Date Distributed: January 4, 2021

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD SUBCOMMITTEE INSPECTION

AGENDA

Meeting of January 13th, 2021
San Antonio, TX

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

1. **Call to Order**

   8:00AM

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 for all committee members and visitors on Wednesday evening at 5:30pm.

6. **Adoption of the Agenda**

7. **Approval of the Minutes of the July 15th, 2020 Meeting**

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

8. **Review of Rosters (Attachment Page 1)**

   a. **Membership Nominations**

   b. **Membership Reappointments**

      The following Subgroup and Subcommittee Inspection memberships are set to expire on January 30, 2021:
      - Mr. Tim Barker
      - Mr. Matt Sansone

   c. **Officer Appointments**

9. **Open PRD Items Related to Inspection**

   There are currently no open PRD items related to Inspection.

10. **Interpretations**

    There are no interpretations for Subcommittee Inspection.

11. Action Items

Item Number: NB16-1402	NBIC Location: Part 2, New Supplement	Attachment Page 2

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

Subgroup: FRP

Task Group: M. Gorman (PM)

July 2020 Meeting Action:
A few of the FRP Task group members joined the meeting to present this item to the Subcommittee. Michael Gorman gave the background information explaining the reasoning behind the proposal. The Subcommittee had many questions for the FRP task group members. The Subcommittee asked them to explain how they addressed the letter balled disapproval comments from the Subcommittee, and what revisions were made based on these comments. Chairman, Jim Getter, has asked the Subcommittee to read through the letter ballot comments/replies from the project manager & recommended we **letter ballot this proposal to Subcommittee**. The Subcommittee has asked that the NBIC Secretary include the Special Permit from DOT, SP16320 in the letter ballot for the Subcommittee to reference in their review of the revised proposal.

Item Number: 18-6	NBIC Location: Part 2, S1.4.2.9	No Attachment

General Description: Riveted stay bolt dimensions

Subgroup: Locomotive

Task Group: M. Janssen (PM)

July 2020 Meeting Action:
No Action as there was no one to report on this item.

Item Number: 18-43	NBIC Location: Part 2, Section 5	Attachment Page 23

General Description: Permanent nameplate removal from pressure vessel being removed from service

Subgroup: Inspection
Task Group: J. Roberts (PM), J. Burgess, J. Calvert, J. Clark, M. Sansone

July 2020 Meeting Action:
Mr. Getter explain that the Subgroup Inspection members unanimously voted to move this item back up to Main Committee with no changes. They want to explain the purpose of the form to the Main committee, and explain that it is a tool and not enforceable. It is for the Owner/User to protect their liability and information for the jurisdiction. A motion was made to move the proposal to Main Committee as is. The motion was seconded and **unanimously approved**. NOTE: Main Committee asked the Subgroup to address the letter ballot comments before they would take a vote on the item.

Item Number: 18-63	NBIC Location: Part 2	Attachment Page 26

General Description: Review inspection requirements for pressure vessels designed for high pressures

Subgroup: Inspection

Task Group: V. Scarcella (PM), J. Mangas, J. Peterson, B. Ray and J. Castle

July 2020 Meeting Action:
Progress Report: Mr. Getter reported that there was a progress report given at the Subgroup meeting.

Item Number: 19-46	NBIC Location: Part 2, S5	No Attachment

General Description: Revisions to Yankee dryer supplement in Part 2 (Scope)

Subgroup: Inspection
Task Group: V. Newton (PM), T. Barker, D. Lesage, J. Jessick

Explanation of Need: Ensure that wording in Part 2, S5.1, is identical to that found in Part 1, S1.1.

July 2020 Meeting Action:
Mr. Newton reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 19-63	NBIC Location: Part 2, S5.2	No Attachment

General Description: Changes to the Yankee Dryer Supplement (ASSESSMENT OF INSTALLATION)

Subgroup: Inspection
Task Group: V. Newton (PM), T. Barker, D. Lesage, J. Jessick

Explanation of Need: Ensure that wording in Part 2, S5.2, is identical to that found in Part 1, S1.2. Note that wording will be the same, but paragraph numberings will be different.

July 2020 Meeting Action:
Mr. Newton reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 19-64	NBIC Location: Part 2, S5.2.1	No Attachment

General Description: Changes to the Yankee Dryer Supplement (DETERMINATION OF ALLOWABLE OPERATING PARAMETERS)

Subgroup: Inspection

Task Group: V. Newton (PM)

Explanation of Need: Ensure that wording in Part 2, S5.2.1, is identical to that found in Part 1, S1.3. Note that wording will be the same, but paragraph numberings will be different.

July 2020 Meeting Action:
Mr. Newton reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 19-84	NBIC Location: Part 2, S2.10.7	Attachment Page 27

General Description: Inspecting riveted joints for failure

Subgroup: SG Historical

Task Group: F. Johnson (PM)

Explanation of Need:
Mr. Rose reported that a progress report was given at the Historical Task Group Meeting.

Item Number: 19-88	NBIC Location: Part 2, 2.2.12.7 c) 2)	Attachment Page 33

General Description: At NBIC Part II propose the following be added to Thermal Fluid Heater

Subgroup: Inspection

Task Group: V. Scarcella (PM), M. Sansone, T. Bolden, M. Wadkinson

Explanation of Need: These items are essential to preventing catastrophic loss and are low cost items.

July 2020 Meeting Action:
Mr. Scarcella reported that a progress report was given at the Subgroup Inspection meeting.

Item Number: 20-5	NBIC Location: Part 2, 4.1 – 4.4	No Attachment

General Description: Add language in NBIC Pt2/Pt3 to minimize CSEs by allowing remote NDE.

Subgroup: Inspection

Task Group: V. Newton (PM), J. Morgan, M. Horbaczewski, D. Graf, D. LeSage, D. Rose

Explanation of Need: In order to minimize higher-risk work, specifically Confined Space Entries, remote NDE methodologies should be specifically allowed by the NBIC, at the discretion of the people performing the inspections.

Item Number: 20-26	NBIC Location: Part 2, S2	No Attachment

General Description: Concern for Historical Boiler Inspections Nationwide

Subgroup: Historical

Task Group: T. Dillon (PM), R. Underwood, L. Moedinger, M. Wahl, D. Rupert, K. Anderson & J. Wolf

Explanation of Need: Currently Jurisdictions are not uniform in adoption of how and when inspections are performed.

Item Number: 20-46	NBIC Location: Part 2, 5.3.2	No Attachment

General Description: Updates to Forms NB-5, NB-6, & NB-7

Subgroup: Inspection

Task Group: D. Buechel (PM), M. Sansone, V. Scarcella

Explanation of Need: On the current forms NB-5, NB-6, & NB-7 there are fields that are already on the ASME Manufactures Data Report making them repetitive. Other fields that ask for in- depth technical information would be hard if not impossible for an inspector to determine and are irrelevant to the inspection process.

New 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 (submitted by Mr. George Galanes).

Subgroup: Inspection

Task Group: None assigned

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.

Item Number: 20-59	NBIC Location: Part 2, 5.2.1 a)	Attachment Page 36

General Description: Temporary nameplate removal for external inspection (submitted by Mr. Doug Biggar).

Subgroup: Inspection

Task Group: None assigned

Explanation of Need: What is being added to NBIC part 2 (item 19-30) for NBIC 2021 edition: [(e) removal and re-attachment of the original manufacturer's nameplate shall only be done in accordance with NBIC Part 3, 5.11]. To have an inspector present onsite each time we need to have a nameplate temporarily removed has a cost that a commercial refurbisher such as ourselves would need to pass onto the customer as well as dramatically affect the efficiency of our assembly line.

Item Number: 20-70	NBIC Location: Part 2, S1.4.2.29	Attachment Page 37

General Description: Inspection of Furnace Slides (submitted by Mr. Mark Ray)

Subgroup: Locomotive

Task Group: M. Ray (PM)

Explanation of Need: Furnace slide supports which are locked in-place by corrosion will adversely impact the thermal expansion of the boiler and lead to staybolt breakage.

Note: The attached proposal has not yet been voted for approval by the Locomotive TG.

Item Number: 20-71	NBIC Location: Part 2, S1.6	Attachment Page 38

General Description: Safety Valve Sizing (Correct Use of Capacity Charts) (submitted by Mr. Mark Ray)

Subgroup: Locomotive

Task Group: M. Ray (PM)

Explanation of Need: This is to ensure safety valves provide the adequate relieving capacity for steam locomotive boilers.

Note: The attached proposal has not yet been voted for approval by the Locomotive TG.

Item Number: 20-79	NBIC Location: Part 2, S10.10.4 c)	Attachment Page 39

General Description: Add nomenclature to formula in S10.10.4 c) (originated from Public Review Comment PR20-0201)

Subgroup: FRP

Task Group: M. Gorman

Explanation of Need: The current formula has no nomenclature to define the variables. The change request came about from Public Review Comment PR20-0201. The Main Committee voted in October of 2020 to open a new action item to add nomenclature for this formula.

Variable definitions from Mr. Gorman: "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."

Item Number: 20-82	NBIC Location: Part 2, 5.2.2 a) & 5.3.3	Attachment Page 40

General Description: Reporting of Form NB-136 (submitted by Mr. Bob Underwood)

Subgroup: Inspection

Task Group: None assigned

Explanation of Need: Revise NB-136 Reporting requirements to permit the original manufacturer of the pressure retaining item to prepare and submit the form.

Item Number: 20-93	NBIC Location: Part 2, S2.10.4	No Attachment

General Description: MAWP in the ogee curve (submitted by Mr. Tom Dillon)

Subgroup: Historical

Task Group: None assigned

Explanation of Need: There is some confusion of what is a stayed flat surface and what to do with the ogee curve.

12. Future Meetings

- July 12th-15th, 2021 – Cincinnati, OH
- January 10th-13th, 2022 – TBD

13. Adjournment

Respectfully submitted,

Jonathan Ellis

Jonathan Ellis
NBIC Secretary

Subcommittee Inspection

Last Name	First Name	Interest Category	Role	Exp. Date	More
Getter	Jim	Manufacturers	Chair	08/30/2021	Details
Horbaczewski	Mark	Users	Vice Chair	08/30/2021	Details
Metzmaier	Jodi		Secretary	01/30/2099	Details
Barker	Timothy	Authorized Inspection Agencies	Member	01/30/2021	Details
Brantley	Ernest	Authorized Inspection Agencies	Member	01/30/2022	Details
Buechel	David	Authorized Inspection Agencies	Member	07/30/2022	Details
Calvert	James	National Board Certificate Holders	Member	08/30/2021	Details
Clark	James	Manufacturers	Member	10/30/2022	Details
Graf	Darrell	National Board Certificate Holders	Member	01/30/2023	Details
LeSage	Donnie	Jurisdictional Authorities	Member	07/30/2023	Details
Mangas	John	General Interest	Member	08/30/2021	Details
Newton	Venus	Authorized Inspection Agencies	Member	07/30/2022	Details
Petersen	Jeffrey	Users	Member	01/30/2023	Details
Ray	Brent	Users	Member	07/30/2023	Details
Roberts	James	Manufacturers	Member	08/30/2023	Details
Rose	David	Users	Member	10/30/2022	Details
Safarz	Jason	General Interest	Member	07/30/2023	Details
Sansone	Matthew	Jurisdictional Authorities	Member	01/30/2021	Details
Scarcella	Vincent	Authorized Inspection Agencies	Member	01/30/2023	Details
Vandini	Thomas	National Board Certificate Holders	Member	01/30/2023	Details
Welch	Paul	Authorized Inspection Agencies	Member	01/30/2022	Details

Supplement 14
Life Extension of High Pressure Fiber Reinforced Plastic Pressure Vessels

S14.1 Scope

This document may be used to evaluate whether the service life of high pressure fiber reinforced plastic pressure vessels (FRP) can be extended for an additional lifetime. High pressure means vessels with a working pressure from 3,000 psi (20 MPa) to 15,000 psi (103 MPa). For vessels intended for cyclic service, fatigue testing of new vessels is carried out by the vessel manufacturer to be certain that the vessel will not fail in service and such testing is typically required by regulatory authorities. Fatigue design and testing is the starting point for consideration of life extension.

S14.2 General

a) The procedure for in-service testing of high pressure composite pressure vessels, **Supplement 10** herein, is incorporated by reference into this procedure for life extension of high pressure composite pressure vessels. Supplement 10 is based on acoustic emission (AE) testing, specifically modal AE (MAE) testing. The MAE inspection procedure employs detection and analysis techniques similar to those found in seismology and SONAR. Much as with earthquakes, transient acoustical impulses arise in a composite material due to the motion of sources such as the rupture of fibers. These transients propagate as waves through the material and, if properly measured and analyzed by the methods in Supplement 10, the captured waves reveal, for example, how many fibers have ruptured. Similar information about other sources is also determinable, such as the presence and size of delaminations. Delaminations can play a significant role in vessel fatigue life, particularly delaminations near the transition regions and in the heads. The rupture behavior can be used to determine the integrity of the vessel. However, the development of criteria for life extension (LE) requires an understanding of the vessel design and fatigue life.

b) Fatigue testing of out of life vessels is a crucial part of the life extension process. It is used to validate the mechanical behavior of the vessels and to develop the numerical values for the allowables in the MAE pass/fail criteria for the particular design, material and construction.

S 14.3 Life Extension Procedure

a) New vessel fatigue life testing data shall be obtained from the Manufacturer's Design Report (MDR) and the number of cycles in a lifetime shall be determined from the MDR. The type of vessel under consideration for life extension shall have been shown through testing to be capable of sustaining at least three lifetimes of cycles to developed fill pressure followed by a subsequent burst test at a pressure greater than minimum design burst pressure.

b) An evaluation of the service the vessel has seen should take into account any operational conditions that may have differed from those used in the design testing and analysis. Such conditions include for example exposure to more severe weather than expected, more cycles

per year, constant high temperature and humidity, chemical attack or any other of a number of conditions under which operations take place that were not specifically included in testing at manufacture. Any such conditions shall be listed on the attached form. If no such conditions exist, it shall be so noted on the form. The test program delineated herein shall be revised to reflect the modified conditions as documented by the user and submitted for approval to the proper authorities.

c) Data and records for all vessels considered for life extension shall be kept and made readily available to inspectors or examination personnel. This includes an operating log, number of operating cycles since the previous examination, total number of operating cycles, examinations, examination techniques and results, maximum operating pressure and any unexpected pressures, temperatures, temperature cycles, damage events or other significant events that were outside the intended operating parameters or conditions.

d) A life extension test program shall be carried out for each type of vessel under consideration. Type of vessel means the particular manufacturer, materials (fiber and resin), water volume and design. If the type of vessel passes all requirements, then that type shall be eligible for life extension testing. If such a vessel passes the life extension MAE test its lifetime can be extended for one additional lifetime in five-year increments. In order to maintain life extension a vessel must be requalified every five years using the MAE test.

S14.4 Life Extension Test Program

a) The type of vessel under consideration for LE shall be noted. Manufacturer, place of manufacture and manufacturing date shall be recorded. The vessel dimensions shall be recorded. The specific fiber, matrix and winding pattern shall be recorded. If the fiber, matrix and winding pattern are not available from the manufacturer, then a vessel of the type under consideration shall be used to verify the winding pattern (hoop and helical angles and number of plies) through destructive testing.

b) Ten out-of-life vessels of the particular type shall be tested in the manner described herein. MAE techniques shall be applied to every vessel tested. Analysis of the MAE data is described herein. Two strain gages, one in the 0-degree and one in the 90-degree direction, shall be applied to every vessel pressure tested under this program. The purpose of strain gage data is to compute the 0 and 90 modulus values and to confirm that the modulus values of the material do not vary during the fatigue cycling required herein. Strain data shall be recorded and analyzed as described later on.

c) The LE test program proceeds by Steps. If the Step 1 is not successful, then there is no need to proceed to Step 2, and so forth.

S14.5 Life Extension Test Program Steps

S14.5.1 Step 1

Three vessels shall be selected from the ten and pressurized to burst. The vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs. MAE testing shall be done in conjunction with this testing as specified in Supplement 10, except for transducer spacing, pressurization plan and accept/reject criteria values. The values in Supplement 10 are for requalification testing. The transducer spacing shall be determined by the distance at which the 400 kHz component of a suitable pulser source is detectable along the axis of the vessel (essentially across the hoop fibers) and in the perpendicular direction (essentially parallel to the hoop fibers). Detectable means that the resulting signal component has an amplitude with at least a signal to noise ratio of 1.4. Transducer frequency response calibration and energy scale shall be carried out as specified in SUPPLEMENT 10. The pressurization plan shall follow that in ASME Section X Mandatory Appendix 8, i.e., there shall be two pressure cycles to test pressure with holds at test pressure as prescribed therein, however, the time interval between the two cycles may be reduced to one minute. For the purposes of life extension, the fiber fracture energy and BEO (background energy oscillation) values shall be as specified below.

a) No BEO greater than 2 times the quiescent energy (see Supplement 10) shall be observed up to test pressure or during pressure holds.

b) No fiber break event energy shall be greater than $24 \times 10^3 \times U_{FB}$ (see Supplement 10) during the second pressurization cycle.

c) No single event shall have an energy greater than $24 \times 10^5 \times U_{FB}$ during the second pressurization cycle.

Note: The numerical values specified in b) and c) can be adjusted through documented testing and stress analysis methods in order to account for the particular design, material and construction.

d) At least two sensors shall remain on each vessel all the way to burst in order to establish the BEO pressure for this type of vessel.

e) Plots of stress versus strain shall show linear behavior up to 90% of burst pressure.

f) The burst pressures of all three vessels shall be greater than the minimum design burst pressure.

g) If the burst pressure of any one of the three vessels is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension and there is no need to proceed with Step 2 below.

Note: It is possible that one or more of the vessels selected had damage not obvious to visual inspection. If during this burst testing phase the MAE test identifies a vessel as damaged, the substitution of three other randomly selected vessels is allowed.

S14.5.2 Step 2

If the vessels pass Step 1, fatigue testing shall be carried out on a minimum of three vessels of the same type being considered for life extension.

a) Prior to testing, the vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs.

b) Prior to fatigue testing, MAE testing as specified in Step 1 shall be done in conjunction with the fatigue testing, hereinafter called the MAE test or MAE testing, in order to determine the suitability of the vessels for fatigue testing, i.e., that they pass the MAE test.

c) Next, the vessels shall be subjected to fatigue cycles. Pressure shall be 100 psi +0, -50% to at least 1.05 x working pressure. Vessels shall survive one and one-half (1.5) additional lifetimes. If they survive then they shall be tested by an MAE test as was done prior to fatigue cycling.

d) Provided they pass the MAE test, they shall be burst tested. At least two sensors shall remain on each vessel all the way to burst in order to establish that the BEO (background energy oscillation) pressure for the fatigued vessels is consistent, i.e., is the same percentage of ultimate, with that of the vessels tested in Step 1.

e) Plots of stress versus strain shall show linear behavior up to 90% of burst pressure.

f) The burst pressures at the end of the fatigue testing shall be greater than or equal to the minimum design burst. If the burst pressure of any one of the three vessels is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension.

S14.5.3 Step 3

If the vessels pass Step 2, impact testing shall be carried out on a minimum of three vessels of the same type being considered for life extension.

a) Prior to testing, the vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs. Prior to impact testing, MAE testing shall be done in order to determine the suitability of the vessels for impact testing, i.e., that they pass the MAE test.

b) Two vessels shall be subjected to an ISO 11119.2 drop test and then subjected to the MAE test.

If they pass the MAE test, then one vessel shall be burst tested. At least two sensors shall remain on the vessel all the way to burst in order to establish that the BEO (background energy oscillation) pressure for the fatigued vessels is consistent, i.e., is the same percentage of ultimate, with that of the vessels tested in Step 1.

c) Plots of stress versus strain shall show linear behavior up to 90% of burst pressure.

d) If the burst pressure is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension.

e) If the first vessel passes the burst test, the other dropped vessel shall be fatigue cycled and subsequently subjected to the MAE test and, if it passes, shall be burst tested under the same conditions as before. If the vessel fails during fatigue cycling, i.e., bursts or leaks, then these vessels shall not be eligible for life extension.

f) If the modulus changes by more than 10%, then these vessels shall not be eligible for life extension. The strain gages should be mounted in a location that is away from the impact zone.

g) The burst pressure at the end of the fatigue testing of the dropped vessel shall be greater than or equal to the minimum design burst. The vessels shall have MAE testing applied during burst testing as before and the BEO shall be consistent with the previously established percent of burst ±10%.

S14.5.4 Step 4

If the vessels pass Step 3, cut testing shall be carried out on a minimum of two vessels of the same type being considered for life extension.

a) Prior to testing, the vessels shall be inspected for visible damage, i.e., cuts, scrapes, discolored areas, and the vessel appearance shall be documented with photographs. Prior to cut testing, MAE testing shall be done in order to determine the suitability of the vessels for cut testing, i.e., that they pass the MAE test.

b) Two vessels shall be subjected to an ISO 11119.2 cut test and then subjected to the MAE test. If they pass, then one shall be burst tested under all the conditions and procedures delineated in Step 2. If the burst pressure is not greater than the minimum design burst pressure, then these vessels shall not be eligible for life extension.

c) If the cut vessel passes, then the other cut vessel shall be fatigue cycled as described in Step 2 and subsequently subjected to the MAE test and then burst tested with at least two MAE sensors remaining on and monitoring the vessel as before. If it does not survive fatigue cycling, then these vessels shall not be eligible for life extension.

d) The burst pressure at the end of the fatigue testing of the cut vessel shall be greater than or equal to the minimum burst pressure specified by ISO 11119.2.

If the vessel type passes Steps 1 to 4, then that type is eligible for life extension. An out of life vessel of the type subjected to the program above may have its life extended for one additional lifetime if it passes the MAE test. The vessel shall pass the MAE test at subsequent five-year intervals or at one-third of the lifetime, whichever is less, in order to continue in service. The vessel shall be labeled as having passed the NBIC life extension test.

U.S. Department
of Transportation

**Pipeline and Hazardous
Materials Safety Administration**

East Building, PHH-30
1200 New Jersey Avenue S.E.
Washington, D.C. 20590

DOT-SP 16320

EXPIRATION DATE: March 31, 2019

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Digital Wave Corporation
Centennial, CO

2. PURPOSE AND LIMITATION:

a. This special permit authorizes the extension of the service life of certain DOT-CFFC cylinders, which are subjected to the requalification and operational controls that are defined in this special permit. This special permit provides no relief from the Hazardous Materials Regulations (HMR) other than as specifically stated herein. The most recent revision supersedes all previous revisions.

b. The safety analyses performed in the development of this special permit only considered the hazards and risks associated with the transportation in commerce.

c. No party status will be granted to this special permit.

3. REGULATORY SYSTEM AFFECTED: 49 CFR Parts 106, 107 and 171-180.

4. REGULATIONS FROM WHICH EXEMPTED: 49 CFR § 180.205(g) in that alternative testing is authorized as provided herein.

5. BASIS: This special permit is based on the application of Digital Wave Corporation dated November 5, 2014 submitted in accordance with § 107.105, the public proceeding thereon, and additional information dated December 23, 2015 and October 11, 2016.

6. HAZARDOUS MATERIALS (49 CFR 172.101):

Hazardous Materials Description			
Proper Shipping Name	**Hazard Class/ Division**	**Identi-fication Number**	**Packing Group**
Air, compressed (breathing air containing up to 39% by volume oxygen)	2.2	UN1002	N/A

7. SAFETY CONTROL MEASURES:

a. Packaging -

(1) Packagings prescribed are limited to certain non-DOT specification composite cylinders made under the DOT-CFFC standard and manufactured under special permits, used exclusively in Self Contained Breathing Apparatus (SCBA) service and maintained under the standard operating procedure as described in the Digital Wave Corporation (DWC) special permit application on file with the Office of Hazardous Materials Safety Approvals and Permits Division (OHMSAPD).

(2) Cylinders may be considered for an extended service life not exceeding 30 years after the original manufacturing date of the cylinder.

(3) Each cylinder considered for extended service life must be requalified by Modal Acoustic Emission (MAE) in accordance with the procedures specified in the DWC application for special permit on file with the OHMSAPD and as prescribed in this special permit.

(4) Cylinders passing the MAE requalification may be marked "DOT-SP 16320" and authorized for an additional 5 years. Cylinders with the DOT-SP 16320 marking must be successfully requalified once every 5 years using MAE in order to remain in service for a maximum service life of 30 years from the date of manufacture.

b. MAE Equipment and Performance - The MAE testing system must include 1) broadband piezoelectric sensors, 2) preamplifiers, 3) high-pass and low-pass filters, 4) amplifiers, 5) A/D (analog-to-digital) converters, 6) a computer program for the collection of data, 7) computer and monitor for the display of data and 8) a computer program for analysis of data. The MAE technician must be capable of examining the waveforms (event by event) and the waveforms for each event must correspond precisely with the pressure and time data during the test. The MAE testing system must include a computer program capable of detecting the first arrival channel. The MAE testing system must include sensors and recording equipment with a current calibration sticker (yearly) or a current certificate of calibration. Sensors shall have a flat frequency response (+/- 6 dB amplitude response over the frequency range specified) from 50 kHz to 400 kHz. Deviation from flat response (signal coloration) must be corrected by using a sensitivity curve obtained with a Michelson Interferometer calibration system similar to the apparatus used by the National Institute for Standards and Technology. MAE sensors must have a diameter no greater than 0.5 inch for the active part of the sensor face. The aperture effect must be taken into account. Sensor sensitivity must be at least 0.1 V/nm. Preamplifiers and amplifiers will have a flat frequency response (+/- 1 dB) over the frequency range of interest. The MAE system must include a high-pass filter of 20 kHz. Additionally, a low-pass filter must be applied to prevent digital aliasing that occurs if frequencies higher than the Nyquist frequency (half the Sampling Rate) are in the signal. The MAE system must include the memory depth (wave window length) and sampling rate of the high speed analog-to-digital (A/D) converter and must be set for the MAE test requirements.

c. Standard References and Calibration -

(1) The MAE system must be calibrated to detect and measure the wave energy of the test object (e.g., fiber breakage from a composite cylinder) by using a Rolling Ball Impactor and Inclined Plate. The rolling ball impactor must be used to create an acoustical impulse in the aluminum-inclined-plate. The impact setup includes a steel ball 1/2 inch in diameter. The ball

impactor is made of chrome steel alloy hardened to R/C 63, ground and lapped to a surface finish of 1.5 micro-inch, within 0.0001 of actual size and roundness within 0.000025 inch. The calibration Inclined Plate is made of aluminum alloy 7075-T6, and must have lateral dimensions of at least 4′ x 4′ in size, and 0.125 inch (0.003 meters) in thickness and be supported by steel blocks. The inclined plate includes a machined square groove 3/8″ wide which supports and guides the impact ball to the impact point. The length of groove and inclined angle must be 16″ and 6°, respectively. The grooved inclined plate must be positioned next to the edge of the aluminum plate such that the center (equator) of the ball impacts the center (mid-line) of the edge of the aluminum plate, as shown in Figure 1 below.

(2) Each Sensor has a flat frequency response (+/- 6 dB amplitude response over the frequency range specified) and has a range of 50 kHz to 400 kHz and diameter less than or equal to 0.5 inch. Each sensor must be mounted on the inclined aluminum plate and tested separately via the rolling ball impact. The vertical position of the ball impact point must be adjusted gradually in order to "peak up" the acoustical signal, much as is done in ultrasonic testing where the angle is varied slightly to peak up the response. The center frequency of the first cycle of the extensional mode plate wave (E wave) must be confirmed as 125 kHz ± 10 kHz. The energy value in joules of the first half cycle of the E wave, is defined as U^{AE}_{RBI}, the wave energy detected by the MAE system, and must be used to scale the fiber break energy, U_{FB}. This must be an "end-to-end" calibration meaning that the energy measured using the complete AE instrumentation (sensor, cables, preamplifiers, amplifiers, filters and digitizer) that is to be used in the actual testing situation. The energy linearity of the complete AE instrumentation (sensor, cables, preamplifiers, amplifiers, filters and digitizer) must be measured by using different roll lengths of 8, 12 and 16 inches. A mechanism (manual or automated) must be used to release the ball down the inclined plane. The start of the E wave must be from the first cycle of the waveform recognizable as the front end of the E wave to the end of the E wave which taken as 10 μs later (the time was calculated from the dispersion curves for the specified aluminum plate). The wave energy must be computed and

recorded from the digital waveform as described in DWC application on file with the OHMSAPD.

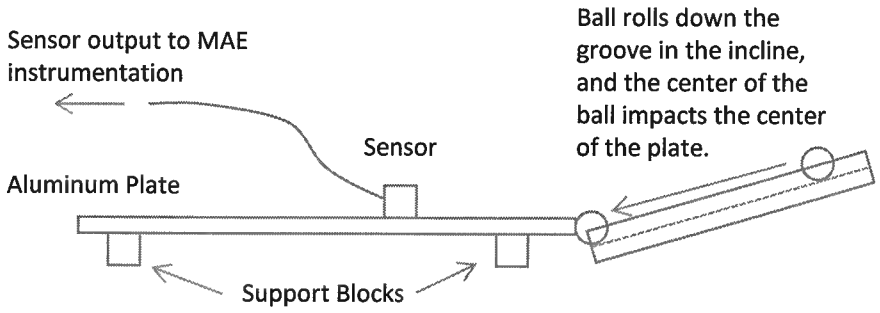


Figure 1. Inclined grooved Plate, impact balls, aluminum plate and sensor configuration

(3) Analog-to-Digital Converter Calibration - The sampling rate of the A/D must be such that aliasing does not occur. The recording system (consisting of all amplifiers, filters and digitizers beyond the sensor) must be calibrated by using a 20 cycle long tone burst with amplitude of 0.1 V at 100, 200, 300, and 400 kHz. The system must display an energy value of

$$U = (V^2 \times N \times T)/(2Z) \text{ joules}$$

at each frequency, where V = 0.1 volts, N = 20, Z is the preamplifier input impedance and T is the period of the cycle. If the measured values agree to within 15% of the theoretical values, the correct sampling rate has been set. These measurements must be performed at a system gain of 0 dB.

(4) Amplifier Gain Correction - All energies must be corrected for gain (e.g., 20 dB (x10) gain increases apparent energy 100 times and 40 dB (x100) gain increases apparent energy 10,000 times).

d. Visual Inspection - Prior to MAE testing, external and internal surfaces of each cylinder must be inspected in accordance with CGA Pamphlet C-6.2. Cylinders that do not meet the visual inspection criteria must be condemned.

e. MAE Test Procedure - After completion of MAE system calibration, the following test procedure must be completed:

(1) Sensor Mounting - A minimum of two (2) sensors must be mounted on each cylinder, one sensor installed at each end of a cylinder. The sensors are located within two inches from the dome-to-sidewall transition area and will be in-line along the axial direction of the vessel.

(2) System sensitivity - The sampling rate and memory depth settings for the MAE system are:

(i) Threshold: 52 dBAE (The sensitivity must be adjusted to account for the response of the sensors as measured from the rolling ball calibration);

(ii) Sampling Rate: 5 MHz; and

(iii) Memory Depth: 2048 Samples.

(3) Sensor Performance Checks - DWC must conduct sensor performance checks prior to each test to verify proper operation and good coupling to the vessel. For the coupling check, the E and F waveforms must be observed by breaking pencil lead at approximately 2 inches (5 cm) from each sensor along the axial direction of the vessel. The energy of the lead break waveforms must be 5×10^{-15} to 20×10^{-15} Joules. If this energy level is not met, the sensor coupling must be checked, or the sensor replaced. All calibration data must be recorded. Amplitude response performance checks must be carried out by pencil lead breaks (Pentel 2H, 0.3 mm) at a location centered along a line between the two sensors. Both sensors must have a maximum amplitude response within 3 dB of each other. The gain settings for the calibration must be such that the signal does not saturate either the amplifiers or the A/D. If so, repeat the lead breaks at a system gain that does not saturate the system. Prior to pressurization, reset the gain to the test gain.

(4) Pressurization Procedure - Each cylinder must be subjected to a two-step hydraulic pressurization process from 0 psig to the cylinder's design test pressure (5/3 marked service pressure). During the first pressurization, the cylinder must be held at test pressure for at least five (5) minutes and up to 15 minutes. If no MAE activity is recorded after a five

(5) minute interval during the hold, the cylinder is stable and the pressure may be reduced to zero (0) psig. The pressure must be held at zero (0) psi for 100 seconds, then the step 1 pressurization must be repeated and held for a period of 100 seconds and depressurized as described above. The MAE event waveforms must be monitored and recorded during the two-step pressurizations process. Pressurization must be stopped, if the Background Energy Oscillation (BEO) exceeds two (2) times the quiescent background energy of that channel. The fill rate must be less than the rate at which flow noise first appears. If at any time during fill, the fill rate is too high in that it causes flow noise, the fill rate must be decreased until the flow noise disappears. A post-test system sensitivity check (lead breaks as described above) must be conducted and the data must be saved. The test temperature shall be between 50 °F (10 °C) and 120 °F (49 °C).

Warning: Appropriate measures shall be taken to ensure safe operation and to contain any energy that may be released as a result of a cylinder rupture during pressurization, regardless of hydraulic or pneumatic pressurization.

f. Accept/Reject Criteria - Each cylinder must be evaluated during MAE testing for the following four (4) Criteria:

(1) Stability - For each channel, the cumulative events versus time plot or event decay rate (B) must be measured.

Rejection - a cylinder must be rejected if the value of B does not meet the following:

$-0.1 \leq B \leq -0.0001$, $R^2 \geq 0.80$

R^2 = coefficient of determination used in regression calculation.

(2) Fiber Breakage - To determine if fiber bundle breakage has occurred during the second pressurization, the frequency spectra of the direct E and F waves in the digital signal must be examined as follows:

(i) Energy Measurement - The energies, U, for the following frequency ranges must be measured and recorded:

U0: 50 - 400 kHz

U1: 100 - 200 kHz

U2: 250 - 400 kHz

(ii) Energy Conditions - The criteria for determining if high frequency spectrum events have occurred, the following conditions must be calculated:

A- $U0 \geq U^{AE}_{FBB}$ Joules; and

B- $U2 / (U1 + U2) \geq 30\%$; and

C- $U2 / U0 \geq 30\%$

(iii) The values of U^{AE}_{FBB} for DOT-CFFC (Carbon Fiber) cylinders are:

U^{AE}_{FBB} for DOT CFFC = 2.7×10^{-16} Joules

Note: These values are sensor and system specific, and must be determined for each monitoring system configuration.

Rejection - A cylinder must be rejected if all three criteria (A, B and C) have occurred.

(3) Friction between Fracture Surfaces - The energy from friction between fracture surfaces is measured from the recorded MAE events.

Rejection - A cylinder must be rejected if a measured MAE event (energy) is greater than 2.7×10^{-14} Joules for carbon fiber cylinders.

(4) Background Energy Oscillation (BEO) - the background energy oscillation of each MAE channel must be measured and recorded during pressurization.

Rejection - A cylinder must be rejected if the BEO exceeds two (2) times the quiescent background energy of that channel at any time during pressurization.

Warning - If BEO with a difference in amplitude is greater than two (2) between minima and maxima, the pressure of the cylinder must be reduced immediately.

g. Action for Rejected Cylinders - When a cylinder is rejected, the retester must securely affix to the cylinder a label with the word "CONDEMNED" overcoated with epoxy near, but not obscuring, the original cylinder manufacturer's label. Alternatively, at the direction of the owner, the requalifier may render the cylinder incapable of holding pressure.

h. Marking - Each cylinder that has passed the requalification described in this special permit for extended service life must be marked "DOT-SP 16320". The new "DOT-SP 16320" marking must cover the current special permit marking by using epoxy, and then epoxy coated to ensure it is permanently attached to the cylinder. All markings, including requalification date (month/year), must be permanently placed on the cylinder as specified in § 180.213. The marking of the RIN symbol on the cylinder certifies compliance with all of the terms and conditions of this special permit.

i. Report - A report must be generated for each cylinder that was tested. The MAE reports must include the following:

(1) RIN;
(2) MAE equipment, model and serial number;
(3) Cylinder manufacture date, serial number, special permit number and marked service pressure;
(4) MAE technicians' name and certification level;
(5) Test date;
(6) Event energies exceeding the fiber bundle failure criteria, if any;
(7) Event energies exceeding the fretting emission energy allowable criteria, if any;
(8) Background energy oscillation pressure;

(9) Visual inspection results (Pass/Fail); and
(10) Acceptance/rejection results. If the cylinder is rejected, include each cause of rejection criteria as described in 7.f.

The MAE reports must be on file at the test site, and must be made available to a DOT representative when requested.

j. Personnel Qualification - Each person who performs retesting or who evaluates or certifies retest results must meet the following requirements:

(1) Project Manager - The senior manager of DWC responsible for compliance with DOT regulations including this special permit. Additionally, the project manager must ensure that each operator and senior review technologist maintains the required certifications described herein.

(2) MAE Tester - The personnel responsible for performing cylinder retesting under this special permit must be qualified to an appropriate Level (Level I, II or III) in MAE testing in accordance with the American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1A-1996 depending upon the assigned responsibility as described below:

(i) As a minimum, a Level II Operator must perform system startup, calibrate the system and review and certify the test results when written acceptance and rejection criteria for cylinders have been provided by a Senior Review Technologist. Based on written criteria, the Level II Operator may authorize cylinders that pass the retest to be marked in accordance with paragraph 7.h. of this special permit. However, a person with Level I certification may perform a system startup, check calibration and perform MAE under the direct guidance and supervision of a Senior Review Technologist or a Level II Operator, either of whom must be physically present at the test site so as to be able to observe examinations conducted under this special permit.

(ii) Senior Review Technologist (SRT) - A person who provides the written MAE procedure, supervisory training and examinations (Level I and II), technical guidance to operators and reviews and verifies the test results. The SRT must prepare and submit the reports required in paragraph 7.i. and annually verify that the MAE program is being operated in accordance with the requirements of this special permit. An SRT must have a thorough understanding of the DOT Regulations (49 CFR) pertaining to the requalification and reuse of DOT cylinders authorized under this special permit and ASNT Recommended Practice SNT-TC-1A and possess:

(A) A Level III certificate from ASNT in Acoustic Emission with a documented minimum of 2 years of experience in Non-Destructive Evaluation (NDE) of pressure vessels or pipelines using the Modal Acoustic Emission test method;

(B) A Professional Engineer (PE) License with a documented minimum of 2 years of experience in Non-Destructive Evaluation (NDE) of pressure vessels or pipelines using the Modal Acoustic Emission test method; or

(C) A PhD degree in Engineering/Physics with documented evidence of experience in Non-Destructive Evaluation (NDE) of pressure vessels or pipelines, using the Modal Acoustic Emission test method or research/thesis work and authoring/co-authoring of technical papers published, in recognized technical journals, in the field of Modal Acoustic Emission testing methods.

The most recent copies of certification (e.g., ASNT Level III or PE license) must be available for inspection at each requalification facility.

k. OPERATIONAL CONTROLS -

(1) The cylinders that are requalified for service life extension under this special permit are limited to DOT-CFFC cylinders that are exclusively used in SCBA service.

(2) Each cylinder covered by the terms of this special permit must have a prominent warning label on the external surface of the cylinder that indicates "The Cylinder must be externally inspected per CGA C6.2 prior to every fill".

(3) A cylinder that has been dropped in a fire may not be returned to service.

(4) Each cylinder that is requalified for service life extension under this special permit must be identified by special permit designation, serial number, the cylinder's owner (e.g., Fire station), and MAE requalification results (fail/pass);

(5) The original special permit marking of each cylinder that is requalified for service life extension under this special permit must be covered and replaced with "DOT-SP 16320" as described in paragraph 7.d. of this special permit.

(6) Record Keeping - Prior to marking a cylinder with "DOT-SP 16320" (designation for extended service life), the identification of each cylinder as described in paragraph 8.c. of this special permit must be submitted to the OHMSAPD.

(7) Revalidation Plan - All cylinders marked with "DOT-SP 16320" are subject to the in-service life extension (Revalidation Plan). The Revalidation Plan is described in paragraph 8.a. of this special permit.

(8) Maximum Service Life - Cylinders requalified under this special permit are authorized for an additional 5 year service life extension. The maximum service life of any cylinder that was qualified under this special permit is 30 years from the date of manufacture.

8. SPECIAL PROVISIONS:

a. Revalidation Plan - DWC must formulate a plan for all the cylinders that are marked "DOT-SP 16320" for the additional service life extension. The plan must be submitted to the OHMSAPD within 12 months of the issuance of this special permit and must include:

(1) A detailed procedure for obtaining the DOT-CFFC cylinders from the field and design qualification testing of each design type;

(2) A procedure for the random selection of a minimum of 5 cylinders which have been in service for 18, 21, 24 and 27 years;

(3) All randomly selected cylinders from the field must be tested in accordance with Sections 8.5.4, 8.5.5, 8.5.7 and 8.5.8 of ISO 11119-2:2002. Acceptance criteria must be as defined in ISO 11119-2; and

(4) The complete MAE test report, including the original test data, must be submitted to the Associate Administrator for Hazardous Materials Safety for assessment within 30 days of completion of the test. Failure to meet the acceptance criteria specified in this special permit may result in the design being restricted to a maximum life of 15 years.

b. The designated SRT must review the MAE program annually. The designated SRT must submit a letter to the OHMSAPD, on January 7th each year that this special permit is effective, verifying that the MAE program is meeting the terms and requirements of this special permit.

c. The total number of cylinders tested under this special permit must be reported by special permit number, type (e.g., CFFC), serial number and age. These results must be summarized and reported to DOT on an annual basis. A summary of the test results at each facility must be reported (electronic or paper) to the Associate Administrator for Hazardous Materials Safety annually to assess the effectiveness of the test program. The summary must include the total number of cylinders tested under this special permit grouped by type or special permit number, size and age. The summary must include the number of cylinders accepted, rejected or condemned. For any rejected or condemned cylinder, the defect causing the rejection/condemnation must be fully characterized and profiled (i.e., cuts, abrasions, impacts, fiber failures, chemical damage, heat damage, etc.) and the specific size of the defect should be determined (i.e., length, depth, width, etc.). The cylinders that were condemned at visual inspection (prior to MAE) must also be included in the report.

d. A statement of qualifications and supporting documentation, for each "qualified MAE tester" used under this special permit and information in support thereof, must be maintained by DWC. The location of this statement, for each "qualified MAE tester", must be identified to the OHMSAPD.

e. A person who is not a holder of this special permit who receives a package covered by this special permit may reoffer it for transportation provided no modification or change is made to the package and it is reoffered for transportation in conformance with this special permit and the HMR.

f. A current copy of this special permit must be maintained at each facility where the package is offered or reoffered for transportation.

g. A current copy of the DOT special permit for the cylinders listed in paragraph 7.a. of this special permit must be maintained at each facility where retesting is performed.

9. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, cargo vessel, passenger-carrying aircraft, cargo aircraft and rail freight.

10. MODAL REQUIREMENTS: A current copy of this special permit must be carried aboard each cargo vessel, aircraft, or motor vehicle used to transport packages covered by this special permit. The shipper must furnish a copy of this special permit to the air carrier before or at the time the shipment is tendered.

11. COMPLIANCE: Failure by a person to comply with any of the following may result in suspension or revocation of this special permit and penalties prescribed by the Federal hazardous materials transportation law, 49 U.S.C. 5101 et seq:

- All terms and conditions prescribed in this special permit and the Hazardous Materials Regulations, 49 CFR Parts 171-180.
- Persons operating under the terms of this special permit must comply with the security plan requirement in Subpart I of Part 172 of the HMR, when applicable.

- Registration required by § 107.601 et seq., when applicable.

Each "Hazmat employee", as defined in § 171.8, who performs a function subject to this special permit must receive training on the requirements and conditions of this special permit in addition to the training required by §§ 172.700 through 172.704.

No person may use or apply this special permit, including display of its number, when this special permit has expired or is otherwise no longer in effect.

Under Title VII of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)— "The Hazardous Materials Safety and Security Reauthorization Act of 2005" (Pub. L. 109-59), 119 Stat. 1144 (August 10, 2005), amended the Federal hazardous materials transportation law by changing the term "exemption" to "special permit" and authorizes a special permit to be granted up to two years for new special permits and up to four years for renewals.

12. REPORTING REQUIREMENTS: Shipments or operations conducted under this special permit are subject to the Hazardous Materials Incident Reporting requirements specified in 49 CFR §§ 171.15 Immediate notice of certain hazardous materials incidents, and 171.16 Detailed hazardous materials incident reports. In addition, the grantee(s) of this special permit must notify the Associate Administrator for Hazardous Materials Safety, in writing, of any incident involving a package, shipment or operation conducted under terms of this special permit.

Issued in Washington, D.C.:

April 21, 2017

William Schoonover
Associate Administrator for Hazardous Materials Safety

Address all inquiries to: Associate Administrator for Hazardous Materials Safety, Pipeline and Hazardous Material Safety Administration, U.S. Department of Transportation, East Building PHH-30, 1200 New Jersey Avenue, Southeast, Washington, D.C. 20590.

Copies of this special permit may be obtained by accessing the Hazardous Materials Safety Homepage at http://hazmat.dot.gov/sp_app/special_permits/spec_perm_index.htm. Photo reproductions and legible reductions of this special permit are permitted. Any alteration of this special permit is prohibited.

PO: MT

1.6 CHANGE OF SERVICE

Supplement 9 of this part provides requirements and guidelines to be followed when a change of service or service type is made to a pressure-retaining item.

Whenever there is a change of service, the Jurisdiction where the pressure-retaining item is to be operated, shall be notified for acceptance, when applicable. Any specific jurisdictional requirements shall be met.

1.7 SCRAPPING PRESSURE RETAINING ITEMS

The owner or user shall deface the code nameplate(s) of any pressure retaining item that is scrapped. The removal or defacement of the Code nameplate(s) should be verified by the Inspector, and the National Board form NB-XXX shall be completed and submitted to the National Board and Jurisdiction, if required.

ADD DEFINITION:

SCRAPPED – Permanent removal from service by owner's or user's procedures.

Scrapping of Pressure Retaining Items

In accordance with provisions of the National Board Inspection Code

1.Submitted to:

Name of Jurisdiction

Address

Phone Number

2. Submitted by:

(Name of Owner/User)

Address

Phone Number

3. Manufactured by:
(name and address)

4. Location of Installation:
(address)

5. Manufacturer's Data Report: ☐ YES ☐ NO

6. Item Registered with National Board: ☐ YES ☐ NO NB Number: _____

7. Item Identification:

Year Built: _____ Mfr. Serial No.: _____

Type: _____ Jurisdiction no.: _____

Dimensions: _____ MAWP: _____

8. Date of removal or defacement of the Code nameplate(s) _____

9. I certify that to the best of my knowledge and belief the statements in this report are correct, and with provisions of the National Board Inspection Code.

Name of Owner or User: _____

Signature: _____ Date: _____

Instructions for Completing the Form NB-XXX, *Scrapping of Pressure Retaining Items Form*

Items 1-9 shall be completed by the owner, user, or "R" Stamp Holder making the request.

1) The name, address, and phone number of the Jurisdiction, Authorized Inspection Agency (when there is no Jurisdiction) the form is being submitted to for approval.
2) Enter the name and address of your company or organization.
3) Enter the name and address of the manufacturer shown on the name plate.
4) Enter the name and address of the location where the pressure-retaining item is installed. If this is the same as number 2, check the box "same as # 4."
5) Manufacturer's Data Report Attached-check the appropriate box.
6) Is the pressure-retaining item registered with the National Board? Check the appropriate box. If yes, provide the National Board Registration Number.
7) Provide as much information as known to help identify the pressure-retaining item.
8) Enter date the removal or defacement of the Code nameplate.
9) Enter the name and signature of the owner, user, or "R" Stamp Holder (and "R" Stamp number if applicable).

Note: Once completed the requester shall file a copy with the Jurisdiction where the pressure retaining item is installed, the National Board (if registered with the National Board), and the owner or user of the vessel if the request was made by an "R" Stamp Holder, and upon request to the Authorized Inspection Agency who witnessed the removal or defacement of the nameplate.

Proposed NBIC Part II Section 2.3.6.11. Task 18-63

2.3.6.11 Inspection of Vessels for pressures at and above 10,000 PSI

a) This section provides guidelines for the inspection of pressure vessels designed for pressures at or above 10,000 PSI.

b) Inspector shall verify the vessel is constructed to a standard acceptable to the jurisdiction.

c) The inspector shall verify the following these requirements as part of the inspection:

1. Records are being kept of cycles
2. Complete documentation of installation of safety interlocks required by the manufacturer and the jurisdiction for the vessel with listed set points, readily available to the operator and inspector. All devices must be listed.
3. Documentation safety device alarms and interlock checks are being completed on each protective device and controls are calibrated in accordance with manufacturers specifications
4. Operators and maintenance personal are trained for the inspection, maintenance and operation of the vessel and systems
5. Documentation of pressure relief device inspection and testing

d) Vessels constructed for a set number of cycles, as defined by the code of construction, which have reached the end of those cycles, must be removed from service or requalified for continued use. Any requalification for continued service must be completed in accordance with the requirements of the jurisdiction. The inspector shall verify that documentation of any requalification is retained.

e) Requalification of any vessel shall either be completed by the original manufacturer or a manufacturer familiar with the construction of pressure vessels at and above 10,000 PSI. Guidance for completing requalification can be found in ASME PCC-3, Inspection Planning and Using Risk-Based Methods.

Action Item Request Form

CODE REVISIONS OR ADDITIONS

Request for Code revisions or additions shall provide the following:

a) Proposed Revisions or Additions

Current text is incomplete with respect to inspecting riveted joints for failure. This proposal suggests adding more text, found in historic inspection documents, to further assist and direct the field inspector for assessing the condition of a riveted joint.

Existing Text:

S2.10.7 LIMITATIONS

a) The maximum allowable working pressure shall be the lesser of that calculated in accordance with NBIC Part 2, S2.10, or the MAWP established by the original manufacturer.

b) The shell or drum of a boiler in which a "lap seam crack" extending parallel to the longitudinal joint and located either between or adjacent to rivet holes, when discovered along a longitudinal riveted joint for either butt or lap joint, shall be permanently discontinued for use under steam pressure, unless it is repaired with jurisdictional approval.

Provide a brief explanation of the need for the revision or addition.

The text covers cracks parallel to a longitudinal joint, but there is no text covering inspection of plate material around a rivet.

c) Background Information

Review of the NBIC shows that failure indicators of riveted seams have not been identified or itemized. This proposal addresses this oversite.

Referenced standards, related discussion follow proposed wording.

Proposed wording

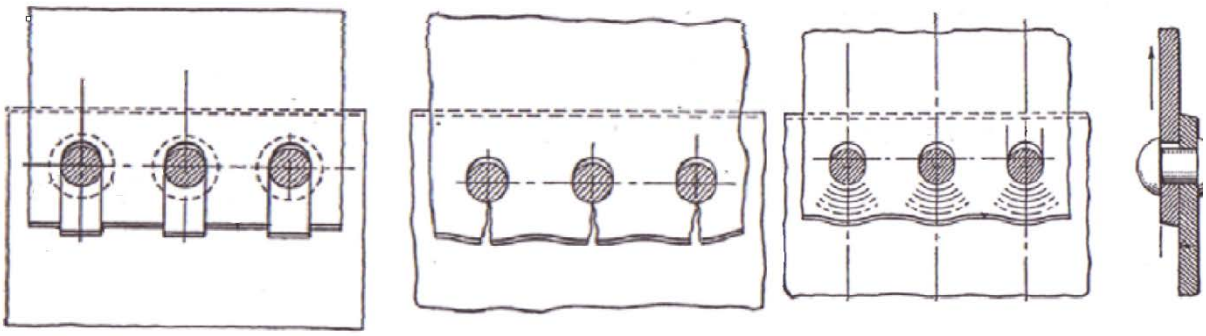
S2.10.2.3 INSPECTION OF RIVETED SEAMS

A riveted joint in a vessel subjected to pressure may fail in a number of different ways, depending on the type and relative proportions of the joint. Methods of failure may be classified as follows:

a.) Rivets may shear off.
b.) The plate may tear along the centerline of the row of rivets.
c.) The plate may shear in front of the rivets.
d.) The plate may tear from the outer edge of the rivet hole to the caulking edge.
e.) The plate may crush in front of the rivets.

Figure S2.10.2.3 illustrates visual indicators of (c), (d), (e). Inspection shall visually inspect for cracked or stressed plate material along a riveted joint. Indications of failure shall be monitored or repaired, at the discretion of the jurisdiction.

FIGURE S2.10.2.3



Note: Good engineering practice requires that the lap of plate outside rivet holes, measured from the outer edge of the rivet holes to the edge of the plate must be at least equal to the diameter of the rivet hole.

Referenced text:

Steam Boiler Design, Part 2, Great Britain, 1922:

20. Methods of Failure of Riveted Joint.—A riveted joint in a vessel subjected to pressure may fail in a number of different ways, depending on the type and relative proportions of the joint; but the simplest methods of failure may be illustrated by taking a single-riveted lap joint as an example. With such a joint, the methods of failure may be classified as follows:

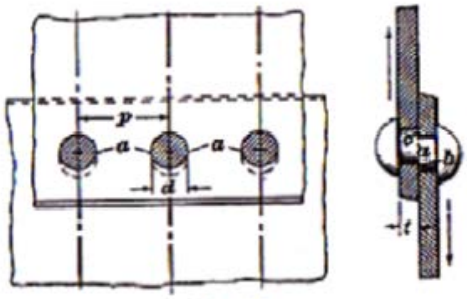


FIG. 19

1. The rivets may shear off, as shown in Fig. 19.

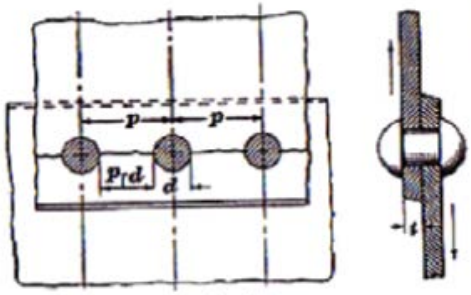


FIG. 20

2. The plate may tear along the center line of the row of rivets, as shown in Fig. 20.

3. The plate may crush in front of the rivets, as shown in Fig. 21.

4. The plate may shear in front of the rivets, as shown in Fig. 22 (*a*).

5. The plate may tear from the outer edge of the rivet hole to the calking edge, as shown in Fig. 22 (*b*).

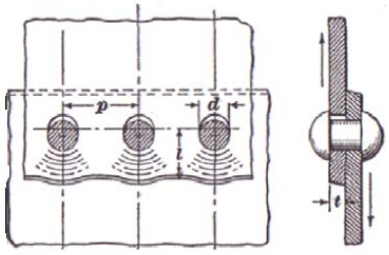


FIG. 21

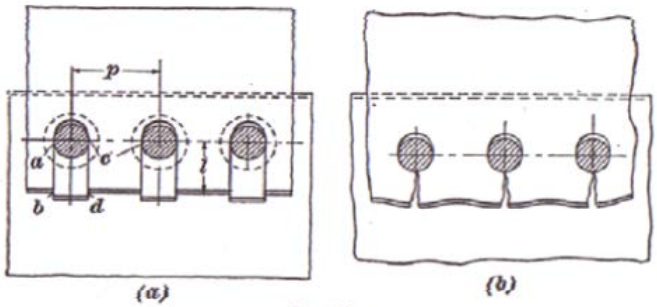


FIG. 22

The provided Note is also important, because a design that does not adhere to this rule may need a different joint efficiency value than what is provided in TABLE S2.10.6. This rule has existed but is not necessarily followed in pre-code boilers.

ASME, 1914:

183 On longitudinal joints, the distance from the centers of rivet holes to the edges of the plates, except rivet holes in the ends of butt straps, shall be not less than one and one-half times the diameter of the rivet holes.

Canadian Interprovincial Standard, 1931:

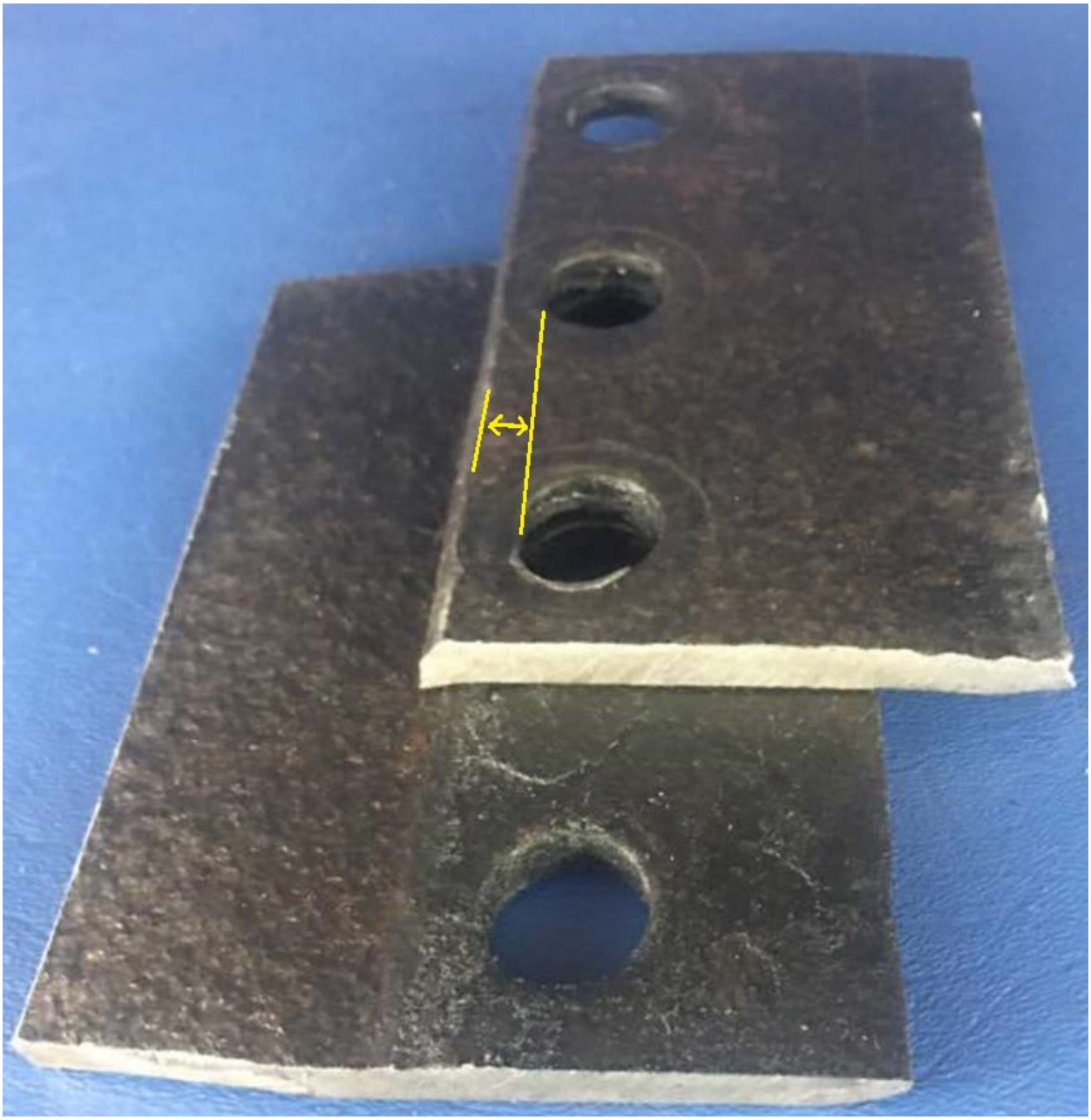
Lap Outside Rivet Holes

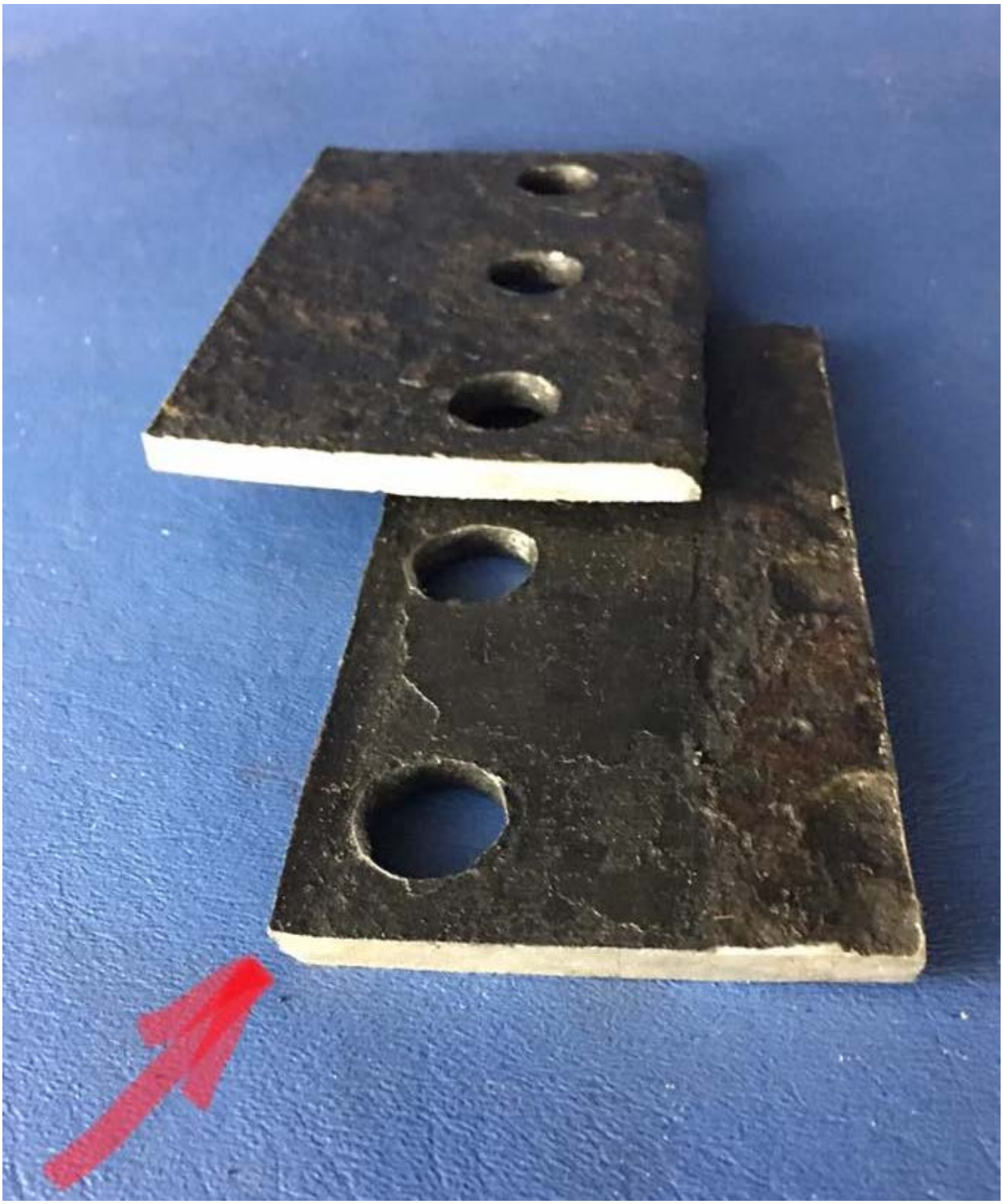
199. The lap of plate outside rivet holes measured from the outer edge of the rivet holes to edge of plate must be at least equal to diameter of rivet hole, and must not be more than 1/8 inch in excess of the diameter of the rivet hole.

Thurston, 1888:

tion. The joint is so proportioned that the fracture will occur by shearing the rivets rather than by breaking out the edge of the sheet or tearing away the lap bodily. The lap usually extends beyond the rivet-hole about 1.5 times the diameter of the rivet.

Single-row lap seam from an 1881 6hp Russell traction engine:





2.2.12.7 THERMAL FLUID HEATERS

a) Design and Operating Features

1) Many thermal fluid heaters are pressure vessels in which a synthetic or organic fluid is heated or vaporized. Some thermal fluid heaters operate at atmospheric pressure. The fluids are typically flammable, are heated above the liquid flash point, and may be heated above the liquid boiling point. The heaters are commonly direct-fired by combustion of a fuel or by electric resistance elements. Heater design may be similar to an electric resistance heated boiler, to a firetube boiler or, more commonly, to a watertube boiler. Depending on process heating requirements, the fluid may be vaporized with a natural circulation, but more often, the fluid is heated and circulated by pumping the liquid. Use of thermal fluid heating permits heating at a high temperature with a low system pressure (600°F to 700°F [316°C to 371°C] at pressures just above atmospheric). To heat water to those temperatures would require pressures of at least 1,530 psig (10.6 MPa).

2) Nearly all thermal heating fluids are flammable. Leaks within a fired heater can result in destruction of the heater. Leaks in external piping can result in fire and may result in an explosion. Water accumulation in a thermal heating system may cause upsets and possible fluid release from the system if the water contacts heated fluid (remember, flashing water expands approximately 1,600 times). It is essential for safe system operation to have installed and to maintain appropriate fluid level, temperature and flow controls for liquid systems, and level, temperature, and pressure controls for vapor systems. Expansion tanks used in thermal heater systems, including vented systems, should be designed and constructed to a recognized standard such as ASME Section VIII, Div. 1, to withstand pressure surges that may occur during process upsets. This is due to the rapid expansion of water exceeding the venting capability.

3) ~~3)~~ Because heat transfer fluids contract and become more viscous when cooled, proper controls and expansion tank venting are required to prevent low fluid level and collapse of the tank. Some commonly used fluids will solidify at temperatures as high as 54°F (12°C). Others do not become solid until -40°F (-40°C) or even lower. The fluids that become viscous will also become difficult to pump when cooled. Increased viscosity could cause low flow rates through the heater. The heater manufacturer recommendations and the fluid manufacturer's Material Safety Data Sheets (MSDS) should be reviewed for heat tracing requirements.

4) Verify the thermal fluid heaters have stack gas temperature indicators, alarms and safety shut down devices. Stack gas temperatures must be monitored daily while in operation.

((Need to present to NBIC Part 1 that the installion of high stack temperature indicator with a safety shut down be mandatory. See Supplament 5.5.7 3 a change "may" to "must"))

b) Industrial Applications

Thermal fluid heaters, often called boilers, are used in a variety of industrial applications such as solid wood products manufacturing, resins, ~~turpentines~~turpentine, and various types of chemicals, drugs,

plastics, corrugating plants, and wherever high temperatures are required. They are also frequently found in asphalt plants for heating of oils, tars, asphalt pitches, and other viscous materials. Many chemical plants use this type of heater in jacketed reactors or other types of heat exchangers.

c) ~~Inspection~~

~~1) Inspection of thermal fluid heaters typically is done in either the operating mode or the shutdown mode. Internal inspections, however, are rarely possible due to the characteristics of the fluids and the need to drain and store the fluid. Reliable and safe operation of a heater requires frequent analysis of the fluid to determine that its condition is satisfactory for continued operation. If the fluid begins to break down, carbon will form and collect on heat transfer surfaces within the heater. Over- heating and pressure boundary failure may result. Review of fluid test results and control and safety device maintenance records are essential in determining satisfactory conditions for continued safe heater operation.~~

~~2)~~1) Due to the unique design and material considerations of thermal fluid heaters and vaporizers, common areas of inspection are:

a. Design — Specific requirements outlined in construction codes must be met. Some jurisdictions may require ASME Section I or Section VIII construction. Code requirements for the particular Jurisdiction should be reviewed for specific design criteria;

b. Materials — For some thermal fluids, the use of aluminum or zinc anywhere in the system is not advisable. Aluminum acts as a catalyst that will hasten decomposition of the fluid. In addition, some fluids when hot will cause aluminum to corrode rapidly or will dissolve zinc. The zinc will then form a precipitate that can cause localized corrosion or plug instrumentation, valves, or even piping in extreme cases. These fluids should not be used in systems containing aluminum or galvanized pipe. The fluid specifications will list such restrictions;

Note: Some manufacturers of these fluids recommend not using aluminum paint on valves or fittings in the heat transfer system.

c. Corrosion — When used in applications and installations recommended by fluid manufacturer, heat transfer fluids are typically noncorrosive. However, some fluids, if used at temperatures above 150°F (65°C) in systems containing aluminum or zinc, can cause rapid corrosion;

d. Leakage — Any sign of leakage could signify problems since the fluid or its vapors can be hazardous as well as flammable. Areas for potential leaks include cracks at weld attachment points and tube thinning in areas where tubes are near soot blowers. The thermal fluid manufacturer specifications will list the potential hazards;

e. Solidification of the fluid — Determine that no conditions exist that would allow solidification of the thermal fluid. When heat tracing or insulation on piping is recommended by the heater manufacturer, the heat tracing and insulation should be checked for proper operation and installation;

~~f.~~ f. Pressure relief devices — Pressure relief valves shall be a closed bonnet design with no manual lift lever. Pressure relief valves must be tested by a qualified repair concern every 12 to 36 months, depending on conditions, unless otherwise directed by the jurisdiction. The pressure relief installation ~~discharge~~ shall ~~ould~~ meet the requirements of NBIC Part IV, Section 2.3. Inspection and testing of the relief device shall meet the requirements of NBIC Part IV, Section 3. ~~be connected to a closed, vented storage tank or blowdown tank with solid piping (no drip pan elbow or other air gap). When outdoor discharge is used, the following should be considered for discharge piping at the point of discharge:~~

~~1. Both thermal and chemical reactions (personnel hazard);~~
~~2. Combustible materials (fire hazard);~~
~~3. Surface drains (pollution and fire hazard);~~
~~4. Loop seal or rain cap on the discharge (keep both air and water out of the system);~~
~~5. Drip leg near device (prevent liquid collection); and~~
f. ~~6. Heat tracing for systems using~~

~~g. Inspections~~

g. Inspections of thermal fluid heaters shall include verifying that fluid testing is conducted annually and that results are compared to the fluid manufacturer's standard. The inspector shall annually verify the documentation of testing of controls and safety devices.

((Need to consult manufactuer on internals))

h. Vapor phase systems must have a documented vessel and piping risk based inspection assessment program in accordance with NBIC Part 2, 4.5.

PROPOSED ACTION ITEM

Item Number:	**20-59**
Submitted by:	Doug Biggar doug@ditechtesting.com
Subject:	Temporary nameplate removal for external inspection. **Explanation of Need:** What is being added to NBIC part 2 (item 19-30) for NBIC 2021 edition: [(e) removal and re-attachment of the original manufacturer's nameplate shall only be done in accordance with NBIC Part 3, 5.11]. To have an inspector present onsite each time we need to have a nameplate temporarily removed has a cost that a commercial refurbisher such as ourselves would need to pass onto the customer as well as dramatically affect the efficiency of our assembly line. **Background Information:** Ditech Testing is the largest commercial refurbisher of LPG pressure vessels in North America. Approximately 15-25% of bulk ASME LPG Pressure vessels can have a raised nameplate which needs complete removal for external inspection and re-coating under it.
NBIC Location:	2019 NBIC Part 2, 5.2.1 a)

Current Text:	**Proposed Text:**
5.2.1 AUTHORIZATION a) Permission from the jurisdiction is not required for the reattachment of nameplates that are partially attached. When traceability cannot be established, the jurisdiction shall be contacted.	**5.2.1 AUTHORIZATION** a) Permission from the jurisdiction is not required for the reattachment of nameplates that are partially attached or wholly removed temporarily for external inspection purposes by a commercial refurbisher. When traceability cannot be established, the jurisdiction shall be contacted.

Item #20-70 **Proposal V1**

Task Group Locomotive Boilers

Summary

Many steam locomotive operators do not inspect the sliding firebox supports on their locomotives (when they are equipped). Inspections have found them to be rusted in-place causing breakage of connection bolts and other damage to the locomotive firebox and mudring.

Furnace slide supports which are locked in-place by corrosion will adversely impact the thermal expansion of the boiler and lead to staybolt breakage.

Proposal

S1.4.2.29 BOILER ATTACHMENT BRACKETS

The boiler attachment brackets and associated components and fasteners used to secure the boiler to the frame shall be inspected for:

a) Correct installation;
b) Damaged or missing components;
c) Looseness;
d) Leakage;
e) Loose, bent, broken, or damaged rivets, nuts, bolts and studs;
f) Defective rivets;
g) Provision for expansion; and
h) Corrosion which may preclude free movement of sliding supports

Item #20-71 **Proposal V1**

Task Group Locomotive Boilers

Summary

Locomotive safety valves may have nameplate data that is missing or illegible. Owners have to rely on capacity charts produced by the manufacturers. These charts were dependent upon the lift of the valve. The valve lift prior to around 1920 was fixed at 0.1 inch. However, after 1920 or so, manufacturers began to increase the lift of their valves. This lead to increased relieving capability. Thus, it is imperative to understand the lift of the valve on the locomotive in order to assign the correct relieving capability.

This is to ensure safety valves provide the adequate relieving capacity for steam locomotive boilers..

Proposal

a) The minimum safety valve capacity in pounds per hour (kilograms per hour) shall be calculated by multiplying the boiler heating surface area by the factor from the appropriate chart in NBIC Part 2, Table S1.6 (1 pound steam/hr/sq. ft = 4.88 kg steam/hr/sq meter).

b) If the original nameplate data for the locomotive’s safety valves is missing or illegible, the relieving capacity of the installed safety valve(s) shall be obtained from the manufacturer's capacity charts corresponding to the valve model, diameter, pressure setting, and valve lift.

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 definitios 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** d) 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)

NBIC Part 2 Inquiry

Robert Underwood
Hartford Steam Boiler
12/15/20

Item No.	**20-82 –** Reporting of Form NB-136
Purpose	To permit the original PRI manufacturer to prepare and submit Form NB-136
Statement of Need:	Revise NB-136 Reporting requirements and Form NB-136 to permit the original manufacturer of the pressure retaining item to prepare and submit the form.
Background Information:	This proposal is the result of a field inquiry. Currently, only the owner, user, or R Stamp holder are permitted to prepare and submit Form NB-136 (Replacement of Stamped Data). After discussing with NB staff, we saw no reason to prohibit the original PRI manufacturer from replacing stamped data or nameplates and preparing/submitting the NB-136 Form. This proposal will revise 5.2.2(a), Form NB-136, and the instructions on how to complete Form NB-136 (paragraph 5.3.3) to permit the original PRI manufacturer to prepare and submit the NB-136 Form.
Existing Text:	**See Attachment**
Proposed Text:	**See Attachment**

5.2.2 REPORTING

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

5.3.3 INSTRUCTIONS FOR COMPLETING THE FORM NB-136, REPLACEMENT OF STAMPED DATA FORM

Items 1-12 shall be completed by the owner, user, original manufacturer, or “R” Stamp holder making the request.

1) Enter purchase order, job, or other identifying number used by your company if applicable.

2) The name, address and phone number of the Jurisdiction, Authorized Inspection Agency (when there is no Jurisdiction) the form is being submitted to for approval.

3) Enter the name and address of your company or organization.

4) Enter the name, email, and phone number of the person who can be contacted if there are any questions concerning this request within your company or organization.

5) Enter the name and address of the location where the pressure-retaining item is installed. If this is the same as number 3, check the box “same as # 3”. If the pressure-retaining item is being refurbished and the final installation location is unknown, check the box “Stock item-unknown”.

6) Enter the date the pressure-retaining item was installed. If unknown check the box “Unknown”.

7) Enter the name of the manufacturer of the pressure retaining item the request is being submitted for.

8) Manufacturer’s Data Report Attached, check the appropriate box.

9) Is the pressure-retaining item registered with the National Board? Check the appropriate block. If yes provide the National Board Registration Number.

10) Provide as much information as known to help identify the pressure-retaining item.

11) Provide a true facsimile of the legible part of the nameplate or stamping.

12) Attach any other documentation that helps provide traceability of the vessels to the original stamping, such as purchase orders, blueprints, inspection reports, etc.

13) Provide the name of owner, ~~or~~ user, or original manufacturer of the pressure-retaining item or “R” Stamp holder making the request. If an “R” Stamp holder, provide the “R” Stamp number. Signature of the requester and date requested.

14) To be completed by the Jurisdiction or Authorized Inspection Agency’s authorized representative.

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

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

After authorization, the form will be returned to the owner, user, original manufacturer, or “R” Stamp holder who made the request. The requester is required to contact the Jurisdiction or an Authorized Inspection Agency to pro- vide a National Board Commissioned Inspector to witness the re-stamping or installation of the new nameplate. If the nameplate is being welded to the pressure-retaining boundary of the vessel, the weld- ing shall be done by a “R” Stamp holder. The requester will provide the new nameplate or have the tools on-hand to do the re-stamping in accordance with the original Code of Construction.

15) Once the re-stamping is completed, or the new nameplate is attached, the requester shall provide a true facsimile of the replacement stamping.

16) The owner, user, original manufacturer, or “R” Stamp Holder shall fill in their name (and number if an “R” Stamp holder), sign and date.

17) To be completed by the National Board Commissioned Inspector who witnessed the re-stamping or installation of the new nameplate.

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

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

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

2. SUBMITTED TO: _____
(Name of Jurisdiction)

_____
(Address)

_____
(Telephone no.)

3. SUBMITTED BY: _____
(Name of Owner, User, **Original Manufacturer,** or **"R"** Certificate Holder)

_____
(Address)

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

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

_____
(Name)

_____
(Address)

6. DATE INSTALLED: _____ ☐ UNKNOWN

7. MANUFACTURER: _____
(Name)

8. MANUFACTURER'S DATA REPORT ATTACHED: ☐ NO ☐ YES

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

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

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

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

NAME: _____ NUMBER: _____
(Name of Owner/user, Original Manufacturer, or "R" Certificate Holder) ("R" Certificate Holder only)

SIGNATURE: _____ DATE: _____
(Authorized Representative)

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

SIGNATURE: _____ DATE: _____
(Authorized Jurisdictional Representative or Inspector)

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

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

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

NAME: _____ NUMBER: _____
(Name of Owner/user, Original Manufacturer, or "R" Certificate Holder) ("R" Certificate Holder only)

SIGNATURE: _____ DATE: _____
(Authorized Representative)

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