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THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD
FRP TASK GROUP

AGENDA

Meeting of October 18th, 2021
Zoom Meeting

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614)888-8320
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1. **Call to Order**
   The Chair, Mr. Bernie Shelley, called the meeting to order at 1:11 PM Eastern Time.

2. **Introduction of Members and Visitors**

   The following task group members were present for the meeting:
   - Mr. Bernie Shelley, Chair
   - Mr. Jonathan Ellis, Secretary
   - Mr. Francis Brown
   - Mr. Doug Eisberg
   - Mr. Norman Newhouse
   - Mr. Brian Linnemann
   - Mr. John Eihusen

   Additionally, Mr. Darrell Graf was in attendance as a visitor.

   With only six of the twelve total voting members present, a quorum was not met. Mr. Shelley stated that discussions would be held on items, but no voting would take place.

3. **Announcements**

4. **Adoption of the Agenda**

   The agenda as presented would be used for discussion by the members present for the meeting.

5. **Approval of the Minutes of April 2021 Meeting**

   The minutes of the April 2021 virtual meeting can be found on the National Board website: https://www.nationalboard.org/Index.aspx?pageID=13&ID=18

   As there was not a quorum for the meeting, Mr. Shelley stated that the April 2021 minutes would have to be approved at the next scheduled meeting.

6. **Review of Rosters**
   - **a.** Membership Nominations
     - **i.** None
   - **b.** Membership Reappointments
     - **i.** None
   - **c.** Officer nominations
     - **i.** Mr. Shelley informed the task group that a new Chair will need to be nominated soon.

7. Action Items

Item Number: NB11-1901	NBIC Location: Part 1	Attachment Page 1

General Description: Add guidance for the safe installation of high pressure composite pressure vessels operating in close proximity to the public

Subgroup: FRP

Task Group: R. Smith (PM), J. Eihusen, N. Newhouse

April Meeting Action: Mr. Shelley asked Mr. Newhouse about his review of the previous proposal for this item. Mr. Newhouse determined that there were two courses of action to take for the proposal to address comments from Subcommittee Installation and Main Committee. The first was to leave the reference to NFPA-2 as is since it fits with the current language. The other option is to differentiate between NFPA-2 for hydrogen and NFPA-52 for CNG. Mr. Newhouse provided revised language adding the reference to NFPA-52. Mr. Shelley asked that the revised proposal be sent to the Task Group as a letter ballot. He also asked that he and Mr. Newhouse should be invited to the SC Installation meeting in July.

Update: This item is being letter balloted to Subcommittee Installation and Subcommittee Pressure Relief Devices. The ballot is set to close on November 3rd.

October 2021 Meeting Discussion: A quick update on item progress and ballot progress was provided.

Item Number: NB16-1402	NBIC Location: Part 2	No Attachment

General Description: Life extension for high pressure vessels above 20 years

Subgroup: FRP

Task Group: M. Gorman (PM), N. Newhouse, J. Eihusen

April Meeting Action: Mr. Gorman provided an update on the item, discussing responses to Subcommittee Inspection questions/comments. He also discussed a new Life Extension Test form that would be used to track testing. A new proposal will be put together to address subcommittee comments, and responses will be provided to SC Inspection to ensure that the FRP responses are adequate.

October Meeting Discussion: Mr. Newhouse gave an update on behalf of Mr. Gorman. ASME has an item open on this subject (life extension of carbon to 40 and glass to 30), and the new proposal for NB16-1402 will be rewritten to be in line with the ASME proposal to provide inspection guidelines for the new life extension numbers. Mr. Newhouse, Mr. Eihusen, and Mr. Gorman will continue to work on the proposal for this item.

Item Number: 20-79	NBIC Location: Part 2, S10.10.4 c)	Attachment Page 9

General Description: Add nomenclature to the formula shown in NBIC Part 2, S10.10.4 c)

Subgroup: FRP

Task Group: M. Gorman (PM).

Background Information: This change request came about from a Public Review Comment submitted to the National Board for the 2021 NBIC. This comment related to action item NB16-1401, which made several changes to Supplement 10. The Main Committee responded to this comment stating that a new action item would be opened to add nomenclature for this formula.

Mr. Gorman, the Project Manager for item NB16-1401, provided the following definitions for the variables in the formula:

> U is the measured signal energy in joules. The signal is the captured waveform from, say, a fiber break source. V is the signal amplitude in volts point by point in the signal. Voltage must be corrected for gain (G). Z is in ohms. The (differential) time is dt in seconds.

April Meeting Action: Mr. Shelley asked Mr. Ellis to submit the proposal for this item as a letter ballot to the Task Group.

Update: This item has been approved by Subcommittee Inspection and will be balloted to Main Committee prior to the January 2022 NBIC meeting.

October Meeting Discussion: Mr. Shelley stated that the proposal for this item will be balloted to Main Committee.

8. Additional Business

Questions Concerning NBIC Part 2, Supplements 4 and 10, submitted by the National Board:

a. The listed qualifications for an inspector of Fiber Reinforced Plastic (FRP) Vessels found in S4.2 refer to the "R" Stamp Holder's inspector. If one looks at these qualifications, they seem perfectly suited for an inspector involved with repairs by an "R" Stamp Holder with an "RP" Scope, but they seem a bit much for the general jurisdictional inspector. For instance, S4.5 a) 7) says that an inspector shall have been directly involved in "Qualification of secondary bonders, laminators, and welders to applicable codes, standards, or specifications". The inspector qualifications seem to require someone who has worked in an FRP shop. Does this mean a jurisdiction needs to hire a very specialized inspector if there are FRP vessels that fall within their inspection scope? The same qualification requirement is listed in S10.3 b). For the same reasons as above, should it be?
   - The task group felt that the inspector would need practical experience/qualification, but it is not a good requirement for jurisdictions because of budget limitations to train current inspectors or hire other inspectors. It could be possible to have the owner/manufacturer bring in their own qualified inspector that is agreeable to the jurisdiction, but the owner would have to pay for it. The section in question should be made clear that the inspector is the R stamp holder's inspector, not the jurisdictional inspector. The jurisdictional inspector would not need to meet these requirements. Mr. Shelley asked Mr. Francis to investigate these paragraphs to make sure they only talk about the R stamp inspector.

b. S4.5 c) states that the "employer of the Inspector shall certify that the employee complies with the above qualification requirements". Would the typical Chief Boiler Inspector want to certify that his inspector met those qualifications?
    - The task group felt that this question would be covered by addressing the previous question.

c. Under S4.6.3 Tools, item c) suggests that an inspector may need a Barcol hardness tester. Since that is the device to measure the hardness and therefore the degree of cure of the vessel, I think it more suited to repairs of these vessels. In-service vessels are already cured.
    - The task group stated that the R stamp holder's inspector would have this tool.

d. Is the "original cutout sample" in S4.8.2 something that is likely to be available? It would be nice to have, but I don't see these vessels being shipped with a cutout sample attached. Let me know if I am wrong.
    - The task group stated that the sample is unlikely to be available. Sometimes vessels are shipped with them, but what happens when the user receives them is up to the user. The task group will review the section to see if this can be removed from the text. Mr. Shelley asked MR. Brown to head up this effort.

e. S10.10.4 c) has an equation that is expressed as an integral. It is a calculus relationship. Do we want our inspectors doing calculus?
    - The task group stated that the inspector would not perform these calculations. An acoustic emissions company/expert would be contracted to run the tests, and the inspector would look at the results and make sure the method matches what is written in the NBIC.

9. Future Meetings

January 17-20, 2022 – NBIC Meeting in San Diego, CA
April 18th, 2022 – Virtual Meeting for FRP Task Group

10. Adjournment

Respectfully submitted,
Jonathan Ellis
Secretary

NB11-1901

SUPPLEMENT X
INSTALLATION OF HIGH PRESSURE COMPOSITE PRESSURE VESSELS

SX.1 SCOPE

This supplement provides requirements for the installation of high-pressure composite pressure vessels. This supplement is applicable to pressure vessels with an MAWP not exceeding 15,000 psi, and is applicable to the following classes of vessels:

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

b) Metallic vessel with a full FRP wrap (both load sharing)

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

d) FRP vessel with a non-load sharing non-metallic liner

SX.2 SUPPORTS

Design of supports, foundations, and settings shall consider the dead loads, live loads, wind, and seismic loads. Vibration and thermal expansion shall also be considered. The design of supports, foundations, and settings shall be in accordance with ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*. The importance factors used in calculating the seismic and wind loads shall be the

highest value specified for any category in ASCE/SEI 7.

SX.3 CLEARANCES

The pressure vessel installation shall allow sufficient clearance for normal operation, maintenance, and inspection. Stacking of pressure vessels is permitted. The minimum clear space between pressure vessels shall be 1 ft. vertical and 2 ft. horizontal. Vessel nameplates shall be visible after installation for inspection. The location of vessels containing flammable compressed natural gas fluids shall comply with NFPA 52. The location of vessels containing hydrogen or other flammable fluids shall comply with NFPA 2. The vessel owner shall document the vessel pressure and pipe diameters used as a basis for compliance with NFPA 2 location requirements.

SX.4 PIPING LOADS

Piping loads on vessel nozzles shall be determined by a formal flexibility analysis per ASME B31.12: paragraph IP-6.1.5(b). The piping loads shall not exceed the maximum nozzle loads defined by the vessel manufacturer.

SX.5 MECHANICAL CONNECTIONS

Mechanical connections shall comply with pressure vessel manufacturer's instructions, and with requirements of the Jurisdiction. Connections to threaded nozzles shall have primary and secondary seals. The seal design shall include a method for detecting a leak in the primary seal. Seal functionality shall be demonstrated at the initial pressurization of the vessel.

SX.6 PRESSURE INDICATING DEVICES

Each pressure vessel shall be equipped with a pressure gage mounted on the vessel. The dial range shall be from 0 psi to not less than 1.25 times the vessel MAWP. The pressure gage shall have an opening not to exceed 0.0550in (1.4mm) (No. 54 drill size) at the inlet connection. In addition, vessel pressure shall be monitored by a suitable remote pressure indicating device with alarm having an indicating range of 0 psi to not less than 1.25 times the vessel MAWP.

SX.7 PRESSURE RELIEF DEVICES

Each pressure vessel shall be protected by pressure relief devices per the following requirements:

a) Pressure relief devices shall be suitable for the intended service.

b) Pressure relief devices shall be manufactured in accordance with a national or international standard and certified for capacity (or resistance to flow for rupture disk devices) by the National Board.

c) Dead weight or weighted lever pressure relief valves are prohibited.

d) Pressure relief valves shall not be fitted with lifting devices.

e) The pressure relief device shall be installed directly on the pressure vessel with no isolation valves between the vessel and the pressure relief device except:

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

2) Upon specific acceptance of the Jurisdiction, an isolation valve between vessel and its pressure relief device may be provided for vessel inspection and repair only. The isolation valve shall be arranged so it can be locked or sealed open.

f) The discharge from pressure relief device(s) shall be directed upward to prevent any impingement of escaping fluid upon the vessel, adjacent vessels, adjacent structures, or personnel. The discharge must be to outdoors, not under any structure or roof that might permit formation of a "cloud". The pressure relief device(s) discharge piping shall be designed so that it cannot become plugged by animals, insects, rainwater, or other materials.

g) When a single pressure relieving device is used, it shall be set to operate at a pressure not exceeding the MAWP of the vessel. When the required capacity is provided in more than one pressure relieving device, only one device need be set at or below the MAWP, and the additional device(s) may be set to open at higher pressures but in no case at a pressure higher than 105% of the MAWP. The requirements of RR-130 of ASME Section X shall also apply.

h) The pressure relief device(s) shall have sufficient capacity to ensure the pressure vessel does not exceed the MAWP of that specified in the original code of construction.

i) The owner shall document the basis for selection of the pressure relief device(s) used, including capacity.

j) The owner shall have such analysis available for review by the Jurisdiction.

k) Pressure relief devices and discharge piping shall be supported so that reaction forces are not transmitted to the vessel.

l) Heat detection system: a heat activated system shall be provided so that vessel contents will be vented per f) (above), if any part of the vessel is exposed to a temperature greater than 220°F.

m) Positive methods shall be incorporated to prevent overfilling of the vessel.

SX.8 ASSESSMENT OF INSTALLATION

a) Isolation valve(s) shall be installed directly on each vessel, but not between the vessel and the pressure relief device except as noted in 3.7, e), above.

b) Vessels shall not be buried.

c) Vessels may be installed in a vault subject to a hazard analysis, verified by the manufacturer, owner, user, qualified engineer, or the Jurisdiction, to include as a minimum the following:

1) Ventilation

2) Inlet and outlet openings

3) Access to vessels

4) Clearances

5) Intrusion of ground water

6) Designed for cover loads

7) Explosion control

8) Ignition sources

9) Noncombustible construction

10) Remote monitoring for leaks, smoke, and fire

11) Remote controlled isolation valves

d) Fire and heat detection/suppression provisions shall comply with the requirements of the Jurisdiction and, as a minimum, include relief scenarios in the event of a fire or impending overpressure from heat sources.

e) Installation locations shall provide the following:

1) Guard posts shall be provided to protect the vessels from vehicular damage per NFPA 2 or NFPA 52, as appropriate. Protection from wind, seismic events shall be provided.

2) Supports and barriers shall be constructed of non-combustible materials.

3) Vessels shall be protected from degradation due to direct sunlight.

4) Access to vessels shall be limited to authorized personnel.

5) Any fence surrounding the vessels shall be provided with a minimum of two gates. The gates shall open outward, and shall be capable of being opened from the inside without a key.

6) Access for initial and periodic visual inspection and NDE of vessels, supports, piping, pressure gages or devices, relief devices and related piping, and other associated equipment.

7) Completed installations shall be validated as required by the Jurisdiction as addressing all of the above, and any requirements of the Jurisdiction, prior to first use. This verification shall be posted in a conspicuous location near the vessel and, when required, on file with the

Jurisdiction. Certificates shall be updated as required by mandated subsequent inspections.

8) Piping installation shall comply with ASME B31.12, NFPA 52, or NFPA 2.

9) The vessels shall be electrically bonded and grounded per NFPA 55.

SX.9 LADDERS AND RUNWAYS

See NBIC Part 1, Section 1.6.4 *Ladders and Runways*

PROPOSED ACTION ITEM

Item Number:	**20-79**
Submitted by:	Jonathan Ellis via PR20-0201 jellis@nationalboard.org
Subject:	Add nomenclature to formula in Part 2, S10.10.4 c) **Explanation of Need:** The current formula has no nomenclature to define the variables. **Background Information:** The change request came about from Public Review Comment PR20-0201, which relates to the approved item NB16-1401. The Main Committee voted in October of 2020 to open a new action item to add nomenclature for this formula. Mike Gorman, Project Manager for item NB16-1401, provided the following definitions for the variables in the equation: "U is the measured signal energy in joules. The signal is the captured waveform from, say, a fiber break source. V is the signal amplitude in volts point by point in the signal. Voltage must be corrected for gain (G). Z is in ohms. The (differential) time is dt in seconds."
NBIC Location:	2021 NBIC Part 2, S10.10.4 c)

Current Text:	**Proposed Text:**
S10.10.4 EQUIPMENT c) Scaling Fiber Break Energy The wave energy shall be computed by the formula: $u = \int v^2 \, dt/z$	**S10.10.4 EQUIPMENT** c) Scaling Fiber Break Energy The wave energy shall be computed by the formula: $u = \int v^2 \, dt/z$ Where: u = signal energy (joules) v = signal amplitude (volts) t = time (seconds) z = resistance (ohms)