THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

Date Distributed: June 27, 2023

NATIONAL BOARD INSPECTION CODE SUBCOMMITTEE INSPECTION

AGENDA

Meeting of July 12th, 2023
St. Louis, MO

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

1. **Call to Order**
   The Chair will call the meeting to order at 8:00 a.m. Central Tim. For those attending in person, the meeting will be held in Cardinal C at the hotel.

2. **Introduction of Members and Visitors**

3. **Check for a Quorum**

4. **Awards/Special Recognition**

5. **Announcements**
   - The National Board will be hosting a reception on Wednesday evening from 5:30 p.m. to 7:30 p.m. at Sports & Social St. Louis Ballpark Village next to the hotel.
   - The National Board will be hosting breakfast and lunch on Thursday for those attending the Main Committee meeting. Breakfast will be served from 7:00 a.m. to 8:00 a.m. in Cardinal C, and lunch will be served from 11:30 a.m. to 12:30 p.m. in Cardinal C.
   - Meeting schedules, meeting room layouts, and other helpful information can be found on the National Board website under the **Inspection Code** tab → NBIC Meeting Information.
   - Remember to add any attachments that you'd like to show during the meeting (proposals, reference documents, power points, etc.) to the NBIC file share site (nbfileshare.org) **prior to the meeting**.
     - Note that access to the NBIC file share site is limited to committee members only.
     - ALL power point attachments/presentations must be sent to the NBIC Secretary prior to the meeting for approval.
     - Contact Jonathan Ellis (*nbicsecretary@nbbi.org*) for any questions regarding NBIC file share access.
   - When possible, please submit proposals in word format showing "strike through/underline".
   - If you'd like to request a new Interpretation or Action item, this should be done on the National Board Business Center.
     - Anyone, member or not, can request a new item.
   - As a reminder, anyone who would like to become a member of a group or committee:
     - Should attend at least two meetings prior to being put on the agenda for membership consideration. The nominee will be on the agenda for voting during their third meeting.
     - The nominee must submit the formal request along with their resume to the NBIC Secretary **PRIOR TO** the meeting. *nbicsecretary@nbbi.org*
     - If needed, we can also create a ballot for voting on a new member between meetings.
   - Thank you to everyone who registered online for this meeting. The online registration is very helpful for planning our reception, meals, room set up, etc. Please continue to use the online registration for each meeting. If you are here in person, and did not register, please visit the National Board website to register now. Registering will make sure we have an accurate count for the reception, breakfast, and lunch. It is also a good way to make sure we have the most up-to-date contact information.

6. **Adoption of the Agenda**

7. **Approval of the Minutes of the January 11, 2023 Meeting**
   The minutes can be found on the NBIC Committee Information page under the Inspection Code tab on NBBI.org.

8. **Review of Rosters**
   a. **Membership Nominations**
   Mr. Joseph Beauregard (Users) and Mr. Randy Kennedy (Certificate Holders) are interested in becoming members of **Subgroup Inspection**.

   b. **Membership Reappointments**
   - The following **Subgroup** members are up for reappointment: Mr. Brent Ray, Mr. James Roberts, and Mr. Jason Safarz.

   - The following **Subcommittee** members are up for reappointment: Mr. Brent Ray, Mr. James Roberts, and Mr. Jason Safarz.

   c. **Officer Appointments**
   None.

9. **Open Items Related to Inspection**
   a. **PRD**
      i. **Item 23-31 – Testing of liquid service valves to be water or other suitable liquid (new item)**

   b. **R&A**
      i. **Item 21-53** – Post repair inspection of weld repairs to CSEF steels. (P. Gilston as PM)
      ii. **Item 21-67** – Add welding requirements to plugging firetubes. (P. Gilston as PM)

10. **Interpretations**.

Item Number: 22-40	**NBIC Location: Part 2, 4.4.7.2**	**No Attachment**
General Description: Allowable stresses for t(required) calculation **Subgroup:** Inspection **Task Group:** T. Clark (PM), B. Ray, B. Wilson, J. Petersen **Submitted by**: Tom Chen **Explanation of Need:** For the purpose of setting up inspection plans, especially with older equipment, we are calculating t(required) per Part 2, para 4.4.7.2. However, we would like to know if it is permissible to use the higher allowable stresses in later editions of ASME BPV Code.		
January 2023 Meeting Action: Mr. Getter gave a progress report stating a task group was created in the SG meeting.		

11. Action Items

a. TG FRP Items

Item Number: NB16-1402	NBIC Location: Part 2, New Supplement	No Attachment
General Description: Life extension for high pressure FRP vessels above 20 years **Subgroup:** FRP **Task Group:** M. Gorman (PM)		
Update from April 2022 FRP Meeting: Mr. Gorman stated that this proposal has been on hold pending ASME action as well as the gathering of data to help inform the best procedures for life extension. Based on recent ASME Section X discussions and the collection of required data, he is prepared to finalize the proposal for this item. He and the item task group will have a proposal ready to share with the group at the October FRP meeting.		
January 2023 Action: PROGRESS REPORT: Update from Jonathan (January 2023) - The FRP TG is still working on a proposal. The PM was hoping to share some updates during the January meeting, but he is unable to do so for next week. He has a presentation planned for the July 2023 meeting, though. From what I understand, ASME has been doing some work on this subject, and the PM has been waiting for that to help inform the proposal. Their goal is to have things ready in time for the 2025 NBIC edition.		

b. TG Historical Items

There are currently no Historical items open for Part 2.

c. TG Locomotive Items

There are currently no Locomotive items open for Part 2.

d. SG Inspection Items

Item Number: 20-57	NBIC Location: Part 2, 4.4.1 a)	No Attachment
General Description: Evaluate revision to Part 2, 4.4 FFS Scope roles and responsibilities and API 579-1/ASME FFS-1 **Subgroup:** Inspection **Task Group:** M. Horbaczewski (PM) and B. Ray. **Submitted by**: George Galanes **Explanation of Need:** Currently, there is confusion surrounding implementation of FFS for Part 2 inspection activities, where the FFS form is located and Part 3 activities regarding Part 3, 3.3.4.8 because it references Part 2 for FFS. In addition, we need to have a Part 2 Inspection member to be assigned to assist in the development of roles and responsibilities.		
January 2023 Action: PROGRESS REPORT: Mr. Horbaczewski gave a progress report to the SC. He stated he will know by July 2023 if we will move forward with this item or close it.		

Item Number: 21-25	NBIC Location: Part 2	Attachment Page 2

General Description: Autoclave/Quick Opening Device PP

Subgroup: Inspection
Task Group: V. Scarcella (PM), T. Bolden, M. Horbaczewski, J. Peterson, J. Clark, W. Hackworth, M.A. Shah, C. Becker.
Submitted by: Kevin Hawes

Explanation of Need: Upon our AIA (Intact) QRR I produced a Power point presentation on Autoclave inspections. Your NB team leader Gary Scribner suggested I forward this inspection presentation to the NB for review of content as mention of good reference material for next NBIC edition. I have attached a copy of this PP for your considerations.

January 2023 Action:
PROGRESS REPORT: Mr. Newton stated to the SC that this item is being sent out to LB for review and comment to the SG.

Item Number: 21-47	NBIC Location: Part 2, 2.2.4 & 2.2.5	No Attachment

General Description: To provide better guidance as it relates to carbon monoxide

Subgroup: Inspection
Task Group: W. Hackworth (PM), V. Scarcella, D. Buechel, T. Barker, T. Bolden

Explanation of Need: Need to provide more comprehensive items to be reviewed to guide the inspector on carbon monoxide and combustion air.

January 2023 Action:
PROGRESS REPORT: Mr. Hackworth gave a progress report to the SC. He believes the TG will have a proposal for the July 2023 meeting.

Item Number: 22-06	NBIC Location: Part 2, 3.4.9 e)	No Attachment

General Description: Part 2 task group to review Part 3 Item 21-53

Subgroup: Inspection
Task Group: M. Horbaczewski (PM), J. Clark, B. Wilson, J. Mangas, P. Polick **Submitted by:** D. Graf

Explanation of Need: Part 2 task group to investigate further changes to Part 2/Part 3 that could be needed because of action item 21-53.

January 2023 Action:
PROGRESS REPORT: Mr. Horbaczewski gave a progress report stating a task group was created in the SG meeting.

Item Number: 22-22	NBIC Location: Part 2, 4.2	No Attachment

General Description: Changes and additions to align with part III with in service inspections

Subgroup: Inspection
Task Group: T. Bolden (PM), J. Clark, J. Petersen, M. Sansone, B. Ray, D. Graf, and J. Mangas
Submitted By: V. Scarcella

Background Information: Several areas where part III after repair in service inspections should be aligned with part II.

January 2023 Action:
PROGRESS REPORT: Mr. Bolden gave a progress report stating the proposal is being sent out to LB for review and comment to the SG.

Item Number: 22-26	NBIC Location: Part 2, 2.3.6.8	No Attachment

General Description: Addition of cast acrylic as a pressure vessel material

Subgroup: Inspection
Task Group: J. Calvert (PM), V. Newton, D. Buechel, D. Rose
Submitted by: J. Calvert

Explanation of Need: Provide inspectors with the criteria necessary to competently inspect vessels like acrylic chromatography columns.

January 2023 Meeting Action:
Mr. Calvert gave a progress report stating a task group was created during the SG meeting and they will have a lot of work to do to before creating a proposal.

Item Number: 22-39	NBIC Location: Part 2, 4.4.8.7 g)	No Attachment

General Description: Recommended clarification of requirements for Evaluating Local Thin Areas

Subgroup: Inspection
Task Group: V. Newton (PM), T. Barker
Submitted by: L. Ponce

Explanation of Need: The existing text may lead to confusion due to a misplaced comma after 'specified' in the first sentence and no reference to what is being specified in the paragraph. The proposed text is a way to tie in the specified requirement in paragraph (f).

January 2023 Meeting Action:
Mr. Newton gave a progress report to the SC stating a TG was created during the SG meeting.

Item Number: 23-08	NBIC Location: Part 2	No Attachment

General Description: Part 2 task group to review Part 3 Item 21-67

Subgroup: Inspection
Task Group: M. Horbaczewski (PM), J. Clark, B. Wilson, J. Mangas, P. Polick
Submitted by: D. Graf

Explanation of Need: Part 2 task group to investigate further changes to Part 2/Part 3 that could be needed because of action item 21-67.

January 2023 Meeting Action:
Mr. Horbaczewski gave a progress report stating a task group was created in the SG meeting.

12. New Items

Item Number: 23-16	NBIC Location: Part 2	No Attachment
General Description: Part III is adding requirements for inservice inspectors for repair F/U **Subgroup:** Inspection **Task Group:** None assigned. **Submitted by:** V. Scarcella **Explanation of Need:** Part III has items pending for mechanical repairs and post repair work inspections and the SG needs to make sure we have adequate instructions for the inspector.		
July 2023 Meeting Action:		

Item Number: 23-17	NBIC Location: Part 2, 2.3.6.4 and 4.4.8.7	Attachment Page 5
General Description: Steel-loss acceptance criteria for pressure-retaining items **Subgroup:** Inspection **Task Group:** None assigned. **Submitted by:** J. Hadley **Explanation of Need:** (1) Resolve inconsistencies between the 2021 NBIC's air, ammonia, LPG, and general acceptance criteria. (2) Provide screening criteria that, if met, would ensure that a pressure-retaining item also meets the conservative criteria in API 579-1/ASME FFS-1, Fitness-For-Service, 2021 edition, "ASME FFS-1", Part 3 Level 1 (brittle fracture) and either Part 4 Level 2 or Part 5 Level 1 (wall thinning). If not met, an owner/user could fall back on more complex, less conservative, ASME FFS-1 assessments. (3) Describe steel-loss screening criteria in one location within NBIC, and reference this location when needed, to facilitate future revisions. (4) Coordinate NBIC with ASME FFS-1. They have been referencing each other for some years, so coordinating them seems worthwhile.		
July 2023 Meeting Action:		

Item Number: 23-19	NBIC Location: Part 2, S6.13.6	Attachment Page 28
General Description: DOT Transport Tank Pressure Testing (Part 2, Supplement 6) **Subgroup:** Inspection **Task Group:** None assigned. **Submitted by:** R. Underwood **Explanation of Need:** The table in 49CFR180.407(g)(1)(iv) appears to have been revised at some point to add “The test pressure on the nameplate or specification plate” to the beginning of each specification pressure test requirement. Table S6.13.6 needs to be revised to reflect the current DOT requirements.		
July 2023 Meeting Action:		

Item Number: 23-26	NBIC Location: Part 2	No Attachment

General Description: Adding verbiage in Part 2 to mention a time limit on tube plugs in vessels

Subgroup: Inspection
Task Group: None assigned.
Submitted by: K. Moore

Explanation of Need: Part 3 is currently revamping 3.3.4.9. We feel like there should be a statement in the NBIC that the Chief or the in-service Inspector can address the operational issues and concerns of plugged tubes.

July 2023 Meeting Action:

Item Number: 23-27	NBIC Location: Part 2, 1.5.1	Attachment Page 30

General Description: Addition of requirement for Inspector to be present for inspections.

Subgroup: Inspection
Task Group: None assigned.
Submitted by: D. Kinney

Explanation of Need: While it has always been standard industry practice for inspections to be performed in-person, and there are requirements for remote inspection, currently there is no language in Part 2 or RCI-1 requiring the Inspector to be present at the location of installation while performing an inspection. This requirement is implied, but not stated.

July 2023 Meeting Action:

Item Number: 23-28	NBIC Location: Part 2, 5.3.3	No Attachment

General Description: Revision to NB-136

Subgroup: Inspection
Task Group: None assigned.
Submitted by: D. Kinney

Explanation of Need: For Line #3, "R" should be added, and should match Line #13.
For Line #13, when filling out the form, there is confusion between Owner or User, and Owner-User. These are two different terms defined in the NBIC. I believe the intention is to use "Owner or User" and not "Owner-User, and this should be clarified on the form.

July 2023 Meeting Action:

Item Number: 23-30	NBIC Location: Part 2, S7. 10 and Table S9.4	No Attachment

General Description: References to change of service for LPG vessels incorrectly use "altered"

Subgroup: Inspection
Task Group: None assigned.
Submitted by: T. Vandini

Explanation of Need: Conversion of service for LPG tanks (typically from above ground to underground service) typically involves changes to the vessel covered under Part 3, Paragraph 3.3.3 and, as such, are considered repairs. As such, the language referring to these conversions that uses the word "altered" or "alteration" may be confusing to an inspector or other user of NBIC. I suggest changing the word "altered" to "converted" and removing the specific reference to "alterations".

July 2023 Meeting Action:

Item Number: 23-37	NBIC Location: Part 2, 1.4	Attachment Page 31

General Description: Add comment to further define responsibility of the owner user

Subgroup: Inspection
Task Group: None assigned.
Submitted by: V. Scarcella

Explanation of Need: Specifically, if the inspector is going to a location where for instance H2S of some harmful pathogen is being handled, those locations have and should provide safety training and equipment needed to complete the inspection. For internals this is already touched on in 1.5.3. "Requirements of occupational safety and health regulations (i.e., federal, state, local, or other), as well as the owner-user's own program and the safety program of the Inspector's employer are applicable."

July 2023 Meeting Action:

Item Number: 23-42	NBIC Location: Part 2, 1.4 a)	No Attachment

General Description: Change for consistency

Subgroup: Inspection
Task Group: None assigned.
Submitted by: L. Ponce

Explanation of Need: Inconsistencies add confusion and increase liabilities of all parties.

July 2023 Meeting Action:

13. Future Meetings

- January 8-11, 2024 – Charlotte, NC
- July 2024 – TBD

14. Adjournment

Respectfully submitted,

Jodi Metzmaier
Subcommittee Inspection Secretary

Subcommittee Inspection

Last Name	First Name	Interest Category	Role	Exp. Date	More
Getter	Jim	Manufacturers	Chair	07/30/2024	Details
Horbaczewski	Mark	Users	Vice Chair	07/30/2024	Details
Metzmaier	Jodi		Secretary	01/30/2099	Details
Barker	Timothy	Authorized Inspection Agencies	Member	01/30/2024	Details
Becker	Chuck	National Board Certificate Holders	Member	01/29/2026	Details
Brantley	Ernest	Authorized Inspection Agencies	Member	01/30/2025	Details
Buechel	David	Authorized Inspection Agencies	Member	07/30/2025	Details
Burton	Damon	National Board Certificate Holders	Member	01/30/2026	Details
Calvert	James	National Board Certificate Holders	Member	07/30/2024	Details
Clark	James	Manufacturers	Member	07/30/2025	Details
Graf	Darrell	National Board Certificate Holders	Member	01/30/2026	Details
Hackworth	William	Authorized Inspection Agencies	Member	07/30/2024	Details
Jessick	Jerry	Users	Member	07/30/2024	Details
Mangas	John	General Interest	Member	07/30/2024	Details
Morgan	Joseph	Users	Member	07/30/2024	Details
Newton	Venus	Authorized Inspection Agencies	Member	01/30/2025	Details
Petersen	Jeffrey	Users	Member	01/30/2026	Details
Polick	Patrick	Jurisdictional Authorities	Member	07/30/2025	Details
Ray	Brent	Users	Member	07/30/2023	Details
Roberts	James	Manufacturers	Member	08/30/2023	Details
Rose	David	Users	Member	07/30/2025	Details
Safarz	Jason	General Interest	Member	07/30/2023	Details
Sansone	Matthew	Jurisdictional Authorities	Member	01/30/2024	Details
Scarcella	Vincent	Authorized Inspection Agencies	Member	01/30/2026	Details
Vandini	Thomas	Manufacturers	Member	01/30/2026	Details

Item 21-25
Scarcella
June 8, 2023

2.3.6.5 INSPECTION OF PRESSURE VESSELS WITH QUICK-ACTUATING CLOSURES

~~a)~~ This section describes guidelines for inspection of pressure vessels equipped with quick-actuating closures. Pressure vessels with less than five cubic feet of volume and a design pressure less than 50 psi are excluded from the requirements of this section. ~~Due to the many different designs of quick-actuating closures, potential failures of components that are not specifically covered should be considered. The scope of inspection should include areas affected by abuse or lack of maintenance and a check for inoperable or bypassed safety and warning devices.~~ Pressure vessels with quick actuating closures have a higher likelihood of personnel being in close proximity of the vessel during opening.

a. Accidents have occurred when gaskets became stuck and released suddenly when pried open. Wear and fatigue damage caused by the repetitive actuation of the mechanism and pressure cycles are also a source of accidents.

b) ~~Temperatures above that for which the quick actuating closure was designed can have an adverse effect on the safe operation of the device. If parts are found damaged and excessive temperatures are suspected as the cause, the operating temperatures may have exceeded those temperatures recommended by the manufacturer.~~ Rapid fluctuations in temperatures due to rapid start-up and shutdown may lead to cracks or yielding caused by excessive warping and high thermal stress. An ~~careful observation~~ inspection ~~should~~ shall be made of the condition of the complete installation~~,~~. Review shall ~~including~~ include maintenance, ~~and~~training, operation, and non-destructive examination records. This review shall serve as a guide ~~in forming an opinion of~~ for evaluating the care the equipment receives. The construction history of the vessel should be established, including~~:~~ year built, materials of construction, extent of postweld heat treatment, previous inspection results, and repairs or alterations performed. Any leak should be thoroughly investigated and the necessary corrective action ~~initiated~~taken by an "R" Certificate Holder.

1) Inspection of parts and appurtenances

The owner user shall adhere to the items below, and the items shall be verified by the inspector if applicable.

a. Seating surfaces of the closure device, including but not limited to the gaskets, O-rings, or any mechanical appurtenance, shall be inspected to ensure proper alignment. ~~of the closure to the seating surface, should be inspected. This inspection can be made by using powdered chalk or any substance that will indicate that the closure is properly striking the seating surface of the vessel flange. If this method is used, a check should be made to ensure that:~~

~~1. Material used shall not contaminate the gasket or material with which it comes into contact; and~~
~~2. The substance used shall be completely removed after the examination.~~

b. The closure mechanism of the device ~~should~~ shall be inspected for freedom of movement and proper contact with the locking elements. This inspection should indicate that the movable portions of the locking mechanism are striking the locking element in such a manner that full stroke can be obtained. Inspection should be made to ensure that the seating surface of the locking mechanism is free of metal burrs and deep scars, which would indicate misalignment or improper operation. A check should be made for proper alignment of the door hinge mechanisms to ensure that adjustment screws and locking nuts are properly secured.

c. When deficiencies are noted, the following corrective actions ~~should~~ shall be initiated:

Commented [JM1]: Can this sentence be changed? Since it is straight out of SECTION VIII, I wasn't sure if we could change it. I think the word "because" should be removed.

Also is this paragraph supposed to be "a."?

a. Accidents have occurred when gaskets became stuck and released suddenly when pried open.

Commented [JCP2R1]: I think the word BECAUSE could be removed.

Commented [JM3]: Editorial - I believe the colon can be removed here.

Commented [JCP4R3]: I agree

Commented [JM5]: I changed this to Certificate Holder

Commented [JCP6R5]: Ok Looks good.

1. If any ~~deterioration~~ defect of the gasket, O-ring, etc., is found, the gasket, O-ring, etc., ~~should~~ shall be removed from service and replaced immediately. Replacements ~~should~~ shall be in accordance with the vessel manufacturer's specifications;
2. If any cracking or excessive wear is discovered on the closing mechanism, the owner or user ~~should~~ shall contact the original manufacturer of the device for spare parts or repair information. If this cannot be accomplished, the owner or user should contact an organization competent in quick-actuating closure design and construction prior to implementing any repairs;
3. Defective safety or warning devices ~~should~~ shall be repaired or replaced prior to further operation of the vessel;
4. Deflections, wear, or warping of the sealing surfaces may cause out-of-roundness and misalignment. The manufacturer of the closure ~~should~~ shall be contacted for acceptable tolerances for out-of-roundness and deflection; and
5. The operation of the closure device through its normal operating cycle should be observed while under control of the operator. ~~This should indicate if the operator is following posted procedures and if the operating procedures for the vessel are adequate~~.

Commented [JCP7]: Jodi: This needs to be added back to this paragraph. Venus lined this out, but I think the working group wanted it left in.

2) Gages, safety devices, and controls

The owner user shall adhere to the items below, and the items shall be verified by the inspector as applicable.

~~a. The required pressure gage should be installed so that it is visible from the operating area located in such a way that the operator can accurately determine the pressure in the vessel while it is in operation. The gage dial size should be of such a diameter that it can be easily read by the operator. This gage should have a pressure range of at least 1 1/2 times, but not more than four times, the operating pressure of the vessel. There should be no intervening valve between the vessel and gage.~~

~~b.~~a. The pressure gage should be of a type that will give accurate readings, especially when there is a rapid change in pressure. It should be of rugged construction and capable of withstanding severe service conditions. Where necessary, the gage should be protected by a siphon or trap.

~~c.~~b. Pressure gages intended to measure the operating pressure in the vessel are not usually sensitive or easily read at low pressures approaching atmospheric. It may be advisable to install an auxiliary gage that reads inches of water (mm of mercury) and is intended to measure pressure from atmospheric through low pressures. This ensures that there is zero pressure in the vessel before opening. It would be necessary to protect the auxiliary ~~low-pressure~~low-pressure gage from the higher operating pressures.

~~d.~~c. Provisions should be made to calibrate pressure gages or to have them checked against a master gage as frequently as necessary.

~~e.~~d. A check should be made to ensure that the closure and its holding elements must be fully engaged in their intended operating position before pressure can be applied to the vessel. A safety interlock device ~~should~~ shall be provided that prevents the opening mechanism from operating unless the vessel is completely depressurized.

~~f.~~e. Quick-actuating closures held in position by manually operated locking devices or mechanisms, and which are subject to leakage of the vessel contents prior to disengagement of the locking elements and release of the closure, shall be provided with an audible and/or visible warning device to warn the operator if pressure is applied to the vessel before the closure and its holding elements are fully engaged, and to warn the operator if an attempt is made to operate the locking device before the pressure within the vessel is released. Pressure tending to force the closure clear of the vessel must be released before the closure can be opened for access.

3. A Risk Based Inspection Assessment (RBIA) program, managed by the owner/user, shall be developed by a professional familiar with the design and applications of quick actuating closures. See NBIC Part 2, Section 4. The RBIA shall be made available for review by the inspector.

January 17, 2023

TO: NBIC Secretary <nbicsecretary@nationalboard.org>
COPY: Luis Ponce <LPonce@nationalboard.org>
Jonathan Ellis <JEllis@nationalboard.org>

RE: NBIC Part 2 code-change request
Steel-loss acceptance criteria for pressure-retaining items

Dear NBIC Secretary,

Please consider the code-change request below.

Existing and Proposed Text
See strikeout and red text on the markup of the 2021 NBIC Part 2 attached to this letter, on pages: 2, 27, 30, 31, 65, 70, 72, 73, 74, 75 (and the next five new pages with the proposed section 4.4.9), 237, 291, 292, 293, 299, and 323.

No markup was made to Supplement 2, Historical Boilers, due to their unique requirements. Perhaps an optional reference to the proposed section 4.4.9 could be added.

Statement of Need

(1) Resolve inconsistencies between the 2021 NBIC's air, ammonia, LPG, and general acceptance criteria. See file (attached to the email that transmitted this letter):
Acceptance_criteria_in_2021_NBIC_Part_2_air_ammonia_LPG_comparison_2022-11-10.xls

(2) Provide screening criteria that, if met, would ensure that a pressure-retaining item also meets the conservative criteria in API 579-1/ASME FFS-1, Fitness-For-Service, 2021 edition, "ASME FFS-1", Part 3 Level 1 (brittle fracture) and either Part 4 Level 2 or Part 5 Level 1 (wall thinning). If not met, an owner/user could fall back on more complex, less conservative, ASME FFS-1 assessments.

(3) Describe steel-loss screening criteria in one location within NBIC, and reference this location when needed, to facilitate future revisions.

(4) Coordinate NBIC with ASME FFS-1. They have been referencing each other for some years, so coordinating them seems worthwhile.

Background Information

The proposed acceptance criteria simplify several 2021 NBIC Part 2 sections by dropping the critical-plane analysis with a 10-inch or longer thickness-averaging length. The thickness-averaging method in ASME FFS-1 has detailed figures for numerous types of components and requires math usually solved with computers, which typically results in an averaging length less than 10-inches for up to 120-inch diameter vessels, depending on the steel loss (shorter averaging length if more steel loss). The conservative screening in the proposed new NBIC Part 2, section 4.4.9, can be done without any critical-plane thickness-averaging effort.

I'd be happy to attend a committee meeting to present this request, either in person or via video call.

Sincerely,

James D. Hadley, P.E.
Member ACS, AIChE, ASCE, ASME

d) American Society of Mechanical Engineers- *ASME Boiler and Pressure Vessel Code Section VII* (Recommended Guidelines for the Care of Power Boilers)

e) American Society of Mechanical Engineers -*ASME B31G* (Manual for Determining the Remaining Strength of Corroded Pipelines)

f) American Society of Mechanical Engineers - *ASME PCC-1* (Guidelines for Pressure Boundary Bolted Joint Assembly)

g) American Society of Mechanical Engineers - *ASME PCC-2* (Repair of Pressure Equipment and Piping)

h) American Society of Mechanical Engineers - *ASME CRTD Volume 41,* (Risk-Based Inspection for Equipment Life Management: An Application Handbook)

i) American Petroleum Institute/American Society of Mechanical Engineers - *API 579-1/ASME FFS-1* (Fitness-For-Service)

j) American Petroleum Institute – *API-510* (Pressure Vessel Inspection Code: In-service Inspection, Rating, Repair and Alteration)

k) American Petroleum Institute - *API 570* (Piping Inspection Code: In-Service Inspection, Rating, Repair and Alteration of Piping Systems)

l) American Petroleum Institute - *API 572* (Inspection of Pressure Vessels)

m) American Petroleum Institute - (Inspection Practices for Piping System Components)

n) American Petroleum Institute - *API 576* (Inspection of Pressure-Relieving Devices)

o) American Petroleum Institute - *Recommended Practice 580* (Risk Based Inspection)

p) American Petroleum Institute - *Recommended Practice* 581 (Base Resource Document on Risk-Based Inspection)

q) Institute of Petroleum - *Model Code of Safe Practice in the Petroleum Industry Part 12 ,* Pressure Vessel Examination

r) Institute of Petroleum - *Model Code of Safe Practice in the Petroleum Industry Part 13,* (Pressure Piping Systems Examination)

s) Australian Standard - *AS 1210* (Unfired Pressure Vessel Code)

t) Australian Standard - *AS 4343* (Pressure Equipment - Hazard Levels)

u) Alberta Boilers Safety Association - *AB-506* (Pressure Equipment Inspection and Servicing Requirements)

1.4 PERSONNEL SAFETY

a) Personnel safety is the joint responsibility of the owner or user and the Inspector. All applicable safety regulations shall be followed. This includes federal, state, regional, and/or local rules and regulations. owner or user programs, safety programs of the Inspector's employer, or similar standards also apply. In the absence of such rules, prudent and generally accepted engineering safety procedures satisfactory to the Inspector shall be employed by the owner or user.

b) Inspectors are cautioned that the operation of safety devices involves the discharge of fluids, gases, or vapors. Extreme caution should be used when working around these devices due to hazards to

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. See NBIC Part 2, 4.4.9.

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 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 an “R” stamp holder.

3. The vessel shall be removed from service until it can be de-rated to a lower MAWP subject to review and approval by the Jurisdiction.

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.

2.3.6.3 EXPANSION TANKS

a) The purpose of an expansion tank is to provide an air cushion to a system that will allow for expansion and contraction, thus minimizing fluctuations in pressure due to temperature variances. These vessels are susceptible to corrosion due to the air and water interface.

b) Inspection shall consist of the following:

1) Design/operation — Verify from the nameplate the code of construction, temperature, and pressure ratings to ensure jurisdictional and system compatibility. It is common to find expansion tanks water logged due to leakage of air out of the tank; therefore, it is important to verify the water level either

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.

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

f) Acceptance criteria

The following are the acceptance criteria for liquid ammonia vessels. Vessels showing indications or imperfections exceeding the conditions noted below are considered unacceptable.

1) Cracks

Cracks in the pressure vessel boundary (e.g., heads, shells, welds) are unacceptable. When a crack is identified, the vessel shall be removed from service until the crack is repaired by an "R" Stamp holder or the vessel permanently removed from service. (See NBIC Part 3, *Repairs and Alterations*.) See also NBIC Part 2, 4.4.9.a.3.

2) Dents

When dents are identified that exceed the limits set forth below, the vessel shall be removed from service until the dents are repaired by an "R" Stamp holder, a fitness for service analysis is performed, or the vessel permanently retired from service.
See also NBIC Part 2, 4.4.9.a.8.

a. Dents in Shells

The maximum mean dent diameter in shells shall not exceed 10% of the shell diameter, and the maximum depth of the dent shall not exceed 10% 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, as shown in b. below.

b. Dents in 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. Dents in Heads

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.

3) Bulges

When bulges are identified that exceed the limits set forth below, the vessel shall be removed from service until the bulges are repaired by an “R” Stamp holder or a fitness for service analysis is performed, the vessel may also be permanently retired from service.

a. Bulges in Shells

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

Bulges

b. ~~Dents~~ in Heads

If a bulge is suspected, the radius of the 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.

See also NBIC Part 2, 4.4.9.a.4.

4) Cuts or Gouges

When a cut or gouge exceeds 25% of the thickness of the vessel, the vessel shall be removed from service until it is repaired by an “R” Stamp Holder or a fitness-for-service analysis is performed. The vessel may also be permanently retired from service. See also NBIC Part 2, 4.4.9.a.8.

5) Corrosion. See NBIC Part 2, 4.4.9.

~~a. For line or crevice corrosion, the depth of the corrosion shall not exceed 25% of the original wall thickness.~~

~~b. 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).~~

~~c. 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. 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 an “R” Stamp holder or a fitness-for-service analysis is performed, or the vessel may be permanently retired from service.~~

2.3.6.5 INSPECTION OF PRESSURE VESSELS WITH QUICK-ACTUATING CLOSURES

a) This section describes guidelines for inspection of pressure vessels equipped with quick-actuating closures. Due to the many different designs of quick-actuating closures, potential failures of components that are not specifically covered should be considered. The scope of inspection should include areas affected by abuse or lack of maintenance and a check for inoperable or bypassed safety and warning devices.

, such as API 579-1/ASME FFS-1

b) Various assessment methods (see NBIC Part 2, 1.3), including those mentioned in this section ~~(an example of guidelines for performing fitness for service assessments are referenced in API recommended practice API-579 "Fitness-for-Service")~~, can be used to establish the next inspection interval of a pressure-retaining item and to ensure safe operation. Condition assessment methods shall be subject to review and acceptance by the Jurisdiction.

c) Safe and adequate implementation of Fitness for Service Assessment (FFSA) programs is the responsibility of the owner or user. Responsibility includes verifying and understanding jurisdictional rules/regulations and inservice inspection requirements. Application of these programs may result in decisions that will deviate from or conflict with jurisdictional requirements (e.g., frequency or types of inspections, repairs and alterations, etc.). The Inspector and Jurisdiction shall be contacted for acceptance, as appropriate, prior to implementing decisions that deviate from or conflict with established requirements.

d) If required by the Jurisdiction, FFSA shall be documented on a Report of FFSA Form NB-403, as shown in NBIC Part 2, 5.3.7. Preparation of the Report of FFSA shall be the responsibility of the owner or user. An Inspector shall indicate acceptance by signing the Report of FFSA. Legible copies of the FFSA report shall be distributed to the Jurisdiction, and the Authorized Inspection Agency responsible for the inservice inspection. The owner or user shall maintain a copy of the FFSA report in the relevant equipment inspection history file.

4.4.2 GENERAL REQUIREMENTS

a) Organizations or qualified individuals with experience in inspection, design, construction, repairs, or failure analysis of pressure-retaining items should be consulted to assist in identifying damage mechanisms, and to evaluate condition assessment results of pressure-retaining items. Documentation and inspection data used for fitness for service assessment should be evaluated for compliance, with codes, industry standards/experience or good engineering practices, and shall be acceptable to the Jurisdiction. Understanding the operation of equipment or systems and interaction with their internal or external service environment is necessary to correctly identify damage mechanisms.

b) There are various condition assessment and fitness for service methods that can be used to determine inspection intervals, based on calculating the remaining service life of the pressure-retaining item. For items subject to corrosion or erosion, the method to determine or adjust inspection intervals is identified in NBIC Part 2, 4.4.7. Methods for assessing other types of inservice damage that affect remaining service life of pressure-retaining items are identified in NBIC Part 2, 4.4.8.

4.4.3 RESPONSIBILITIES

a) Owner or User

The owner or user of the pressure-retaining item is responsible for the selection and application of a suitable fitness for service or condition assessment methodology described in this section, subject to review and approval by the Jurisdiction, if required.

b) Inspector

The Inspector shall review the condition assessment methodology and ensure inspection data and documentation are in accordance with this section.

4.4.4 REMAINING SERVICE LIFE ASSESSMENT METHODOLOGY

a) An evaluation of inservice damage using one or more condition assessment methods is not intended to provide a precise determination of the actual time to failure for a pressure-retaining item. Instead, the extent of inservice damage should be estimated based on the quality of available information,

h) Circumferential Stresses After General Corrosion. See NBIC Part 2, 4.4.9.

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

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

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

i) Longitudinal Stresses After General Corrosion. See NBIC Part 2, 4.4.9.

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

j) Local Metal Loss

Corrosion pitting shall be evaluated in accordance with NBIC Part 2, 4.4.8.7 and 4.4.9. ~~Widely scattered corrosion pits may be left in the pressure-retaining item in accordance with the following requirements:~~

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

~~2) The total area of the pits does not exceed 7 sq. in. (4,500 sq mm) within any 50 sq. inches (32,000 sq. mm); and~~

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

k) Weld Joint Efficiency Factor

When the surface at a weld having a joint efficiency factor of other than one is corroded as well as surfaces remote from the weld, an independent calculation using the appropriate weld joint efficiency factor shall be made to determine if the thickness at the weld or remote from the weld governs the maximum allowable working pressure. For the purpose of this calculation, the surface at a weld includes 1 in. (25 mm) on either side of the weld, or two times the minimum thickness on either side of the weld, whichever is greater.

l) Formed Heads

1) When evaluating the remaining service life for ellipsoidal, hemispherical, torispherical or toriconical shaped heads, the minimum thickness may be calculated by:

   a. Formulas used in original construction; or

   b. Where the head contains more than one radii of curvature, the appropriate strength formula for a given radius.

2) When either integral or non-integral attachments exist in the area of a knuckle radius, the fatigue and strain effects that these attachments create shall also be considered.

measured in situ using ultrasonic techniques;

3) Metallographic examination to determine the extent of exposure to creep damage; and

4) After removal of a material sample for creep rupture testing, a test matrix is selected to yield the most meaningful results from the sample. Test specimens are machined from the sample and tested under representative loads and temperatures (as selected in the test matrix). Creep strain vs. time and temperature vs. time to rupture data are recorded.

See also NBIC Part 2, 4.4.9.a.5.

TABLE 4.4.8.1

TEMPERATURES ABOVE WHICH CREEP BECOMES A CONSIDERATION

Carbon steel and C-1/2 Mo and ferritic stainless steels	750°F (400°C)
Low alloy steels (Cr-Mo)	850°F (455°C)
Austenitic stainless Steel	950°F (510°C)
Aluminum alloys	200°F (93°C)

4.4.8.2 EXPOSURE TO BRITTLE FRACTURE

a) Determining susceptibility to brittle fracture should be required as part of the overall assessment for evaluating remaining service life or to avoid failure of the pressure-retaining item during a pressure test. In order to carry out brittle fracture assessment, mechanical design information, materials of construction and materials properties are to be determined. This information is required for pressure-retaining components in order to identify the most limiting component material that governs brittle fracture. Design information, maintenance/operating history, and information relating to environmental exposure shall be evaluated to determine if there is a risk of brittle fracture.

b) When brittle fracture is a concern, methods to prevent this failure shall be taken. These methods could include changes to operating conditions and further engineering evaluations to be performed by a qualified engineer (metallurgical/corrosion/mechanical). Engineering evaluation methods to prevent brittle fracture shall be reviewed and accepted by the owner or user, Inspector, and Jurisdiction, as required.

See also NBIC Part 2, 4.4.9.c.1.

4.4.8.3 EVALUATING CONDITIONS THAT CAUSE BULGES/BLISTERS/LAMINATIONS

a) Blistering in pressure-retaining items can result from laminations, inclusions in the metal, or damage mechanisms that occur in service. Procedures for evaluating bulges/blisters/laminations are referenced in applicable standards (see NBIC Part 2, 1.3).

b) An engineering evaluation shall be performed to ensure continued safe operation when bulges/blisters/laminations are identified. If a bulge/blister/lamination is within the specified corrosion allowance, further assessment shall be performed to evaluate any crack-like indications in surrounding base material.

Note: Proximity of crack-like indications in welds and HAZ is important. Cracks and blisters should be evaluated separately.

See also NBIC Part 2, 4.4.9.a.3, 4.4.9.a.4, and 4.4.9.a.9.

4.4.8.4 EVALUATING CRACK-LIKE INDICATIONS IN PRESSURE-RETAINING ITEMS

a) Crack-like indications in pressure-retaining items are planar flaws characterized by length and depth with a sharp root radius. Cracks may occur within material or on the surface and may be individual or multiple in nature. In some cases, a conservative approach is to treat aligned porosity, inclusions, undercuts, and overlaps as crack-like indications. It is important that the cause of cracking be identified prior to any further determination of inspection intervals.

b) If crack-like indications are on the surface and within the specified corrosion allowance, removal by blend grinding or air arc gouging can be performed. Measurements shall be taken to ensure minimum thickness is met, and effective monitoring techniques should be established. If a crack-like flaw is not completely removed and repaired, then an engineering fracture mechanics or other evaluation must be performed to verify continued safe operation.

c) There are various methods or approaches for evaluating crack-like indications, some of which are referenced in applicable standards (see NBIC Part 2, 1.3).

See also NBIC Part 2, 4.4.9.a.3.

4.4.8.5 EVALUATING EXPOSURE OF A PRESSURE-RETAINING ITEM TO FIRE DAMAGE

a) The extreme heat of a fire can produce visual structural damage and less apparent degradation of mechanical properties (decrease in yield strength or fracture toughness). Potential damage includes changes in mechanical properties, decrease in corrosion resistance, distortion, and cracking of pressure boundary components. Distortion of equipment extremities such as ladders and platforms does not necessarily mean that the pressure equipment is no longer suitable for continued service. Process fluid inside the vessel may serve as a cooling medium, thus preserving mechanical properties of the equipment. Instrumentation and wiring are commonly damaged during a fire. Data requirements and history information should be obtained as identified in NBIC Part 2, 4.4.5.

b) Recommended measurements and collection of data for evaluation of fire damage shall include but are not limited to:

1) Concentrated areas of fire damage versus overall fire damage as it relates to normal operation;

2) Determination of cause and origin of fire;

3) Temperature extremes;

4) Nature of the fuel;

5) Source of ignition;

6) Time at temperature;

7) Cooling rate;

8) Photographs taken;

9) Plant personnel interviewed; and

10) Actual strength and toughness properties of the material.

Note: It is important that evidence be maintained in order to perform a proper evaluation.

c) Components subjected to fire damage can exhibit altered mechanical properties, and should be evaluated to determine if the material has retained necessary strength and toughness as specified in the original code of construction. Heating above the lower critical temperature results in a phase transformation that, upon rapid cooling, can dramatically affect material properties. Evaluation methods may consist of:

1) Portable hardness testing;

2) Field metallography or replication;

3) Liquid pressure testing;

4) Magnetic particle testing;

5) Liquid penetrant testing;

6) Visual examination; or

7) Dimensional verification checks.

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

See NBIC Part 2, 4.4.9.a.7.

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

4.4.8.6 EVALUATING EXPOSURE OF PRESSURE-RETAINING ITEMS TO CYCLIC FATIGUE

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

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

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

See also NBIC Part 2, 4.4.9.a.10.

4.4.8.7 EVALUATING PRESSURE-RETAINING ITEMS CONTAINING LOCAL THIN AREAS

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

1) Original design and current operating conditions;

2) Component is not operating in the creep range;

3) Material has sufficient toughness;

4) Not operating in cyclic service;

5) Does not contain crack-like indications;

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

7) Applied loads; and

8) The range of temperature or pressure fluctuation.

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

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

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

1) Thickness profiles within the local region;

2) Flaw dimensions;

3) Flaw to major structural discontinuity spacing;

4) Vessel geometry; and

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; and

4) Uniformity.

NBIC Part 2, 4.4.9.

f) Widely scattered corrosion pits may be left in the pressure-retainig item in accordance with ~~the following requirements:~~

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

~~2) The total area of the pits does not exceed 7 in.^{2} (4,500 mm^2) within any 50 in.^{2} (32,000 mm^2); and~~

~~3) The sum of their dimensions (depth and width) along any straight line within this 50 in.^{2} (32,000 mm^2) area does not exceed 2 in. (50 mm).~~

g) 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, ~~and a detailed engineering evaluation shall be performed to ensure continued safe operation.~~ see NBIC Part 2, 4.4.9.

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

[Insert proposed new section 4.4.9 here, see next 5 pages of this markup.]

4.5 RISK-BASED INSPECTION ASSESSMENT PROGRAMS

4.5.1 SCOPE

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

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

4.5.2 DEFINITIONS

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

POF — Probability of failure. Extent to which a failure is likely to occur within a specific time frame.

4.4.9 STEEL-LOSS ACCEPTANCE CRITERIA FOR PRESSURE-RETAINING ITEMS

(a) Scope and Limitations.

This section only applies to carbon steels and stainless steels that are currently in service for the pressure-retaining walls of vessels, piping, or other pressure-retaining items, such as the alloys listed in Table 4.1 of API 579-1/ASME FFS-1, Fitness-for-Service (2021 edition unless otherwise indicated in this section), "ASME FFS-1".

The following are not covered by this section. See NBIC Part 2, 4.4.8.7 for additional background and data requirements.

1) Supports damage, including steel loss from internal or external supports. This requires a separate engineering assessment. Pay particular attention to supports welded or fastened to vessels. Consider the earthquake, wind, nozzle reaction, and other forces that may act on the pressure-retaining item in the location where it is installed. See ASCE 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers (ASCE) and the free, online, ASCE 7 Hazard Tool. See also NBIC Part 2, 2.2.5.c, 2.3.3.c, 2.3.3.e.5, and the additional NBIC support-inspection requirements for specific types of pressure-retaining items.

2) Buckling. Steel loss from the pressure-retaining item's wall, particularly near supports, may cause buckling. Criteria in NBIC Part 2, 4.4.9.c.2, 4.4.9.c.7, and 4.4.9.c.8 help avoid buckling, but they assume that the manufacturer-reported required thickness (t_min) is adequate to prevent buckling under operating and environmental conditions, which may not always be the case due to earthquakes, wind, snow, people stepping on piping, and so forth. Any steel loss near supports will reduce the buckling-prevention safety margin. Finite element analysis is typically needed to reliably assess buckling risks. Buckling risks are higher for pressure vessels that are:
   A) horizontal with a length-between-supports to diameter ratio greater than 2.5 or a diameter greater than 10 ft. (3.0 m), or
   B) vertical with a height to diameter ratio greater than 3.0 or a height greater than 100 ft. (30 m).

   See NBIC Part 2, 4.4.7.2.i as well as ASME FFS-1 2D.4, Figure 4.3, and Figure 4.4.

3) Blisters, cracks, crack-like flaws, and grooves. See NBIC Part 2, 3.4.7, 3.4.8, 3.4.9, 4.4.8.3, and 4.4.8.4 as well as ASME FFS-1 Parts 5, 7, and 9. But, if the cause of the blisters, cracks, crack-like flaws, or grooves is identified and adequately resolved, this section may be used to assess steel loss after blend grinding out blisters, cracks, crack-like flaws, or grooves. See also NBIC Interpretation 98-30, Alteration Due to Grinding or Machining.

4) Weld misalignment or wall distortions. See NBIC Part 2, 2.3.3.c, 2.3.3.d, 2.3.3.e.3, 2.4.4.e, and 2.5.4.f as well as ASME FFS-1 Part 8.

5) Creep and operation above 650°F (343°C). See NBIC Part 2, 3.4.2 and 4.4.8.1 as well as ASME FFS-1 Part 10 and Table 4.1, Temperature Limit Used to Define the Creep Range.

6) Metallurgical changes, including embrittlement (loss of toughness), such as strain-age embrittlement of carbon steels operated above 300°F (149°C) and many other causes. See NBIC Part 2, 3.4.3 to 3.4.6 and ASME FFS-1 2B.4.6.

7) Fire damage. See NBIC Part 2, 3.4.8 and 4.4.8.5 as well as ASME FFS-1 Part 11.

8) Dents, gouges, and dent-gouge combinations. See the NBIC Part 2 dent and gouge requirements for specific types of pressure-retaining items as well as ASME FFS-1 Part 12. But, if the cause of the gouge is adequately resolved, such as by improving protection from mechanical damage, this section may be used to assess steel loss after blend grinding out gouges that are not in dents.

9) Laminations. See NBIC Part 2, 4.4.8.3 and ASME FFS-1 Part 13.

10) Fatigue from cyclic loading. See NBIC Part 2, 3.4.1 and 4.4.8.6 as well as ASME FFS-1 Part 14. For steel, typically, fatigue only occurs after at least 150 loading cycles, such as large pressure or temperature variations (ASME FFS-1 4.2.6.c and 5.2.5.c).

b) Notation definitions.

1) C_j means the joint clearance, the distance from the center of a joint to the edge of the zone where it affects steel-loss acceptability.
   A) For welded joints, C_j is 1 in. (25.4 mm) or t_nom, whichever is greater.
   B) For bolted or riveted joints, without flanges, C_j is the distance from the center of the joint to 6 in. (153 mm) beyond the outermost row of fasteners.
   C) For joints with flanges, the C_msd criteria apply; see NBIC Part 2, 4.4.9.c.7 and 4.4.9.c.8 below.

   These C_j definitions are based on the weld band and riveted-joint band definitions in ASME FFS-1 2C.2.5. For t_nom 5/8 in. (16 mm) or greater, the welded C_j defined here would be less conservative than NBIC Part 2, 4.4.7.2.k, 2021 edition, which used, "1 in. (25 mm) on either side of the weld, or two times the minimum thickness on either side of the weld, whichever is greater".

2) C_msd means the major-structural-discontinuity clearance, the distance from the edge of a major structural discontinuity to the edge of the zone where it affects steel-loss acceptability. C_msd is 1.8*(D*t_nom)^0.5, which means "1.8 multiplied by the square root of the product of D multiplied by t_nom". This C_msd definition is based on ASME FFS-1 Equation 5.10 (see also its Figures 4.6 and 5.5), with t_nom replacing the "corroded wall thickness, t_c" as a conservative simplification.

3) D is the inner diameter of an approximately cylindrical or spherical pressure-retaining item, at the time of inspection, increased by any allowance for post-inspection steel loss from the interior surface of its pressure-retaining wall. For a cylindrical vessel with elliptical heads, D is the inner diameter of the cylinder. For pressure-retaining items with other shapes, D and C_msd may be determined by an engineering assessment.

4) DCA is the design-corrosion allowance reported on the manufacturer's Data Report per the ASME Boiler and Pressure Vessel Code (B&PV Code), nameplate, shop drawing, or similar as-built documentation. Erosion may be treated like corrosion.

5) FCA means the future-corrosion allowance, which is the sum of any post-inspection steel-loss allowances for both the interior and exterior surfaces of the pressure-retaining item's wall, estimated during the post-inspection evaluation.

6) t_min is the required thickness, of the pressure-retaining item's wall at the steel-loss location, per its construction code or NBIC Part 2, 4.4.9(d) below. If the construction code calls for calculating more than one required thickness at the steel-loss location, such as longitudinal and circumferential, the thickest one is t_min.

7) t_m is a measured thickness, of the pressure-retaining item's wall, at the time of the inspection after any needed blend grinding to remove cracks or crack-like flaws and preferably other damage that may promote cracks or corrosion, such as blisters, gouges, grooves, or pitting. Typically, the thickness needs to be measured in more than one location; each location measured is a t_m. If a grid is used, its spacing should be not more than 1-inch (25 mm) or 2*t_nom, whichever is less (ASME FFS-1 Equation 4.2, conservatively simplified by using t_nom). See NBIC Part 2, 4.2 Nondestructive Examination Methods.

8) t_mm is the minimum-measured thickness (the lowest t_m), measured where needed to reasonably determine the minimum wall thickness, such as in pits.

9) t_nom is the nominal thickness, of the pressure-retaining item's wall (as designed prior to fabrication), or optionally a thinner minimum furnished (as built) wall thickness allowed by its construction code, considering mill undertolerance.

10) All of the above, (1) to (9), may be measured in inches (in.), millimeters (mm), or any consistent length unit.

11) - means "minus".

12) < means "is less than".

13) * means "multiplied by".

14) ^0.5 means "the square root of the items enclosed in the preceding parenthesis" in other words "raised to the 0.5 power".

c) Pressure-retaining items shall be evaluated per ASME FFS-1 latest edition, repaired per NBIC Part 3, or removed from service if any condition below is discovered.

1) t_mm < t_nom - DCA. Brittle Fracture. Promptly reassess brittle-fracture prevention after discovering any steel loss greater than the design-corrosion allowance (DCA). If no manufacturer's DCA documentation is found, assume the DCA is zero or reassess brittle-fracture prevention and t_min to estimate an acceptable corrosion allowance. If the pressure-retaining item is susceptible to brittle fracture, examine the entire steel-loss area with a method capable of detecting surface discontinuities, such as magnetic particle, dye/liquid penetrant, or angled/shear wave ultrasonic testing; see ASME FFS-1 5.3.4.3.a. The manufacturer may have relied on a wall

thickness greater than what its shop drawing reports as the "t_min" when the manufacturer determined the minimum temperature for avoiding brittle fracture, which is the nameplate Minimum Design Metal Temperature (MDMT) for ASME pressure vessels; see UCS-66, particularly Figure UCS-66.1, and UG-20(f) of the ASME B&PV Code, Section VIII, Division 1. See also NBIC Part 2, 4.4.8.2, Exposure to Brittle Fracture, and ASME FFS-1 Part 3, Assessment of Existing Equipment for Brittle Fracture.

2) t_mm < t_nom - DCA and designed by analysis. Reassess following an appropriate design method. Examples of deigned by analysis vessels and piping include:
   A) API 620 tanks -- designed to American Petroleum Institute (API), Standard 620, Design and Construction of Large, Welded, Low-Pressure Storage Tanks, any edition;
   B) Div. 2 pressure vessels -- designed to ASME B&PV Code, Section VIII, Division 2, any edition; and
   C) piping whose required thickness might be governed by supplemental loads (and not solely by internal pressure), such as piping with structural attachments, piping with nominal pipe sizes greater than 10 in. (250 mm), piping operated below -50°F (-46°C) or above 200°F (93°C), or piping built or supported in a way that does not allow for its thermal expansion and contraction or that causes unacceptable stress concentration at supports. For less conservative criteria, see ASME FFS-1 4.4.1.4, Table 4.2, and Figure 4.5.

3) t_mm - FCA < 0.1 in. (2.54 mm). Pinhole leak and measurement error, from the more conservative, vessel, criteria in ASME FFS-1 Table 4.4.

4) t_mm - FCA < 0.2*t_nom. Excessive loss from the original thickness, from ASME FFS-1 Table 4.4; also complies with ASME FFS-1 Equation 5.7.

5) t_mm - FCA < 0.5*t_min. Excessive local strain, from ASME FFS-1 Table 4.4.

6) t_m - FCA < 0.9*t_min at more than 7 sq. in. (4,500 sq. mm) within any 8 in. (200 mm) diameter circle, or if the sum of the lengths of these thinned areas along any straight line within the circle exceeds 2 in. (50 mm), or if any two of these circles is within an arc length of C_msd from each other. Local steel loss criteria based on the 2021 NBIC for ammonia and air that would pass an ASME FFS-1 Part 5 Level 1 assessment, after excluding situations failing the other criteria in NBIC Part 2, 4.4.9.c.

7) t_mm - FCA < 0.9*t_min within an arc length of C_msd from:
   A) a flange,
   B) a nozzle,
   C) a piping branch connection,
   D) a conical-transition reinforcement zone,
   E) a support that allows movement between the pressure-retaining item's wall and the support, such as typical saddle supports, or
   F) a reinforcing pad or plate for any of the above (A) to (E).

   Steel loss near components suitable for ASME FFS-1 Part 4 Level 2 analysis, including Type A and some Type B components; see ASME FFS-1 4.4.1.2.b, Table 4.2, and Figure 5.5, which includes reinforcing pads.

8) t_mm - FCA < t_min within an arc length of C_msd from:
   A) a support welded or fastened to the wall of the pressure-retaining item, or the reinforcing pad/plate for these -- such as legs, lugs/brackets, or skirts on some pressure vessels (Type C component per ASME FFS-1 Table 4.2; Figure 5.5 includes reinforcing pads),
   B) a cylinder to flat head junction (Type B Class 2 component but not suitable for Level 2 per ASME FFS-1 4.4.1.2.b),
   C) an integral tubesheet connection (Type B Class 2 component but not suitable for Level 2 per ASME FFS-1 4.4.1.2.b),
   D) a stiffening ring attached to the shell of a pressure vessel (Type C component per ASME FFS-1 Table 4.2), or
   E) a head to shell junction of a pressure vessel, except for steel loss located on the shell side of the circumferential weld between a shell and a 2-to-1 elliptical-ratio head if both the shell and the head have required thicknesses governed only by internal pressure (Type C component per ASME FFS-1 Table 4.2, except as noted).

   Steel loss near components that otherwise would require an ASME FFS-1 Part 4 Level 3 assessment.

9) t_mm - FCA < t_min within an arc length of C_j from the center of a welded joint, unless this portion of the welded joint and its heat-affected zone have been volumetrically examined via radiography or shear-wave/angled ultrasonic testing, t_min verified or recalculated based on the results, and any discovered flaws assessed per the guidance referenced in NBIC Part 2, 4.4.9.a, Scope and Limitations. See also NBIC Part 2, 4.4.9.c.1 Brittle Fracture and 4.2 Nondestructive Examination Methods. Steel loss near welded joints, based in part on ASME FFS-1 5.3.4.3.

d) t_min may be recalculated per the pressure-retaining item's construction code but with a joint efficiency, E, of 1.0, if:
   1) this t_min recalculation accounts for brittle fracture and
   2) the steel loss is greater than an arc length of
      A) C_j from the center of a joint and
      B) C_msd from the edge of a major-structural discontinuity, such as those listed in NBIC Part 2, 4.4.9.c.7 and 4.4.9.c.8 above.

   For example, if the joint efficiency is 0.85 (spot tested longitudinal welded joint in a cylindrical shell), the recalculated cylindrical-shell t_min typically would be approximately 15% lower than t_min per the ASME B&PV Code, Section VIII, Division 1. This would allow an overall general steel loss to approximately 77% of t_min, at wall locations meeting the C_j and C_msd criteria in this paragraph, if brittle-fracture prevention is also acceptable at this thickness. 77% of t_min is similar to the 75% of t_min that formerly was allowed by the 2011 to 2023 editions of NBIC Part 2, for some types of pressure vessels. This paragraph is based on ASME FFS-1 2C.2.5, 4.4.1.2.b, Table 4.2, and 5.3.4.3.

e) The remaining life and future-inspection timing shall be assessed following NBIC Part 2, 4.4.1 to 4.4.8, as applicable. ASME FFS-1 also provides guidance on assessing remaining life and inspection timing.

3) Maximum material thickness: 38 mm (1-1/2 in.).

b) Transport tanks manufactured prior to the adoption of ASME Section XII by the Competent Authority were manufactured in accordance with ASME Section VIII, Div. 1. Transport tanks manufactured to this Code were required to be stamped with the “U” Code Symbol Stamp in accordance with Section VIII, Div. 1, if the design pressure of the transport tank was 241 kPa (35 psi) (depending on material being transported) and greater. If the design pressure was less than 241 kPa (35 psi) (depending on the media being transported), the transport tank was constructed in accordance with Section VIII, Div. 1, but not stamped with the “U” Code Symbol Stamp.

c) For these transport tanks, the requirements established in NBIC Part 2, for continued service inspection, repairs, or modifications shall apply, unless specifically exempted by the DOT.

S6.9 REFERENCES TO OTHER CODES AND STANDARDS

Other existing inspection codes, standards, and practices pertaining to the continued service inspection, i.e., CFR 49, Parts 100 through 185, ASME Section XII, etc., of transport tanks can provide useful information and references relative to the inspection techniques listed in this Appendix. Additionally, supplementary guidelines for assisting in the evaluation of inspection results and findings are also available. Some acceptable requirements and guidelines are as follows:

a) American Society of Mechanical Engineers — *ASME Boiler and Pressure Vessel Code*, Section VIII, Div. 1 (*Rules for Construction of Pressure Vessels*).

b) American Society of Mechanical Engineers:

1) ASME Section V (*Nondestructive Examination*).

2) ASME Section IX (*Welding and Brazing Qualifications*).

c) Code of Federal Regulations, Title 49, Parts 100 through 185, *Transportation*.

API 579-1/ASME FFS-1, Fitness-For-Service.

d) ~~American Petroleum Institute — API 579, *Fitness for Service*.~~

e) ADR 2003, *European Agreement Concerning the International Carriage of Dangerous Goods by Road*. (Published by the UN Economic Commission for Europe, Information Service, Palais des Nations, CH-1211 Geneve, Suisse.)

f) CGA 6-4.1, *Cleaning Equipment for Oxygen Service*.

g) CGA S-1.2, *Pressure Relief Device Standard*, Part 2: *Cargo and Portable Tanks for Compressed Gases*. (Published by the Compressed Gas Association, Inc. [CGA], 4221 Walney Road, Chantilly, VA 20151.)

h) IMDG Code 2002, *International Maritime Dangerous Goods Code* (including Amendment 31-02. (Published by the International Maritime Organization [IMO], 4 Albert Embankment, London, SE1 7SR England.)

i) RID 2003, *Carriage of Dangerous Goods*. (Published by the Intergovernmental Organization for International Carriage by Rail [OTIF], Gyphenhubeliweg 30, CH-3006 Bern, Switzerland.)

j) *United Nations Recommendations on the Transport of Dangerous Goods – Modal Regulations.* (Published by the United Nations Publications, 2 UN Plaza, New York, New York 10017.)

k) SSPC Publication #91-12, *Coating and Lining Inspection Manual*. (Published by Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15212-2683.)

S7.7 FIRE DAMAGE

a) Pressure vessels 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. 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.

See also NBIC Part 2, 4.4.9.a.7.

S7.8 ACCEPTANCE CRITERIA

The acceptance criteria for LPG 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 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).

See also NBIC Part 2, 4.4.9.a.3.

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 pressure vessel shall be removed from service until the dents are repaired by a qualified repair organization or permanently retired from service.

See also NBIC Part 2, 4.4.9.a.8.

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 pressure vessel shall be removed from service until the bulges are repaired by a qualified repair organization or permanently retired from service.

See also NBIC Part 2, 4.4.9.a.4.

S7.8.4 CUTS OR GOUGES

When a cut or a gouge exceeds 25% of the thickness of the pressure vessel, the pressure vessel shall be removed from service until it is repaired by a qualified repair organization or permanently removed from service. See also NBIC Part 2, 4.4.9.a.8.

S7.8.5 CORROSION

See NBIC Part 2, 4.4.9.

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~~

~~1) Isolated pits may be disregarded provided that:~~

~~a. Their depth is not more than 25% the required thickness of the pressure vessel wall;~~

~~b. 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~~

~~c. 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.~~

a)

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

S7.8.6 ANHYDROUS AMMONIA SERVICE

Pressure vessels of 3000 gal. (11.4 m^3) water capacity or less used to store anhydrous ammonia, except for pressure vessels used in cargo tank vehicle service, shall not be converted to LPG service.

Cargo tank pressure vessels less than 3000 gal. (11.4 m^3) water capacity to be converted from ammonia to LPG service shall be wet-fluorescent magnetic particle tested (WFMT) on all internal surfaces (see NBIC Part 2, 2.3.6.4).

Blue coloring of the brass valves is one indication that the pressure vessel has been in anhydrous ammonia service.

S7.9 ASME LPG PRESSURE VESSELS LESS THAN 2000 GALLONS BEING REFURBISHED BY A COMMERCIAL SOURCE (21)

Commercially refurbished pressure vessels are used 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 pressure vessels is unknown, special attention shall be given to inspection and repair before returning any of these pressure vessels back to service. ASME LPG 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) Pressure vessels of this size 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 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 pressure vessel has had its valves removed or is known to have been out of service for an extended period.

e) Removal and re-attachment of the original manufacturer's nameplate shall only be done in accordance with NBIC Part 3, 5.11.

4) Existing or additional loads imposed on nozzles and highly stressed areas.

5) Change in pressure or temperature, and cycling.

API 579-1/ASME FFS-1

6) Compliance to product or industry standards, such as ANSI K61, ~~API 579~~, or NFPA 58.

b) Material Consideration:

1) Chemical and mechanical properties of existing material or any new material to be added or replaced to ensure it has the required strength and toughness to withstand the pressure and temperature effects of the new environment.

2) Effects of erosion or corrosion.

3) Time dependent effects on service life - creep or fatigue, or both effects combined.

c) Environment

1) Physical condition of the pressure-retaining item.

2) Overpressure protection needs.

3) Regulatory environment – Verification of compliance to new or existing jurisdictional rules or regulations.

4) Vessel cleanliness – When changing lading fluids or contents consideration should be given to cleaning or decontaminating the vessel as appropriate.

d) Operational History

1) A review of current and past operational logs or records should be made to ensure that no conditions existed where any further use would render the pressure-retaining item hazardous or otherwise unsafe.

2) Records to be obtained and reviewed would include Manufacturer's Data Reports, Repair and Alteration Forms, Inspection reports, etc.

e) Repairs and Alterations Made:

A review of any repairs, alterations, reratings, or reconfigurations that have been performed on the pressure-retaining item, so as to ensure that they will not have a detrimental impact on the intended use.

f) Proposed Rework

1) Any physical work to be performed to restore the material to the existing or intended state or to meet any requirements for the new operating conditions.

2) Repairs and alterations shall be performed in accordance with NBIC Part 3, *Repair and Alterations*.

3) The effects of heat applied as a result of welding or heat treatment on the material or shaped parts.

4) The method and extent of any physical or non destructive examination should be considered.

5) Any physical testing or pressure testing to be performed to determine or verify leak tightness or structural integrity of the pressure-retaining item.

6) The pressure-retaining item shall meet the code requirements for the new environment at the time of change.

b) Describe the accuracy of the model digitization either by use of convergence or to the accuracy of previous successful models.

S11.4.2.6 RESULTS

For each model the following should be presented:

a) Give temperature plots.

b) Give deformed geometry plots.

c) Give stress classification line results and comparison to code allowable.

d) Relate the results of the model to the defined allowable stresses of the original code of construction.

e) Refer to ASME Section VIII, Division 2, Part 2, 2.3.3.1 (c) (2) Documentation requirements of design-by-analysis calculations in Part 5.

S11.4.2.7 REFERENCE DOCUMENTS USED

Typical reference documents could include:

a) ASME BPVC II-D;

b) ASME BPVC Section VIII Division 1;

c) ASME BPVC Section VIII Division 2;

d) ~~ASME/API 579;~~ API 579-1/ASME FFS-1, Fitness-For-Service;

e) Drawings;

f) User Design Specification (UDS); and

g) ASCE.

EXISTING TEXT

TABLE S6.13.6
PRESSURE TEST REQUIREMENTS

Cargo Tank Specification	Test Pressure
MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306	20.7 kPa (3 psig) or design pressure, whichever is greater
MC 304 and MC 307	275.8 kPa (40 psig) or 1.5 times design pressure, whichever is greater
MC 310, MC 311, and MC 312	20.7 kPa (3 psig) or 1.5 times design pressure, whichever is greater
MC 330 and MC 331	1.5 times either MAWP or the re-rated pressure, whichever is applicable
MC 338	1.25 times either MAWP or the re-rated pressure, whichever is applicable
DOT 406	34.5 kPa (5 psig) or 1.5 times the MAWP, whichever is greater
DOT 407	275.8 kPa (40 psig) or 1.5 times the MAWP, whichever is greater
DOT 412	1.5 times the MAWP

PROPOSED TEXT

TABLE S6.13.6
PRESSURE TEST REQUIREMENTS

Transport Tank Specification	Test Pressure
MC 300, 301, 302, 303, 305, 306	The test pressure on the name plate or specification plate, 20.7 kPa (3 psig) or design pressure, whichever is greater.
MC 304, 307	The test pressure on the name plate or specification plate, 275.8 kPa (40 psig) or 1.5 times design pressure, whichever is greater.
MC 310, 311, 312	The test pressure on the name plate or specification plate, 20.7 kPa (3 psig) or 1.5 times design pressure, whichever is greater.
MC 330, 331	The test pressure on the name plate or specification plate, 1.5 times either MAWP or the re-rated pressure, whichever is applicable. DOT Transport Tanks constructed in accordance with Part UHT in Section VIII, Division I of the ASME Code shall be tested at a pressure at least twice the design pressure.
MC 338	The test pressure on the name plate or specification plate or 1.5 times the design pressure, plus static head of lading, plus 101.3 kPa (14.7 psi) if subjected to external vacuum. DOT Transport Tanks constructed in accordance with Part UHT in Section VIII, Division I of the ASME Code shall be tested at a pressure at least twice the design pressure.
DOT 406	The test pressure on the name plate or specification plate, 34.5 kPa (5 psig) or 1.5 times the MAWP, whichever is greater.
DOT 407	The test pressure on the name plate or specification plate, 275.8 kPa (40 psig) or 1.5 times the MAWP, whichever is greater.
DOT 412	The test pressure on the name plate or specification plate, 1.5 times the MAWP, whichever is greater.

Current Table in 180.407(g)(1)(iv)

ECFR CONTENT

49CFR180.407(g)(1)(iv)

Table 1 to Paragraph (g)(1)(iv)

Specification	Test pressure
MC 300, 301, 302, 303, 305, 306	The test pressure on the name plate or specification plate, 20.7 kPa (3 psig) or design pressure, whichever is greater.
MC 304, 307	The test pressure on the name plate or specification plate, 275.8 kPa (40 psig) or 1.5 times the design pressure, whichever is greater.
MC 310, 311, 312	The test pressure on the name plate or specification plate, 20.7 kPa (3 psig) or 1.5 times the design pressure, whichever is greater.
MC 330, 331	The test pressure on the name plate or specification plate, 1.5 times either the MAWP or the re-rated pressure, whichever is applicable.
MC 338	The test pressure on the name plate or specification plate, 1.25 times either the MAWP or the re-rated pressure, whichever is applicable.
DOT 406	The test pressure on the name plate or specification plate, 34.5 kPa (5 psig) or 1.5 times the MAWP, whichever is greater.
DOT 407	The test pressure on the name plate or specification plate, 275.8 kPa (40 psig) or 1.5 times the MAWP, whichever is greater.
DOT 412	The test pressure on the name plate or specification plate, or 1.5 times the MAWP, whichever is greater.

PROPOSED REVISION OR ADDITION

Item No.

A 23-27

Subject/Title

Addition of requirement for Inspector to be present for inspections.

NBIC Location

Part: Inspection; Section: 1; Paragraph: 1.5.1

Project Manager and Task Group

Source (Name/Email)

Donald Kinney / don.kinney@labor.nc.gov

Statement of Need

While it has always been standard industry practice for inspections to be performed in-person, and there are requirements for remote inspection, currently there is no language in Part 2 or RCI-1 requiring the Inspector to be present at the location of installation while performing an inspection. This requirement is implied, but not stated.

Background Information

An Inspector's state commission was recently revoked due to accepting photographs for the purpose of conducting certificate inspections, in lieu of going to the location and inspecting in-person. While the inspector clearly violated the jurisdictional and NBIC Part 2 requirements for remote inspection, it was discovered that no language actually exists to require the inspections be performed in-person.

Existing Text

Proposed Text

Visual examination is the basic method used when conducting an inservice inspection of pressure-retaining items. Except as provided for remote visual inspection, the Inspector shall be present at the location of installation and in direct contact with the pressure-retaining item during inspections. (Added to the beginning of the paragraph)

	VOTE:						
COMMITTEE	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date

PROPOSED REVISION OR ADDITION

Item No.

A 23-37

Subject/Title

Add comment to further define responsability of the owner user

NBIC Location

Part: Inspection; Section: 1.4; Paragraph: d

Project Manager and Task Group

Source (Name/Email)

Vincent Scarcella / Vincent.Scarcella@cna.com

Statement of Need

Specificall if the inspector is going to a location where for instance H2S of some harmful pathogen is being handled, those locations have and should provide safety training and equipment needed to complete the inspection. For internals this is already touched on in 1.5.3. "Requirements of occupational safety and health regulations (i.e., federal, state, local, or other), as well as the owner-user's own program and the safety program of the Inspector's employer are applicable."

Background Information

This came up during the review for the BOT WG for NB 380

Existing Text

Proposed Text

d) Where the expsoure exists that cannot be mitigated and/or for which the inspector has not been trained, the owner user shall provide training and safety equipment neccesary to complete the inspection.

	VOTE:						
COMMITTEE	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date