depth of the corrosion shall not exceed 25% of the original wall thickness.

b) Isolated Pitting
Isolated pits may be disregarded provided that:
1) Their depth is not more than 25% the required thickness of the ~~container~~pressure vessel wall;
2) 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
3) The sum of their dimensions along any straight line within this circle does not exceed 2 in. (50 mm).

c) General Corrosion
For a corroded area of considerable size, the thickness along the most damaged 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, and the average shall not be less than 90% of the required wall thickness. When general corrosion is identified that exceeds the limits set forth in this paragraph, the pressure vessel shall be removed from service until it is repaired by a qualified "R" Stamp holder or permanently removed from service unless an acceptable for service evaluation is performed in accordance with NBIC Part 2, 4.4.

S7.8.6 ANHYDROUS AMMONIA SERVICE

~~Containers~~Pressure vessels that have been previously used in anhydrous ammonia service shall not be converted to LPG service. Any blue coloring of the brass valves indicates that the ~~container~~pressure vessel has been in anhydrous ammonia service.

S7.9 ASME LPG ~~CONTAINERS~~PRESSURE VESSELS LESS THAN 2000 GALLONS BEING REFURBISHED BY A COMMERCIAL SOURCE.

Commercially refurbished ~~containers~~pressure vessels are used ~~containers~~pressure vessels that are temporarily taken out of service for repair and or renewal and sent to a company which specializes in this type of work. Because the history of some of these ~~containers~~pressure vessels is unknown, special attention shall be given to inspection and repair before returning any of these ~~containers~~pressure vessels back to service. ASME LPG ~~containers~~pressure vessels less than 2,000 gal. (7,570 l) may be refurbished subject to the following conditions:

a) A complete external inspection shall be completed under the guidelines of this supplement. If any defects are found, as defined in S7.8.1 through S7.8.5, the defect shall be repaired under NBIC Part 3, Repairs and Alterations, by qualified personnel or permanently removed from service;

b) ~~Containers~~Pressure vessels that have been previously used in anhydrous ammonia service shall not be converted to LPG service. See NBIC Part 2, S7.8.6;

c) The coating on the outside of the ~~container~~pressure vessel shall be removed down to bare metal so that an inspection can be performed under the guidelines of this supplement; and

d) Verify that there is no internal corrosion if the ~~tank~~pressure vessel has had its valves removed or is known to have been out of service for an extended period.

S7.10 REQUIREMENTS FOR CHANGE OF SERVICE FROM ABOVE GROUND TO UNDERGROUND SERVICE

ASME LPG ~~storage~~ pressure vessels may be altered from above ground (AG) service to underground (UG) service subject to the following conditions.

a) ~~Vessel~~Pressure vesselss that have been previously used in anhydrous ammonia service are not permitted to be converted to LPG service.

b) The outside surface of the ~~vessel~~pressure vessel shall be cleaned to bare metal for an external inspection of the ~~vessel~~pressure vessel under the guidelines of this supplement. Prior to placing underground, the outside surface of the ~~vessel~~pressure vessel shall be prepared consistent with the paint manufactures specification and coated with a coating suitable for UG service. Any touch-up coating shall be the same coating material. All corrosion shall be repaired in accordance with the NBIC.
c) Verify that there is no internal corrosion due to valves having been removed while the ~~container~~pressure vessel is out or service.

d) Any unused connections located on the ~~vessel~~pressure vessel shall be closed by seal welding around a forged plug or removed using a flush patch. If a flush patch is used the material shall be the same material thickness and material grade as the original code of construction.

e) All connections on top of the ~~vessel~~pressure vessel, except for the liquid withdrawal opening, shall be replaced with a riser pipe with multi-valve suitable for UG LPG service. The valve shall be enclosed in a protective housing and placed underground in accordance with jurisdictional requirements.

f) The liquid withdrawal opening shall be located within the protective housing.

g) The liquid level tube in the multivalve shall be the length required according to jurisdictional requirements.

h) The NBIC nameplate shall be made of stainless steel and continuous welded to the ~~vessel~~pressure vessel wall. The nameplate shall also have the information from the original nameplate. This shall include the manufactures name, ~~container~~pressure vessel serial number, National Board number, (if registered with the National Board) MAWP, year built, head and shell thickness, be stamped for “UG service”, the “liquid level tube length = inches” and the National Board “R” stamp. The original manufacturer’s nameplate shall remain attached to the ~~vessel~~pressure vessel. See Part 2, Section 5.2 of this Part and NBIC, Part 3, Section 5.7 for additional stamping requirements.

i) The support legs and lifting lugs may remain in place and shall be welded around the entire periphery to prevent crevices that create a potential area for corrosion. Unused attachments shall be removed and welds ground flush.

j) A connection shall be added for the attachment of an anode for cathodic protection, per NFPA, 58 .

k) All welding shall be performed by a holder of a current “R” Certificate of Authorization, using a qualified welding procedure.

NB16-0202

Add to glossary:

CGA – Compressed Gas Association

NB15-0801 – Part 2, S10 - & NB15-0901
(PM) Mooney, Newton, Welch, Barker

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Section/Subsection Referenced: **Supplement 10, Inspection of Liquid Carbon Dioxide Storage Vessels**

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

AIA believes that several aspects of the proposed requirements are either undefined or otherwise beyond the normal scope and training of National Board Commissioned Inspectors. Imposing these requirements on Special Inspectors may also place them in the untenable position of assuming liability beyond the limits of the insurance policies under which they perform inspections. Items of concern include the failure to define the terms "sufficient clearance" (S10.2b), "safely supported" (S10.2d), "guarded (S10.2f); and "permanent" (S10.3a). We recommend either defining or deleting these terms. Furthermore, Commissioned Inspectors are not qualified to (i) determine whether a CO2 detector is set to alarm at any particular concentration (S10.5); (ii) verify the posting of warning signs and determine the setpoint of any alarms (S10.6); or (iii) determine the length of safety relief/vent lines or verify that the materials selected for valves, piping, tubing, hoses and fittings used in the LCDSV system meet certain requirements. We recommend deleting these sections.

SUPPLEMENT 10 INSPECTION OF LIQUID CARBON DIOXIDE STORAGE VESSELS

S10.1 SCOPE

This supplement provides ~~requirements~~ guidelines for owners or users ~~when inspecting~~for the inspection of Liquid Carbon Dioxide Storage Vessels (LCDSVs), fill boxes, fill lines and pressure relief discharge/vent circuits used for carbonated beverage systems, swimming pool pH control systems and other fill in place systems storing liquid CO_2.

S10.2 GENERAL REQUIREMENTS (ENCLOSED AND UNENCLOSED AREAS)

The ~~Inspector~~ inspection ~~shall~~ should verify that LCDSVs are:

a) ~~are~~ not ~~be~~ located within 10 feet (3050 mm) of elevators, unprotected platform ledges or other areas where falling would result in dropping distances exceeding half the container height;

b) ~~are~~ installed with ~~sufficient~~ clearance to satisfactorily allow for~~for~~ filling, operation, maintenance, inspection and replacement of the vessel parts or appurtenances;

c) ~~are~~ not ~~installed~~ located on roofs;

d) ~~are safely~~ adequately supported ~~as~~ to prevent the vessel from tipping or falling, and to meet seismic requirements as required by design~~as needed.~~;

e) ~~are~~ not located within 36 in. (915 mm) of electrical panels; and

f) located outdoors in areas in the vicinity of vehicular traffic are protected with barriers designed to ~~guarded to~~ prevent accidental impact by vehicles.

S10.3 ENCLOSED AREA LCDSV INSTALLATIONS

The ~~Inspector~~ inspection ~~shall~~ should verify that:

a) ~~Permanent~~ LCDSV installations that are not periodically removed with remote fill connections:

1) Are equipped with a gas detection system installed in accordance with ~~NBIC Part 2,~~paragraph S10.5 of this supplement;

2) Have signage posted in accordance with ~~NBIC Part 2,~~paragraph S10.6 of this supplement; and

3) Are equipped with fill boxes, fill lines and safety relief/vent valve circuits installed in accordance with ~~NBIC Part 2, S10.4.~~paragraph S10.4 of this supplement.

b) Portable LCDSV installations with no permanent remote fill connection:

Warning: LCDSVs shall not be filled indoors or in enclosed areas under any circumstances. Tanks must always be moved to the outside to an unenclosed, free airflow area for filling.

1) Are equipped with a gas detection system installed in accordance with paragraph S10.5 of this supplement~~NBIC Part 2, S10.5~~**;**

2) Have signage posted in accordance with paragraph S10.6 of this supplement~~NBIC Part 2, S10.6~~.

3) Have a safety relief/vent valve circuit connected at all times except when the tank is being removed for filling. Connections may be fitted with quick disconnect fittings meeting the requirements of paragraph S10.4 of this supplement~~NBIC Part 2, S10.4~~.

4) Are provided with a pathway that provides a smooth rolling surface to the outdoor, unenclosed fill area. There shall not be any stairs or other than minimal inclines in the pathway.

S10.4 FILL BOX LOCATION /SAFETY RELIEF/VENT VALVE CIRCUIT TERMINATION

The ~~Inspector~~ inspection ~~shall~~ should verify that fill boxes and/or vent valve terminations are installed above grade, outdoors in an unenclosed, free airflow area, and that the fill connection is located so not to impede means of egress or the operation of sidewalk cellar entrance doors, including during the delivery process and that they are:

a) At least three (3) feet (915 mm) from any door or operable windows;*

b) At least three (3) feet (915 mm) above grade;*

c) Not located within ten (10) feet (3050 mm) from side to side at the same level or below, from any air intakes;*

d) Not located within ten (10) feet (3050 mm) from stair wells that go below grade.*

* Note: Many systems installed prior to 1/1/2014 do not meet the above requirements and the local Jurisdiction should be consulted for guidance.

S10.5 GAS DETECTION SYSTEMS

~~Rooms or areas where carbon dioxide storage vessel(s) are located indoors or in enclosed or below grade outdoor locations shall be provided with a gas detection and alarm system for general area monitoring that is capable of detecting and notifying building occupants of a CO_2 gas release. Alarms will be designed to activate a low level pre-alarm at 1.5% concentration of CO_2 and a full high alarm at 3% concentration of CO_2 which is the NIOSH & ACGIH 15 minute Short Term Exposure Limit for CO_2. These systems are not designed for employee personal exposure monitoring. Gas detection systems shall be installed and tested in accordance with manufactures installation instructions and the following requirements:~~

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 air gas can congregate and in below grade outdoor locations. Carbon dioxide (CO_2) sensors shall be provided within 12 inches (305mm) 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/m^3) 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/m^3). When carbon dioxide is detected at the high level alarm, the systemshall activate an audible and visual alarm at a location approved by the jurisdiction having authority.

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

b) The Inspector inspection shall 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.

S10.6 SIGNAGE

The Inspector inspection shall should verify that warning hazard identification signs are posted at the entrance to the building, room, enclosure, or enclosed area where the container is located. The warning sign shall be at least 8 in (200mm) wide and 6 in. (150mm) high. And indicate The wording shall be concise and easy to read and the upper portion of the sign must be orange as shown in figure NBIC Part 2, Figure S10.6. The size of the lettering must be as large as possible for the intended viewing distance and in accordance with jurisdictional requirements. When no jurisdictional requirements exist, the minimum letter height shall be in accordance with NEMA American National Standard for Environmental and Facility Safety Signs (ANSI Z535.2). The warning signs shall be as shown in figure S10.6.

CAUTION- CARBON DIOXIDE GAS

Ventilate the area before entering.

A high carbon dioxide (CO_2) gas concentration

In this area can cause asphyxiation.

Figure S10.6

Additional instructional signage shall be posted outside of the area where the container is located and such signage shall contain at minimum the following information:

a) Carbon dioxide monitors for general area monitoring (not employee personal exposure monitoring) are provided in

~~this area. These monitors are set to alarm at 5,000 ppm(1.5% concentration) for the low level alarm and at 30,000 ppm (3% concentration) for high level alarm.~~
~~b) Low Level Alarm (5,000 ppm) – Provide appropriate cross ventilation to the area. Personnel may enter area for short periods of time (not to exceed 15 minutes at a time) in order to identify and repair potential leaks.~~
~~c) High Level Alarm (30,000 ppm) – Personnel should evacuate the area and nobody should enter the affected area without proper self-contained breathing apparatus until the area is adequately ventilated and the concentration of CO_2 is reduced below the high alarm limit.~~

S10.7 VALVES, PIPING, TUBING AND FITTINGS

a) Materials – The ~~Inspector~~ inspection should ~~shall~~ verify that the materials selected for valves, piping, tubing, hoses and fittings used in the LCDSV system meet following requirements:

1) Components shall be rated for the operational temperatures and pressures encountered in the applicable circuit of the system.
2) All valves and fittings used on the LCDSV shall be rated for the maximum allowable working pressure(MAWP) stamped on the tank.
3) All piping, hoses and tubing used in the LCDSV system shall be rated for the working pressure of the applicable circuit in the system and have a burst pressure rating of at least four times the MAWP of the piping, hose or tubing.

b) Relief Valves – The ~~Inspector shall~~inspection should verify that each LCDSV shall have at least one ASME/NB stamped & certified relief valve with a pressure setting at or below the MAWP of the tank. The relief valve shall be suitable for the temperatures and flows experienced during relief valve operation. The minimum relief valve capacity shall be designated by the manufacturer. Additional relief valves that do not require ASME stamps may be added per Compressed Gas Association pamphlet, CGA S-1.3 Pressure Relief Device Standards Part 3, Stationary Storage Containers for Compressed Gases, recommendations. Discharge lines from the relief valves shall be sized in accordance with NBIC Part 2, Tables S10-a and S10-b.
Note: Due to the design of the LCDSV the discharge line may be smaller in diameter than the relief valve outlet size.
Caution: Company's and or individuals filling or refilling LCDSV's shall be responsible for utilizing fill equipment that is acceptable to the manufacturer to prevent over pressurization of the vessel.

c) Isolation Valves – The ~~Inspector shall~~inspection should verify that each LCDSV shall have an isolation valve installed on the fill line and tank discharge, or gas supply line in accordance with the following requirements:

1) Isolation valves shall be located on the tank or at an accessible point as near to the storage tank a possible.
2) All valves shall be designed or marked to indicate clearly whether they are open or closed.
3) All valves shall be capable of being locked or tagged in the closed position for servicing.
4) Gas supply and liquid CO_2 fill valves shall be clearly marked for easy identification.

d) Safety Relief/Vent Lines – The ~~Inspector~~inspection, where possible, ~~shall~~ should verify the integrity of the pressure relief/vent line from the pressure relief valve to outside vent line discharge fitting. All connections shall be securely fastened to the LCDSV. The minimum size and length of the lines shall be in accordance with NBIC Part 2, Tables S2 10-a and S2 10-b. Fittings or other connections may result in a localized reduction in diameter have been factored into the lengths given by the NBIC Part 2, Tables S2 10-a and S2 10-b.

~~e) Indicators – The inspection should verify the LCDSV is provided with pressure gauges and liquid level gauges or indicators. Where the filling connection is remote from the storage container, a means shall be provided to determine when the container is filled to its design capacity that is visible from the filling location.~~

Table S10-a Minimum LCDSV System Pressure Relief/Vent Line Requirements (Metallic)

Tank Size
(Pounds)
Fire Flow Rate
Requirements
(Pounds per Minute)
Maximum Length of
3/8 inch ID Nominal
Metallic Tube Allowed
Maximum Length of 1/2
inch ID Nominal
Metallic Tube
Allowed
Less than 500 2.60 maximum 80 feet 100 feet
500-750 3.85 maximum 55 feet 100 feet
Over 750-1000 5.51 maximum 18 feet 100 feet

Table S10-b Minimum LCDSV System Pressure Relief/Vent Line Requirements (Plastic/Polymer)

Tank Size
(Pounds)
Fire Flow Rate
Requirements (Pounds
per Minute)
Maximum Length of
3/8 inch ID
Plastic/Polymer
Materials Tube Allowed
Maximum Length of ½
inch ID Plastic/Polymer
Materials
Tube Allowed
Less than 500 2.60 maximum 100 feet 100 feet
500-750 3.85 maximum 100 feet 100 feet
Over 750-1000 5.51 maximum N/A see ½ inch 100 feet

Table S10-a Metric Minimum LCDSV System Pressure Relief /Vent Line Requirements (Metallic)

Tank Size
(Kilograms)
Fire Flow Rate
Requirements
(Kilograms per Minute)

Maximum Length of
10mm ID Nominal
Metallic Tube Allowed
Maximum Length of
13mm ID Nominal
Metallic Tube Allowed
Less than 227 1.8 maximum 24 m 30.5 m
227-340 1.75 maximum 17 m 30.5 m
340-454 2.50 maximum 5.5 m 30.5 m

Table S10-b Metric Minimum LCDSV System Pressure Relief/Vent Line Requirements (Plastic/Polymer)

Tank size
(kg)
Fire Flow Rate (kg per
Minute)
Maximum Length of 10
mm ID Nominal Metallic
Tube Allowed
Maximum Length of 10
mm ID Plastic/Polymer
Materials Tube Allowed
Less than 227 1.18 maximum 30.5 m 30.5 m
227-340 1.75 maximum 30.5 m 30.5 m
Over 340-454 2.5 maximum N/A see 13 mm 30.5 m
Note: Due to the design of the LCDSV the discharge line may be smaller in diameter than the pressure relief valve outlet size but shall not be smaller than that shown in tables NBIC Part 2, S10-a and S10-b.

NB16-0809D – 7-13-16 - Besserman

1.1 SCOPE

~~This section~~This part ~~provides~~ provides ~~general guidelines and~~ requirements and guidelines for conducting inservice inspection of pressure-retaining items.

~~Appropriately~~This section provides general requirements and guidelines for inservice inspection. ~~, t~~This section includes precautions for the safety of inspection personnel. The safety of the public and the Inspector is the most important aspect of any inspection activity.

2.1 SCOPE

~~a)~~ This section ~~describes~~ provides general and detailed inspection requirements and guidelines for pressure-retaining items to determine corrosion deterioration and possible prevention of failures for boilers, pressure vessels, piping, and pressure relief devices.

~~b)~~ Materials to be inspected shall be suitably prepared so that surface irregularities will not be confused with or mask any defects. Material conditioning such as cleaning, buffing, wire brushing, or grinding may be required by procedure or, if requested, by the Inspector. The Inspector may require insulation or component parts to be removed.

3.1 SCOPE

This section describes damage mechanisms applicable to pressure-retaining items. Further information concerning metallurgical properties of steels and nonferrous alloys are described in ASME Section II, Part D, of the Boiler and Pressure Vessel Code, Non Mandatory Appendix A, titled Metallurgical Phenomena. A damage (or deterioration) mechanism is a process that induces deleterious micro and/or macro material changes over time that are harmful to the material condition or mechanical properties. Damage mechanisms are usually incremental, cumulative and, in some instances, unrecoverable. Common damage mechanisms include corrosion, chemical attack, creep, erosion, fatigue, fracture, and thermal aging.

4.1 SCOPE

This section describes acceptable examination and test methods that are available to the Inspector during inspection of pressure-retaining items. This section also describes evaluation of test results and assessment methodologies.

5.1 SCOPE

This section provides ~~guidelines and requirements~~requirements and guidelines for stamping and documentation (forms) for inservice inspections of PRIs. This section also describes evaluation of inspection results and assessment methodologies.

S1.1 SCOPE

~~This~~ This supplement ~~supplement is provided as a guide~~provides requirements and guidelines for inspection and storage of steam locomotive firetube boilers operating on tracks gaged 24 in (610 mm) or greater or for steam locomotives under the requirements of the Federal Railroad Administration (FRA). These rules shall be used in conjunction with the applicable rules of the NBIC. See NBIC Part 2, Figures S1.1-a and S1.1-b.

S2.1 SCOPE

~~a) This supplement is provided as a~~ This supplement ~~guide~~provides requirements and guidelines ~~to~~ for inspection of historical steam boilers of riveted and/or welded construction not falling under the scope of NBIC Part 2, Supplement 1. These historical steam boilers would include: steam tractors, traction engines, hobby steam boilers, portable steam boilers, certain steam locomotive boilers, and other such boilers that are being preserved, restored, and maintained for demonstration, viewing, or educational purposes. (See Note below)

Note: This supplement is not to be used for steam locomotive boilers operating on tracks gaged 24 in. (610 mm) or greater or for steam locomotive boilers falling under the requirements of the Federal Railroad Administration (FRA). FRA rules for steam locomotive boilers are published in 49 CFR 230. Specific rules and special requirements for inspection, repairs, alterations, and storage of steam locomotive boilers are identified in NBIC Part 2, Supplement 1.

~~b)~~ The rules specified in this supplement shall be used in conjunction with the applicable rules in this code. References specified or contained in this supplement may provide additional information to assist the user when applying the requirements of this supplement.

S3.1 SCOPE

~~a) The purpose of this supplement is~~ This supplement ~~to~~ provides requirements and guidelines for inservice inspection of pressure equipment manufactured from impervious graphite materials.

a~~b~~) The impervious graphite (carbon, graphite, or graphite compound) used for the construction of graphite pressure vessels is a composite material, consisting of “raw” carbon or graphite that is impregnated with a resin using a tightly controlled pressure/heat cycle(s). The interaction between the raw material and the resin is the determining factor when considering the design characteristics of the material. The design characteristics include the strengths (flexural, compressive, and tensile), permeability, co-efficient of thermal expansion, thermal conductivity, and ultimately, the safe operating life of the vessel.

b~~c~~) The process used in the manufacturing of the raw material is well documented. The expertise developed in this field allows for many different grades to be manufactured to meet the specific needs of various industries, including corrosive chemical-processing pressure vessels. In the chemical processing industry the properties of the raw material are dictated by the manufacturer of the impregnated material, based on the pressure/temperature cycle and the type of resin used for impregnation. The raw material requirements are defined and communicated to the manufacturer of the raw material. The cycle and resin type may vary from manufacturer to manufacturer, and also for each “grade” of impregnated material a manufacturer produces.

c~~d~~) After over a century of experience with graphite pressure equipment, the essential variables of the process have been defined and apply universally to all manufacturers of impervious graphite equipment. Therefore, by requiring the essential variables of the resin impregnation cycle to be identified and verified, it is possible to assign a “lot” number to all certified materials at completion of the resin impregnation process. This can be done with the assurance of meaningful and consistent test results.

S4.1 SCOPE

This supplement provides specific requirements and guidelines for inspection of fiber-reinforced thermosetting plastic pressure equipment.

S5.1 SCOPE

~~a) This~~ This supplement ~~supplement describes~~ provides guidelines for the inservice inspection of a Yankee dryer. A Yankee dryer is a pressure vessel with the following characteristics:

a) A Yankee dryer is a rotating steam-pressurized cylindrical vessel commonly used in the paper industry, and is made of cast iron, finished to a high surface quality, and characterized by a center shaft connecting the heads.

b) Yankee dryers are primarily used in the production of tissue-type paper products. When used to produce machine-glazed (MG) paper, the dryer is termed an MG cylinder. A wet paper web is pressed onto the finished dryer surface using one or two pressure (pressing) rolls. Paper is dried through a combination of mechanical dewatering by the pressure roll(s); thermal drying by the pressurized Yankee dryer; and a steam-heated or fuel-fired hood. After drying, the paper web is removed from the dryer.

c) The dryer is typically manufactured in a range of outside diameters from 8 to 23 ft. (2.4 m to 7 m), widths from 8 to 28 ft. (2.4 m to 8.5 m), pressurized and heated with steam up to 160 psi (1,100 kPa), and rotated at speeds up to 7,000 ft./min (2,135 m/min). Typical pressure roll loads against the Yankee dryer are up to 600 pounds per linear inch (105 kN/m). A thermal load results from the drying process due to difference in temperature between internal and external shell surfaces. The dryer has an internal system to remove steam and condensate. These vessels can weigh up to 220 tons (200 tonnes).

d) The typical Yankee dryer is an assembly of several large castings. The shell is normally a gray iron casting, in accordance with ASME designation SA-278. Shells internally may be smooth bore or ribbed. Heads, center shafts, and journals may be gray cast iron, ductile cast iron, or steel.

S6.1 SCOPE

This supplement provides ~~rules~~ requirements and guidelines for continued service inspections of transport tanks, i.e., cargo tanks, rail tanks, portable tanks, and ton tanks that transport dangerous goods as required in the Code of Federal Regulations, Title 49, Parts 100 through 185, and the United Nations Recommendations for Transport of Danger ous Goods-Model Regulations. This supplement, where applicable, shall be used in conjunction with other applicable Parts of the *National Board Inspection Code* (NBIC) and Section XII, *Transport Tanks*, of the *ASME Boiler and Pressure Vessel Code*.

S7.1 SCOPE

This supplement provides requirements and guidelines for the inspection of pressure vessels in liquefied petroleum gas service.

a) Containers designed for storing liquefied petroleum gas (LPG) can be stationary or can be mounted on skids. LPG is generally considered to be non-corrosive to the interior of the vessel. ~~NBIC Part 2, Supplement 7 is provided for~~ This supplement provides ~~guidance~~ guidelines of a general nature for the owner, user, or jurisdictional authority. There may be occasions where more detailed procedures will be required such as changing from one service to another (e.g., above ground to underground; or containers that are commercially refurbished).

b) The application of this supplement to underground containers will only be necessary when evidence of structural damage to the vessel has been observed, leakage has been determined, or the tank has been dug up, and is to be reinstalled. Special consideration will be given to containers that are going to be commercially refurbished (see NBIC Part 2, S7.9).

S8.1 SCOPE

This supplement provides guidelines for determining the pressure differential between the pressure relief valve setting and the boiler or pressure vessel operating pressure. 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 closed 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.

S9.1 SCOPE

This supplement provides requirements and guidelines to be followed when a change of service or service type is made to a pressure-retaining item. Whenever there is a change of service, the jurisdiction where the pressure-retaining item is to be operated shall be notified for acceptance. Any specific jurisdictional requirements shall be met.

S10.1 SCO PE

This supplement provides specific requirements and guidelines for inspection of high-pressure composite pressure vessels, hereafter referred to as vessels. This supplement is applicable to pressure vessels with a design pressure that exceeds 3,000 psi (21 MPa) but not greater than 15,000 psi (103 MPa), and is applicable to the following four types of pressure vessels:

a) Metallic vessel with a hoop Fiber Reinforced Plastic (FRP) wrap over the straight shell cylindrical part of the vessel (both load sharing).

b) Fully wrapped FRP vessel with a non-load sharing metallic liner.

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

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

This supplement is intended for inspection of ASME Section X, Class III, vessels and ASME Section VIII, Division 3, Composite Reinforced Pressure Vessels (CRPVs). However, it may be used for inspection of similar vessels manufactured to other construction codes with approval of the jurisdiction in which the vessels are installed.

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PART 2, SECTION 3
INSPECTION — CORROSION AND FAILURE MECHANISMS

3.1 SCOPE

This section describes damage mechanisms applicable to pressure-retaining items. Further information concerning metallurgical properties of steels and nonferrous alloys are described in ASME Section II, Part D, of the Boiler and Pressure Vessel Code, Non Mandatory Appendix A~~, titled *Metallurgical Phenomena*~~.