**Attachment 3**

## PROPOSED INTERPRETATION

| | | | | | |
|---|---|---|---|---|---|
| **Inquiry No.** | IN12-0201 | | | | |
| **Source** | Daren Daily & Mark Anderson | | | | |
| **Subject** | Part 2, 5.5.2-5.2.3 | | | | |
| **Edition** | 2011 Edition | | | | |
| **Question** | If a National Board Commissioned Inspector has verified the replacement of stamped data or nameplate by an "R" Certificate Holder on Corrugated rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, is the application of an NB-136"Replacement of Stamped Data" form required? | | | | |
| **Reply** | No, if performed by an "R" Certificate holder and verified by an National Board Commissioned Inspector the responsibility of traceability and nameplate accuracy is on the Certificate Holder similar to nameplate replacement in the NBIC Part 3, 5.5.9.5. | | | | |
| **Committee's Question** | | | | | |
| **Committee's Reply** | | | | | |
| **Rationale** | | | | | |
| **SC Vote** | Unanimous | No. Affirmative | No. Negative | No. Abstain | No. Not Voting |
| **NBIC Vote** | Unanimous | No. Affirmative | No. Negative | No. Abstain | No. Not Voting |
| **Negative Vote Comments** | | | | | |

## PROPOSED INTERPRETATION

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|---|---|---|---|---|---|
| **Inquiry No.** | IN12-0202 | | | | |
| **Source** | Daren Daily & Mark Anderson | | | | |
| **Subject** | Part 2, 5.5.2-5.2.3 | | | | |
| **Edition** | 2011 Edition | | | | |
| **Question** | Can an NB-136 "Replacement of Stamped Data Form" which is required to be signed by a National Board Commissioned Inspector, for Corrugated Rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, be filed with The National Board and copied to the applicable Jurisdiction in lieu of obtaining an approval signature from the Jurisdiction? | | | | |
| **Reply** | Yes, the approval from one Jurisdiction should not be incumbent on any other Jurisdiction due to transient nature of Corrugated Roll Pressure Equipment. Similarly, if there was no Jurisdiction in the location of installation another Jurisdiction would be compelled to accept National Board filing if the equipment is moved. | | | | |
| **Committee's Question** | | | | | |
| **Committee's Reply** | | | | | |
| **Rationale** | | | | | |
| **SC Vote** | Unanimous | No. Affirmative | No. Negative | No. Abstain | No. Not Voting |
| **NBIC Vote** | Unanimous | No. Affirmative | No. Negative | No. Abstain | No. Not Voting |
| **Negative Vote Comments** | | | | | |

IN 12-0201

# TECHNICAL INQUIRY -REVISIONS AND ADDITIONS & INTERPRETATIONS

**Secretary, NBIC Committee**
**The National Board of Boiler and**
**Pressure Vessel Inspectors**
**1055 Crupper Avenue**
**Columbus, OH 43229**

## RE: NBIC PART 2, SECTION 5, 5.2 THROUGH 5.2.3

## REPLACEMENT OF STAMPING DURING INSERVICE INSPECTION

## & NB-136 REPLACEMENT OF STAMPED DATA FORM

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### Statement of Need:

The verbiage of the NB-136 "REPLACEMENT OF STAMPED DATA FORM" appears to have originally been written around stationary equipment that has its In-Service Inspections performed at the Owners or Users site by an Inspector. Because it does not appear to address transient equipment that is serviced off-site, and moved between Jurisdictions, it has caused confusion with regards to who should file this form (owner/user or Certificate Holder) and if this form is applicable to all Pressure Equipment or just stationary equipment.

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### Background Information:

- Corrugated Rolls are not stationary and are routinely transported to an "R" Certificate holder's facility for refurbishment, frequently requiring the replacement of lost or illegible nameplates.
- Corrugated Roll owners rely on a Certificate Holder to perform nameplate maintenance and the filing of any applicable documentation.
- Multi-Plant owners routinely exchange Corrugated Rolls from one Jurisdiction to another, including to and from areas that have no Jurisdiction.



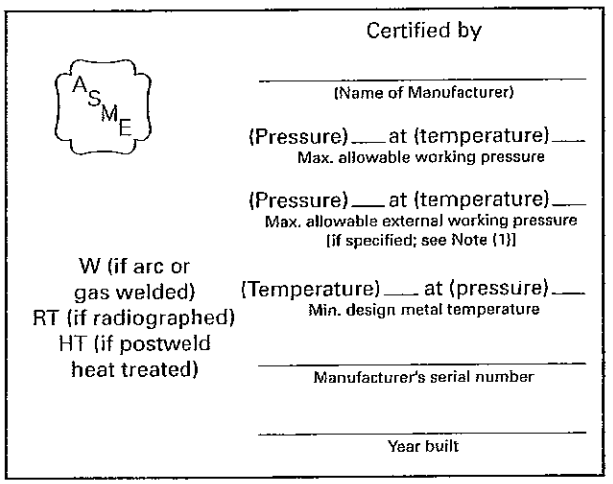
(2) 8/16

## Background Information (continued):

- Being the trusted eyes, ears, and hands of any Jurisdiction, a National Board Commissioned Inspector's signature could be sufficient evidence of compliance to I.D. traceability and verification of a Pressure Vessel in lieu of requiring authorization, as is the case in new construction and where no Jurisdiction exists.
- NBIC Part 3, Section 5, 5.9.5 [(a) & (b)] allows for the re-stamping or nameplate replacement on Safety Valves without the requirement for the creation or filing of an NB-136 "Replacement of Stamped Data Form", instead putting the responsibility on the Certificate Holder.
- In processing the NB-136 form, some Jurisdictions prefer the National Board Commissioned Inspector to verify everything before it is sent to them, which requires the replacement nameplate to already be attached, others prefer to follow the format of the form and sign for authorization first.
- Pressure Equipment that did not have its data report filed with The National Board, (EG: U-3 for UM stamped equipment), and no longer has a data report available (> 5 years), can only have its traceability verified matching historical stampings to historical documentation as available. Such historical stampings may be located on various surfaces of the Pressure Equipment and as such can only be assured by on on-site inspector prior to commencement of preparing a replacement nameplate.
- Verbiage is suggested to provide uniformity to the ASME Code [UG-119 (d) & (f)], see attached.

(10) (a)

FIG. UG-118 FORM OF STAMPING




GENERAL NOTE: Information within parentheses is not part of the required marking. Phrases identifying data may be abbreviated; minimum abbreviations shall be MAWP, MAEWP, MDMT, S/N, and year, respectively.

NOTE:

(1) The maximum allowable external working pressure is required only when specified as a design condition.

*(1)* The required markings on a nameplate shall be in characters not less than $\frac{5}{32}$ in. (4 mm) high, except that characters for pressure relief device markings may be smaller.

*(2)* Characters shall be either indented or raised at least 0.004 in. (0.10 mm) and shall be legible and readable.

*(d)* The nameplate may be marked before it is affixed to the vessel, in which case the Manufacturer shall ensure that the nameplate with the correct marking has been applied to the proper vessel, and the Inspector shall satisfy himself that this has been done.

*(e)* The nameplate shall be attached to the vessel or to a pad, bracket, or structure that is welded, brazed, soldered, or attached with mechanical fasteners directly to the vessel. Mechanical fasteners shall be of a material and design that is compatible with the vessel, bracket materials, and the vessel service. After installation of the pad, bracket, or structure, the heads of the fasteners shall be welded, brazed, or soldered to the pad, bracket, or structure that supports the nameplate. The nameplate shall be located within 30 in. (760 mm) of the vessel. Removal shall require the willful destruction of the nameplate, or its attachment system. (See M-3.)

*(1)* Nameplates may be attached either by welding, brazing, or soldering.

*(2)* Nameplates may be attached by tamper-resistant mechanical fasteners of suitable metal construction.

*(3)* Nameplates may be attached with pressure-sensitive acrylic adhesive systems provided that, in addition to the requirements of this paragraph, those of Appendix 18 are met.

*(f)* An additional nameplate in accordance with (a) through (d) may be installed on the skirt, supports, jacket, or other permanent attachment to a vessel. All data on the additional plate, including the Certification Mark with the Designator, shall be as required for the mandatory nameplate. The marking need not be witnessed by the Inspector. The additional nameplate shall be marked: "DUPLICATE."

*(g)* When a nameplate is employed, the Manufacturer's name or identifying trademark, and vessel serial number (or National Board Number, if applicable,) may also be marked directly on the vessel in close proximity to the nameplate attachment. The marking shall be of a visible permanent type that is not detrimental to the vessel, and its location shall be indicated on the Data Report.

*(1)* If the thickness limitations of UG-118 preclude marking directly on the vessel shell or heads, it may be applied to the skirt, supports, jacket, or other permanent attachment to the vessel.

## UG-120 DATA REPORTS (10) (a)

*(a)* A Data Report shall be filled out on Form U-1 or Form U-1A by the Manufacturer and shall be signed by the Manufacturer and the Inspector for each pressure vessel marked with the Certification Mark with the U Designator.

*(1)* Same day production of vessels may be reported on a single Form provided all of the following requirements are met:

*(a)* vessels must be identical;

*(b)* vessels must be manufactured for stock or for the same user or his designated agent;

*(c)* serial numbers must be in uninterrupted sequence; and

*(d)* the Manufacturer's written Quality Control System includes procedures to control the development, distribution, and retention of the Data Reports.

*(2)* The number of lines on the Data Report used to describe multiple components (e.g., nozzles, shell courses) may be increased or decreased as necessary to provide space to describe each component. If addition of lines used to describe multiple components results in the Data Report exceeding one page, space must be provided for the Manufacturer and Authorized Inspector to initial and date each of the additional pages. Horizontal spacing for information on each line may be altered as necessary. All information must be addressed; however, footnotes described in the remarks block are acceptable, e.g., for multiple cases of "none" or "not applicable."

*(3)* The Manufacturer shall:

*(a)* furnish a copy of the Manufacturer's Data Report to the user and, upon request, to the Inspector:



Inspection

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c) The existing repair nameplates, if applicable, shall not be removed during such testing.

### 5.9.5 REPLACEMENT OF ILLEGIBLE OR MISSING NAMEPLATES

a) Illegible Nameplates
When the information on the original manufacturer's or assembler's nameplate or stamping is illegible, but traceability can be confirmed, the nameplate or stamping will be augmented by a nameplate furnished by the "VR" stamp holder stamped "Duplicate." It shall contain all information that originally appeared on the nameplate or valve, as required by the applicable section of the ASME Code, except the "V," "HV," or "UV" symbol and the National Board mark. The repair organization's nameplate, with the "VR" stamp and other required data specified in 5.9.2, will make the repairer responsible to the owner and the Jurisdiction that the information on the duplicate nameplate is correct.

b) Missing Nameplates
When the original valve nameplate is missing, the repair organization is not authorized to perform repairs to the valve under the "VR" program, unless positive identification can be made to that specific valve and verification that the valve was originally stamped with an ASME "V" or "UV" symbol or marked with an ASME "HV" symbol. Valves that can be positively identified will be equipped with a duplicate nameplate, as described in this section, in addition to the repairer's "VR"-stamped nameplate. The repairer's responsibilities for accurate data, as defined in 5.9.5(a) (Illegible Nameplates), shall apply.

c) Marking of Original Code Stamp
When a duplicate nameplate is affixed to a valve, as required by this section, it shall be marked "Sec. I," "Sec. IV," or "Sec. VIII," as applicable, to indicate the original ASME Code stamping.

### 5.10 ALTERNATIVE MARKING AND STAMPING FOR GRAPHITE PRESSURE EQUIPMENT

a) General Requirements

1) This procedure may be used in lieu of the stamping and nameplate requirements defined in this section.

2) The required data as defined in this section shall be 5/32 in. (4 mm) high, minimum.

3) The National Board code symbol ("R") shall be used to make the impression in the cement.

b) Application of the "R" Code Symbol

1) The graphite surface shall be clean and smooth.

2) Apply a thin coating of cement onto the Code part. The cement should have the consistency of toothpaste.

3) Apply sufficient heat to the cement so that it begins to form a skin.

4) Apply a coating of a thinned release agent, such as "ANTISEIZE," to the tip of the "R" stamp with a brush.

5) Press the coated stamp all the way to the bottom of the cement and remove by pulling straight out before the cement hardens.

6) Cure or heat the impression as required.

7) When cured, the part may be washed to remove any excess release agent.

c) Application of characters directly to graphite

1) Use a very thin template of a flexible material (stainless steel; flexible and easily cleaned).



Inspection

6/47 (5) 5/6

## Requested Interpretations:

**Q:**, If a National Board Commissioned Inspector has verified the replacement of stamped data or nameplate by an "R" Certificate holder on Corrugated Rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, is the application of an NB-136 "Replacement of Stamped Data Form" required?

---

**PROPOSED REPLY:** No, if performed by an "R" Certificate holder and verified by a National Board Commissioned Inspector the responsibility of traceability and nameplate accuracy is on the Certificate Holder similar to nameplate replacement in the NBIC, Part 3, SECTION 5, 5.9.5.

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

**Q:** Can an NB-136 "Replacement of Stamped Data Form", which is required to be signed by a National Board Commissioned Inspector, for Corrugated Rolls that are not stationary and subject to operation in multiple Jurisdictions, possibly by multiple owners, be filed with The National Board and copied to the applicable Jurisdiction in lieu of obtaining an approval signature from the Jurisdiction?

---

**PROPOSED REPLY:** Yes, the approval from one Jurisdiction should not be incumbent on any other Jurisdiction due to the transient nature of Corrugated Roll Pressure Equipment. Similarly, if there was no Jurisdiction in the location of installation another Jurisdiction would be compelled to accept National Board filing if the equipment is moved.

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

**Respectfully submitted:**
**Daren Daily & Mark Anderson**
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**Phillips, WI 54555**
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## ACTION ITEM NB08-0701

LPG storage containers may be changed from aboveground service to underground service subject to the following conditions:

1. Any connections located on the bottom of the container shall be welded shut using a forged plug or removed and replaced with a flush patch.

2. All connections on the top of the tank shall be relocated to one area that can be enclosed by a domed sleeve that reaches the top of the grade.

3. The check lock/liquid withdrawal connection on top of the container shall have a tube that reaches the bottom of the container.

4. The dip tube shall be of the correct length for the container size.

5. The support legs may remain in place. All welds shall encircle the legs to prevent a potential area of corrosion.

6. There shall be connections for attachment of anodes for cathodic protection.

7. The protective coating shall be in good condition. Any coating touch up needed at the time of installation shall be compatible with the original coating.

8. Lifting lugs may remain in place and their attachment welds shall encircle the lug.

9. The thickness of the pressure boundary parts shall have a NDE examination to confirm compliance with the original code of construction.

10. Any flush patches shall be of the same thickness as the original material.

11. Any welding shall be performed by a qualified "R" stamp holder.

12. Verify that there is no internal corrosion due to valves having been removed while the container is in storage.

13. Verify that the container has never been previously in anhydrous ammonia service. Any blue coloring of the brass valves indicates that the vessel has been in anhydrous ammonia service.

14. The nameplate shall transfer the information from the original nameplate. This shall include the manufacturers name, vessel serial number, National Board number, MAWP, year built, head and shell thicknesses, but not necessarily the original code stamping. Additional information should include an indication of underground service, new dip tube length, a National Board R stamp.

Inspection 1/1

**NB10-1301 Part 2, SG Inspection Specific**

***Task Group on Anhydrous Ammonia Nurse Tank Inspection***

*Task Group Members: Greg McRae (Trinity), Stan Staniszewski (DOT), Jim Getter (Worthington Cylinders), Bob Reetz (State of North Dakota)*

***June 11, 2012 Draft***

*This would be a new section of Part 2. It should be numbered 2.3.6.5 and come directly after 2.3.6.4., the current section on "Liquid Ammonia Vessels". (Present 2.3.6.5 would be renumbered as 2.3.6.6)*

## 2.3.6.5 ANHYDROUS AMMONIA NURSE TANKS

a) Nurse tanks (considered as implements of husbandry) are anhydrous ammonia pressure vessels on farm wagons, not exceeding a capacity of 3,000 water gallons (11,355 liters), used for agricultural application of liquid anhydrous ammonia to farm fields as fertilizer. Nurse tanks come under United States Department of Transportation (DOT) requirements and may also be subject to various local jurisdictional requirements. Nurse tanks should be inspected closely at least once per seasonal use. Inspections of nurse tanks include the following items. These items are not meant to be all inclusive.

b) Inspection shall consist of the following:

1) Pressure Vessel - Verify that the pressure vessel is constructed for anhydrous ammonia service and that it is ASME stamped and National Board registered, as required by the jurisdiction. Check that the data plate is legible and not painted over or sand blasted. If the data plate is missing or illegible, welding is prohibited, and the tank shall be tested and operated under the DOT Hazardous Material Regulation (HMR) as required in Title 49 Code of Federal Regulations (CFR) 173.315m or the tank shall be removed from service. Post-construction welding, if any, to the pressure vessel, nozzles or support legs shall be in accordance with NBIC procedures and stamping as required in Part 3. (Also see ANSI K61.1 for the definition of repair.) Cracks, dents, bulges, cuts, gouges and corrosion shall not exceed the acceptance criteria of Section 2.3.6.4 (f).

2) Valves and Fittings - Verify that the pressure relief device is ASME constructed and National Board capacity certified, has correct capacity and set pressure, is date current, and is not leaking, corroded or painted. Check that a rain cap is installed. Ensure that the hydrostatic relief valve is set for 350-400 psi (2415-2760 kPa), is in place in or on the liquid withdrawal valve and that it is in good condition and date current. A liquid level float gage shall be installed and be operable. In addition, a fixed liquid level gage (85% gage) shall be operable and unobstructed by tape or paint. A pressure gage with a clear lens and with a 0-400 psi (0-2760 kPa) dial range shall be installed and be observed to be operable. A liquid withdrawal valve shall be in place and observed to be in good condition. Liquid and vapor fill valves shall be in operable condition and their end fittings protected with valve covers. In addition, check that no galvanized, brass, or cast iron fittings are installed.

3) Nurse Tank Painting, Decals, and Marking – The paint shall be white or aluminum, the painted surface not damaged or faded, and the tank surface not rusted. A nurse tank unique owner identification number shall be observed to be in place. A DOT approved slow-moving vehicle (SMV) emblem or sign shall be installed at the rear. Legible transfer and safety decals shall be in place near the fill valves. "INHALATION HAZARD" markings or decals shall be observed to be in place on each side. On each side and on each end, observe that "DOT 1005" markings or decals and "ANHYDROUS AMMONIA" markings or decals are in place. (Note that these markings or decals are not required on the end of a tank with valves and fittings on that end.) Liquid and vapor valves shall be observed to be color coded or labeled for liquid or vapor. Markings for tests and inspections required due to a missing or illegible data plates shall be in place as required by DOT Hazardous Material Regulations.

4) Safety Specific and Miscellaneous Equipment - Roll-over protection for valves and appurtenances, to include the pressure relief device, shall be observed to be in place. This required protection must include any bottom liquid withdrawal valves. Observe that the transfer hose, if so equipped, is date current and in good condition (not cut to the cords or showing stretch damage, bulging, or kinking). Check that a fitting is in place to secure the transfer hose (if so equipped) during transport and storage. Protective gloves and Z87 rated goggles shall be observed to be in a safety kit on the nurse tank. A safety water container [5 gallon (19 liter) minimum capacity] with adequate withdrawal hose shall be on the nurse tank and be in usable condition.

5) Trailer and Running Gear – Ensure that the hitch and undercarriage are in good repair. Observe that welds are not cracked or the rails bent. The trailer tires shall be in serviceable condition with no cuts to the cords. Two safety chains and hooks shall be in place with one hitch pin and lock pin available. The tank to trailer anchorage shall be satisfactory and any bolting tightened. Spring leaves shall not be cracked or broken on inspection and the ends secured.

NB11-0901

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MINNESOTA DEPARTMENT OF
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October 4, 2010

Secretary, NBIC Committee
The National Board of Boiler and Pressure Vessel Inspectors
1055 Crupper Ave
Columbus, OH 43229

Subject: Historical Boiler internals under external pressure.

Dear Committee Members,

I am writing to request an addition to the NBIC Part 2, Section 6. The current NBIC contains charts and formulas to determine the maximum allowable working pressure for cylindrical components and stayed surfaces under internal pressure.

I believe the NBIC committee should also add chart(s) and formula(s) for calculating the maximum allowable working pressure for cylindrical components under external pressure. We have many return flue and vertical boilers in which inspectors need to calculate the maximum allowable working pressures for these components.

Thank you for your consideration.

Respectfully,

Joel T. Amato
Chief Boiler Inspector
Minnesota Department of Labor and Industry



1/1

NB11-1101

New Item

Request for Code Change below to address thickness readings for adjusting MAWP if general or localized pitting is observed.

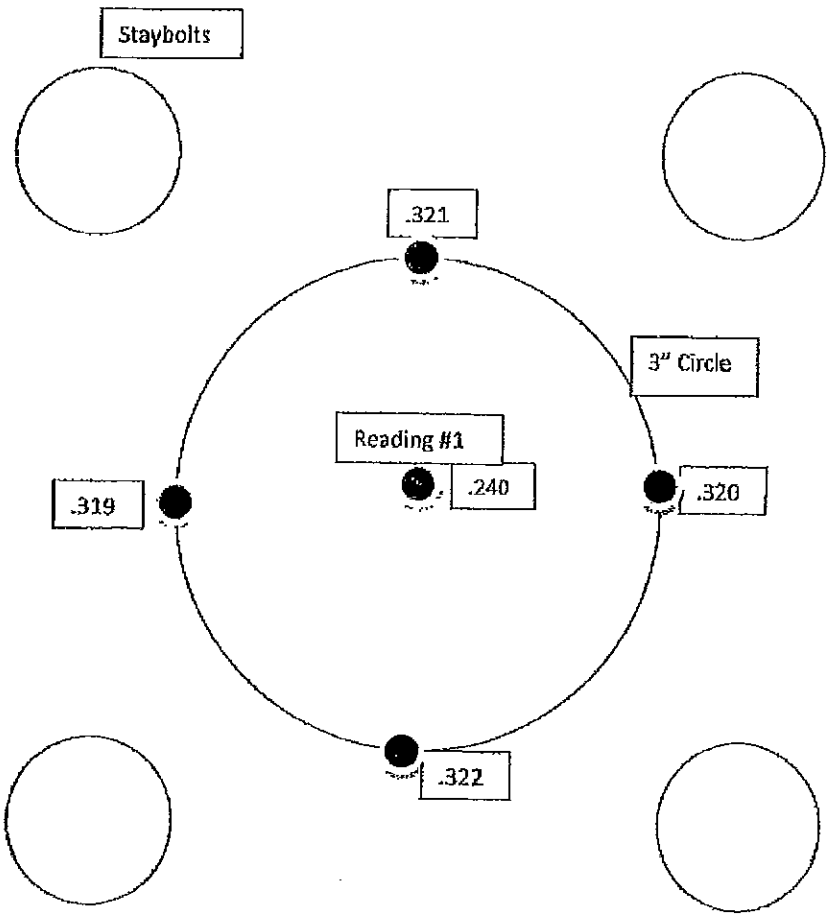
Part II, Section 6, Paragraph S2.6.2 b) should be revised to provide more guidance for evaluating local pitting corrosion versus general corrosion. See example below;

Once region of corrosion pitting is detected by UT (.240" in the attached illustration), a three-inch circle should be drawn around the pitted region. After four readings around the perimeter of the circle are determined by UT and show significant difference with the original lowest reading, the lowest of the four readings should be used as the actual thickness for that particular subsection of the boiler (e.g., the staybolt quadrant as shown, or the grid section of the barrel).
The lowest center reading is assumed to be a localized pit, and can be disregarded in the MAWP calculation because of surrounding material that provides some level of reinforcement.

1/2

Sample Readings

Exhibit 1




2 12

**Subject:** 2010 Edition, Part 2, Supplement 2, S2.10.4.1 – Staybolts

**File Number:** NB11-1601

**Prop. Page:** 141

## Proposal:

Update the text and reference tables in S2.10.4.1 for two purposes:

- Correct errors in equations (both typographical and mathematical)
- Introduce consideration for, and distinction between, iron and steel staybolts

***Current wording:***

**A08 S2.10.4.1 STAYBOLTS**

**A09** Table S2.10.4.1 may be used to determine the MAWP for corroded staybolts. The table is based on a stress value of 7,500 psi (51.7 MPa) for staybolts that was the value used in the ASME Section 1, 1971 Edition. The table identifies a calculated MAWP based on measuring the staybolt spacing on the crownsheet and the minimum diameter of the corroded staybolt. See Table S2.10.4.1.

| Thickness of Stayed Surface, in. | Staybolt Spacing (Maximum Pitch), in. | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.5 | 3.625 | 3.75 | 3.875 | 4 | 4.125 | 4.25 | 4.375 | 4.5 | 4.625 | 4.75 | 4.875 | 5 | 5.125 | 5.25 | 5.375 | 5.5 | 5.625 | 5.75 | 5.875 | 6 |
| 0.19 | 85 | 80 | 74 | 70 | 65 | 61 | 58 | 55 | 52 | 49 | 46 | 44 | 42 | 40 | 38 | 36 | 35 | 33 | 32 | 30 | 29 |
| 0.2 | 95 | 88 | 82 | 77 | 72 | 68 | 64 | 61 | 57 | 54 | 51 | 49 | 46 | 44 | 42 | 40 | 38 | 37 | 35 | 34 | 32 |
| 0.21 | 104 | 97 | 91 | 85 | 80 | 75 | 71 | 67 | 63 | 60 | 57 | 54 | 51 | 49 | 46 | 44 | 42 | 40 | 39 | 37 | 36 |
| 0.22 | 115 | 107 | 100 | 93 | 88 | 82 | 78 | 73 | 69 | 66 | 62 | 59 | 56 | 53 | 51 | 49 | 46 | 44 | 42 | 41 | 39 |
| 0.23 | 125 | 117 | 109 | 102 | 96 | 90 | 85 | 80 | 76 | 72 | 68 | 65 | 61 | 58 | 56 | 53 | 51 | 48 | 46 | 44 | 43 |
| 0.24 | 136 | 127 | 119 | 111 | 104 | 98 | 92 | 87 | 82 | 78 | 74 | 70 | 67 | 64 | 61 | 58 | 55 | 53 | 50 | 48 | 46 |
| 0.25 | 148 | 138 | 129 | 121 | 113 | 106 | 100 | 95 | 89 | 85 | 80 | 76 | 72 | 69 | 66 | 63 | 60 | 57 | 55 | 52 | 50 |
| 0.26 | 160 | 149 | 139 | 130 | 122 | 115 | 108 | 102 | 97 | 92 | 87 | 82 | 78 | 75 | 71 | 68 | 65 | 62 | 59 | 57 | 54 |
| 0.27 | 172 | 161 | 150 | 141 | 132 | 124 | 117 | 110 | 104 | 99 | 94 | 89 | 85 | 80 | 77 | 73 | 70 | 67 | 64 | 61 | 59 |
| 0.28 | 185 | 173 | 162 | 151 | 142 | 134 | 126 | 119 | 112 | 106 | 101 | 96 | 91 | 87 | 82 | 79 | 75 | 72 | 69 | 66 | 63 |
| 0.29 | 199 | 185 | 173 | 162 | 152 | 143 | 135 | 127 | 120 | 114 | 108 | 103 | 97 | 93 | 88 | 84 | 81 | 77 | 74 | 71 | 68 |
| 0.3 | 213 | 198 | 185 | 174 | 163 | 153 | 144 | 136 | 129 | 122 | 116 | 110 | 104 | 99 | 95 | 90 | 86 | 82 | 79 | 76 | 72 |
| 0.31 | 227 | 212 | 198 | 185 | 174 | 164 | 154 | 146 | 138 | 130 | 123 | 117 | 111 | 106 | 101 | 96 | 92 | 88 | 84 | 81 | 77 |
| 0.32 | 242 | 226 | 211 | 198 | 185 | 174 | 164 | 155 | 147 | 139 | 132 | 125 | 119 | 113 | 108 | 103 | 98 | 94 | 90 | 86 | 82 |
| 0.33 | 258 | 240 | 224 | 210 | 197 | 185 | 175 | 165 | 156 | 148 | 140 | 133 | 126 | 120 | 115 | 109 | 104 | 100 | 95 | 91 | 88 |
| 0.34 | 273 | 255 | 238 | 223 | 209 | 197 | 185 | 175 | 165 | 157 | 148 | 141 | 134 | 128 | 122 | 116 | 111 | 106 | 101 | 97 | 93 |
| 0.35 | 290 | 270 | 252 | 236 | 222 | 209 | 197 | 185 | 175 | 166 | 157 | 149 | 142 | 135 | 129 | 123 | 117 | 112 | 107 | 103 | 99 |
| 0.36 | 307 | 286 | 267 | 250 | 235 | 221 | 208 | 196 | 185 | 176 | 166 | 158 | 150 | 143 | 136 | 130 | 124 | 119 | 114 | 109 | 104 |
| 0.37 | 324 | 302 | 282 | 264 | 248 | 233 | 220 | 207 | 196 | 185 | 176 | 167 | 159 | 151 | 144 | 137 | 131 | 125 | 120 | 115 | 110 |
| 0.38 | 342 | 318 | 298 | 279 | 262 | 246 | 232 | 219 | 207 | 196 | 185 | 176 | 167 | 159 | 152 | 145 | 138 | 132 | 127 | 121 | 116 |
| 0.39 | 360 | 335 | 313 | 294 | 275 | 259 | 244 | 230 | 218 | 206 | 195 | 185 | 176 | 168 | 160 | 153 | 146 | 139 | 133 | 128 | 122 |
| 0.4 | 379 | 353 | 330 | 309 | 290 | 273 | 257 | 242 | 229 | 217 | 206 | 195 | 185 | 177 | 168 | 160 | 153 | 147 | 140 | 134 | 129 |
| 0.41 | 398 | 371 | 346 | 324 | 304 | 286 | 270 | 255 | 241 | 228 | 216 | 205 | 195 | 185 | 177 | 169 | 161 | 154 | 147 | 141 | 135 |
| 0.42 | 417 | 389 | 364 | 340 | 320 | 300 | 283 | 267 | 252 | 239 | 227 | 215 | 204 | 195 | 185 | 177 | 169 | 162 | 155 | 148 | 142 |
| 0.43 | 437 | 408 | 381 | 357 | 335 | 315 | 297 | 280 | 265 | 251 | 237 | 225 | 214 | 204 | 194 | 185 | 177 | 169 | 162 | 155 | 149 |
| 0.44 | 480 | 447 | 418 | 391 | 367 | 345 | 325 | 307 | 290 | 275 | 261 | 247 | 235 | 224 | 213 | 203 | 194 | 186 | 178 | 170 | 163 |
| 0.45 | 502 | 468 | 437 | 409 | 384 | 361 | 340 | 321 | 304 | 287 | 272 | 259 | 246 | 234 | 223 | 213 | 203 | 194 | 186 | 178 | 171 |
| 0.46 | 524 | 489 | 457 | 428 | 402 | 378 | 356 | 336 | 317 | 300 | 285 | 270 | 257 | 245 | 233 | 222 | 212 | 203 | 194 | 186 | 178 |
| 0.47 | 547 | 510 | 477 | 447 | 419 | 394 | 371 | 350 | 331 | 314 | 297 | 282 | 268 | 255 | 243 | 232 | 222 | 212 | 203 | 194 | 186 |
| 0.48 | 571 | 532 | 497 | 466 | 437 | 411 | 387 | 365 | 345 | 327 | 310 | 294 | 280 | 266 | 254 | 242 | 231 | 221 | 212 | 203 | 194 |

TS = Tensile Strength 55 000 psi
t = Thickness of Stayed Surface, in.
S = 13 800 psi

$P = t^2 \cdot S \cdot C / p^2$

For Thicknesses 0.4375 and less, C = 2.1
For Thicknesses larger than 0.4375, C=2.2
MAWP is expressed in psi

140.1

***Proposed wording:***

**S2.10.4.1 STAYBOLTS**

The maximum allowable working pressure for symmetrically spaced corroded staybolts will be calculated using the formula provided in either of the 2 following paragraphs or the accompanying tables. Equations calculate MAWP based on measuring the staybolt spacing on the stayed surface and the minimum diameter of the corroded staybolt.

**a) IRON STAYBOLTS**

Staybolts which are of iron or of unknown material shall be calculated using the following formula or Table S2.10.4.1.a. The table is based on a stress value of 7,500 psi (51.7 MPa) for staybolts. Refer to ASME Section 1, 1971 Edition, Table PG-23.3 for allowable loads for all staybolts.

$$P = \frac{\pi\left[\frac{d}{2}\right]^2 S}{p^2}$$ , S = 7,500 (51.7 MPa)

**b) STEEL STAYBOLTS**

Staybolts of known, steel material shall be calculated using the following formula or Table S2.10.4.1.b. The table is based on a stress value of 11,300 psi (78.0 MPa) for staybolts. Refer to ASME Section 1, 1971 Addenda for allowable loads for all staybolts.

$$P = \frac{\pi\left[\frac{d}{2}\right]^2 S}{1.1 \times p^2}$$ , S = 11,300 (78.0 MPa)

| Staybolt Spacing, in. | Actual Diameter of Corroded Iron Staybolts, in. | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.35 | 0.375 | 0.4 | 0.425 | 0.45 | 0.475 | 0.5 | 0.525 | 0.55 | 0.575 | 0.6 | 0.625 | 0.65 | 0.675 | 0.7 | 0.725 | 0.75 | 0.775 | 0.8 | 0.825 | 0.85 | 0.875 | 0.9 |
| 3.5 | 59 | 68 | 77 | 87 | 97 | 108 | 120 | 133 | 145 | 159 | 173 | 188 | 203 | 219 | 236 | 253 | 270 | 289 | 308 | 327 | 347 | 368 | 389 |
| 3.625 | 55 | 63 | 72 | 81 | 91 | 101 | 112 | 124 | 136 | 148 | 161 | 175 | 189 | 204 | 220 | 236 | 252 | 269 | 287 | 305 | 324 | 343 | 363 |
| 3.75 | 51 | 59 | 67 | 76 | 85 | 95 | 105 | 115 | 127 | 138 | 151 | 164 | 177 | 191 | 205 | 220 | 236 | 252 | 268 | 285 | 303 | 321 | 339 |
| 3.875 | 48 | 55 | 63 | 71 | 79 | 89 | 98 | 108 | 119 | 130 | 141 | 153 | 166 | 179 | 192 | 206 | 221 | 236 | 251 | 267 | 283 | 300 | 318 |
| 4 | 45 | 52 | 59 | 66 | 75 | 83 | 92 | 101 | 111 | 122 | 133 | 144 | 156 | 168 | 180 | 194 | 207 | 221 | 236 | 251 | 266 | 282 | 298 |
| 4.125 | 42 | 49 | 55 | 63 | 70 | 78 | 87 | 95 | 105 | 114 | 125 | 135 | 146 | 158 | 170 | 182 | 195 | 208 | 222 | 236 | 250 | 265 | 280 |
| 4.25 | 40 | 46 | 52 | 59 | 66 | 74 | 82 | 90 | 99 | 108 | 117 | 127 | 138 | 149 | 160 | 171 | 183 | 196 | 209 | 222 | 236 | 250 | 264 |
| 4.375 | 38 | 43 | 49 | 56 | 62 | 69 | 77 | 85 | 93 | 102 | 111 | 120 | 130 | 140 | 151 | 162 | 173 | 185 | 197 | 209 | 222 | 236 | 249 |
| 4.5 | 36 | 41 | 47 | 53 | 59 | 66 | 73 | 80 | 88 | 96 | 105 | 114 | 123 | 133 | 143 | 153 | 164 | 175 | 186 | 198 | 210 | 223 | 236 |
| 4.625 | 34 | 39 | 44 | 50 | 56 | 62 | 69 | 76 | 83 | 91 | 99 | 108 | 116 | 125 | 135 | 145 | 155 | 165 | 176 | 187 | 199 | 211 | 223 |
| 4.75 | 32 | 37 | 42 | 47 | 53 | 59 | 65 | 72 | 79 | 86 | 94 | 102 | 110 | 119 | 128 | 137 | 147 | 157 | 167 | 178 | 189 | 200 | 211 |
| 4.875 | 30 | 35 | 40 | 45 | 50 | 56 | 62 | 68 | 75 | 82 | 89 | 97 | 105 | 113 | 121 | 130 | 139 | 149 | 159 | 169 | 179 | 190 | 201 |
| 5 | 29 | 33 | 38 | 43 | 48 | 53 | 59 | 65 | 71 | 78 | 85 | 92 | 100 | 107 | 115 | 124 | 133 | 142 | 151 | 160 | 170 | 180 | 191 |
| 5.125 | 27 | 32 | 36 | 41 | 45 | 51 | 56 | 62 | 68 | 74 | 81 | 88 | 95 | 102 | 110 | 118 | 126 | 135 | 144 | 153 | 162 | 172 | 182 |
| 5.25 | 26 | 30 | 34 | 39 | 43 | 48 | 53 | 59 | 65 | 71 | 77 | 83 | 90 | 97 | 105 | 112 | 120 | 128 | 137 | 145 | 154 | 164 | 173 |
| 5.375 | 25 | 29 | 33 | 37 | 41 | 46 | 51 | 56 | 62 | 67 | 73 | 80 | 86 | 93 | 100 | 107 | 115 | 122 | 130 | 139 | 147 | 156 | 165 |
| 5.5 | 24 | 27 | 31 | 35 | 39 | 44 | 49 | 54 | 59 | 64 | 70 | 76 | 82 | 89 | 95 | 102 | 110 | 117 | 125 | 133 | 141 | 149 | 158 |
| 5.625 | 23 | 26 | 30 | 34 | 38 | 42 | 47 | 51 | 56 | 62 | 67 | 73 | 79 | 85 | 91 | 98 | 105 | 112 | 119 | 127 | 135 | 143 | 151 |
| 5.75 | 22 | 25 | 29 | 32 | 36 | 40 | 45 | 49 | 54 | 59 | 64 | 70 | 75 | 81 | 87 | 94 | 100 | 107 | 114 | 121 | 129 | 136 | 144 |
| 5.875 | 21 | 24 | 27 | 31 | 35 | 39 | 43 | 47 | 52 | 56 | 61 | 67 | 72 | 78 | 84 | 90 | 96 | 103 | 109 | 116 | 123 | 131 | 138 |
| 6 | 20 | 23 | 26 | 30 | 33 | 37 | 41 | 45 | 49 | 54 | 59 | 64 | 69 | 75 | 80 | 86 | 92 | 98 | 105 | 111 | 118 | 125 | 133 |
| 6.125 | 19 | 22 | 25 | 28 | 32 | 35 | 39 | 43 | 47 | 52 | 57 | 61 | 66 | 72 | 77 | 83 | 88 | 94 | 100 | 107 | 113 | 120 | 127 |
| 6.25 | 18 | 21 | 24 | 27 | 31 | 34 | 38 | 42 | 46 | 50 | 54 | 59 | 64 | 69 | 74 | 79 | 85 | 91 | 97 | 103 | 109 | 115 | 122 |
| 6.375 | 18 | 20 | 23 | 26 | 29 | 33 | 36 | 40 | 44 | 48 | 52 | 57 | 61 | 66 | 71 | 76 | 82 | 87 | 93 | 99 | 105 | 111 | 117 |
| 6.5 | 17 | 20 | 22 | 25 | 28 | 31 | 35 | 38 | 42 | 46 | 50 | 54 | 59 | 64 | 68 | 73 | 78 | 84 | 89 | 95 | 101 | 107 | 113 |
| 6.625 | 16 | 19 | 21 | 24 | 27 | 30 | 34 | 37 | 41 | 44 | 48 | 52 | 57 | 61 | 66 | 71 | 75 | 81 | 86 | 91 | 97 | 103 | 109 |
| 6.75 | 16 | 18 | 21 | 23 | 26 | 29 | 32 | 36 | 39 | 43 | 47 | 51 | 55 | 59 | 63 | 68 | 73 | 78 | 83 | 88 | 93 | 99 | 105 |
| 6.875 | 15 | 18 | 20 | 23 | 25 | 28 | 31 | 34 | 38 | 41 | 45 | 49 | 53 | 57 | 61 | 66 | 70 | 75 | 80 | 85 | 90 | 95 | 101 |
| 7 | 15 | 17 | 19 | 22 | 24 | 27 | 30 | 33 | 36 | 40 | 43 | 47 | 51 | 55 | 59 | 63 | 68 | 72 | 77 | 82 | 87 | 92 | 97 |

**$S$ = 7,500 psi**

**$P$ = MAWP psi**

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

**$p$ = staybolt spacing, in.**

**$d$ = Minimum diameter of corroded staybolt, in.**

**Table S2.10.4.1.a [US Customary Units]**

**Maximum Allowable Working Pressure Based on the Load Carrying Capacity of a Single Corroded Iron Staybolt**

| Staybolt Spacing, mm | Actual Diameter of Corroded Iron Staybolts, mm | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 10.5 | 11 | 11.5 | 12 | 12.5 | 13 | 13.5 | 14 | 14.5 | 15 | 15.5 | 16 | 16.5 | 17 | 17.5 | 18 | 18.5 | 19 | 19.5 | 20 | 20.5 | 21 | 21.5 | 22 |
| 90 | 501 | 553 | 607 | 663 | 722 | 783 | 847 | 914 | 983 | 1054 | 1128 | 1204 | 1283 | 1365 | 1449 | 1535 | 1624 | 1716 | 1810 | 1906 | 2005 | 2107 | 2211 | 2317 | 2426 |
| 92.5 | 475 | 523 | 574 | 628 | 683 | 742 | 802 | 865 | 930 | 998 | 1068 | 1140 | 1215 | 1292 | 1371 | 1453 | 1538 | 1624 | 1713 | 1805 | 1898 | 1994 | 2093 | 2194 | 2297 |
| 95 | 450 | 496 | 544 | 595 | 648 | 703 | 760 | 820 | 882 | 946 | 1012 | 1081 | 1152 | 1225 | 1300 | 1378 | 1458 | 1540 | 1624 | 1711 | 1800 | 1891 | 1984 | 2080 | 2178 |
| 97.5 | 427 | 471 | 517 | 565 | 615 | 667 | 722 | 778 | 837 | 898 | 961 | 1026 | 1093 | 1163 | 1234 | 1308 | 1384 | 1462 | 1542 | 1624 | 1709 | 1795 | 1884 | 1974 | 2067 |
| 100 | 406 | 448 | 491 | 537 | 585 | 634 | 686 | 740 | 796 | 854 | 914 | 976 | 1039 | 1105 | 1173 | 1244 | 1316 | 1390 | 1466 | 1544 | 1624 | 1706 | 1791 | 1877 | 1965 |
| 102.5 | 386 | 426 | 468 | 511 | 557 | 604 | 653 | 704 | 758 | 813 | 870 | 929 | 989 | 1052 | 1117 | 1184 | 1252 | 1323 | 1395 | 1470 | 1546 | 1624 | 1704 | 1787 | 1871 |
| 105 | 368 | 406 | 446 | 487 | 530 | 575 | 622 | 671 | 722 | 774 | 829 | 885 | 943 | 1003 | 1064 | 1128 | 1193 | 1261 | 1330 | 1400 | 1473 | 1548 | 1624 | 1702 | 1783 |
| 107.5 | 351 | 387 | 425 | 465 | 506 | 549 | 594 | 640 | 689 | 739 | 791 | 844 | 900 | 957 | 1015 | 1076 | 1138 | 1203 | 1268 | 1336 | 1405 | 1477 | 1550 | 1624 | 1701 |
| 110 | 336 | 370 | 406 | 444 | 483 | 524 | 567 | 612 | 658 | 706 | 755 | 806 | 859 | 914 | 970 | 1028 | 1087 | 1149 | 1211 | 1276 | 1342 | 1410 | 1480 | 1551 | 1624 |
| 112.5 | 321 | 354 | 388 | 424 | 462 | 501 | 542 | 585 | 629 | 675 | 722 | 771 | 821 | 873 | 927 | 983 | 1039 | 1098 | 1158 | 1220 | 1283 | 1348 | 1415 | 1483 | 1553 |
| 115 | 307 | 339 | 372 | 406 | 442 | 480 | 519 | 560 | 602 | 646 | 691 | 738 | 786 | 836 | 887 | 940 | 995 | 1051 | 1108 | 1167 | 1228 | 1290 | 1354 | 1419 | 1486 |
| 117.5 | 294 | 324 | 356 | 389 | 424 | 460 | 497 | 536 | 576 | 618 | 662 | 707 | 753 | 801 | 850 | 901 | 953 | 1007 | 1062 | 1118 | 1176 | 1236 | 1297 | 1360 | 1423 |
| 120 | 282 | 311 | 341 | 373 | 406 | 441 | 477 | 514 | 553 | 593 | 634 | 677 | 722 | 768 | 815 | 864 | 914 | 965 | 1018 | 1072 | 1128 | 1185 | 1244 | 1303 | 1365 |
| 122.5 | 271 | 298 | 327 | 358 | 390 | 423 | 457 | 493 | 530 | 569 | 609 | 650 | 693 | 737 | 782 | 829 | 877 | 926 | 977 | 1029 | 1082 | 1137 | 1193 | 1251 | 1310 |
| 125 | 260 | 287 | 314 | 344 | 374 | 406 | 439 | 474 | 509 | 546 | 585 | 624 | 665 | 708 | 751 | 796 | 842 | 889 | 938 | 988 | 1039 | 1092 | 1146 | 1201 | 1258 |
| 127.5 | 250 | 275 | 302 | 330 | 360 | 390 | 422 | 455 | 490 | 525 | 562 | 600 | 639 | 680 | 722 | 765 | 809 | 855 | 902 | 950 | 999 | 1050 | 1102 | 1155 | 1209 |
| 130 | 240 | 265 | 291 | 318 | 346 | 375 | 406 | 438 | 471 | 505 | 541 | 577 | 615 | 654 | 694 | 736 | 778 | 822 | 867 | 914 | 961 | 1010 | 1060 | 1111 | 1163 |
| 132.5 | 231 | 255 | 280 | 306 | 333 | 361 | 391 | 422 | 453 | 486 | 520 | 556 | 592 | 630 | 668 | 708 | 749 | 792 | 835 | 879 | 925 | 972 | 1020 | 1069 | 1119 |
| 135 | 223 | 246 | 270 | 295 | 321 | 348 | 377 | 406 | 437 | 468 | 501 | 535 | 570 | 607 | 644 | 682 | 722 | 763 | 804 | 847 | 891 | 936 | 983 | 1030 | 1078 |
| 137.5 | 215 | 237 | 260 | 284 | 309 | 336 | 363 | 391 | 421 | 452 | 483 | 516 | 550 | 585 | 621 | 658 | 696 | 735 | 775 | 817 | 859 | 903 | 947 | 993 | 1039 |
| 140 | 207 | 228 | 251 | 274 | 298 | 324 | 350 | 378 | 406 | 436 | 466 | 498 | 530 | 564 | 599 | 634 | 671 | 709 | 748 | 788 | 829 | 871 | 914 | 958 | 1003 |
| 142.5 | 200 | 220 | 242 | 264 | 288 | 312 | 338 | 364 | 392 | 420 | 450 | 480 | 512 | 544 | 578 | 612 | 648 | 684 | 722 | 760 | 800 | 840 | 882 | 924 | 968 |
| 145 | 193 | 213 | 234 | 255 | 278 | 302 | 326 | 352 | 379 | 406 | 435 | 464 | 494 | 526 | 558 | 591 | 626 | 661 | 697 | 734 | 773 | 812 | 852 | 893 | 935 |
| 147.5 | 187 | 206 | 226 | 247 | 269 | 292 | 315 | 340 | 366 | 392 | 420 | 448 | 478 | 508 | 539 | 572 | 605 | 639 | 674 | 710 | 747 | 784 | 823 | 863 | 903 |
| 150 | 180 | 199 | 218 | 239 | 260 | 282 | 305 | 329 | 354 | 379 | 406 | 434 | 462 | 491 | 522 | 553 | 585 | 618 | 651 | 686 | 722 | 758 | 796 | 834 | 873 |
| 152.5 | 175 | 192 | 211 | 231 | 251 | 273 | 295 | 318 | 342 | 367 | 393 | 419 | 447 | 475 | 505 | 535 | 566 | 598 | 630 | 664 | 698 | 734 | 770 | 807 | 845 |
| 155 | 169 | 186 | 205 | 224 | 243 | 264 | 286 | 308 | 331 | 355 | 380 | 406 | 433 | 460 | 488 | 518 | 548 | 578 | 610 | 643 | 676 | 710 | 745 | 781 | 818 |
| 157.5 | 164 | 180 | 198 | 216 | 236 | 256 | 277 | 298 | 321 | 344 | 368 | 393 | 419 | 446 | 473 | 501 | 530 | 560 | 591 | 622 | 655 | 688 | 722 | 757 | 792 |
| 160 | 159 | 175 | 192 | 210 | 228 | 248 | 268 | 289 | 311 | 333 | 357 | 381 | 406 | 432 | 458 | 486 | 514 | 543 | 573 | 603 | 634 | 667 | 699 | 733 | 768 |
| 162.5 | 154 | 170 | 186 | 203 | 221 | 240 | 260 | 280 | 301 | 323 | 346 | 369 | 394 | 419 | 444 | 471 | 498 | 526 | 555 | 585 | 615 | 646 | 678 | 711 | 744 |
| 165 | 149 | 164 | 180 | 197 | 215 | 233 | 252 | 272 | 292 | 314 | 336 | 358 | 382 | 406 | 431 | 457 | 483 | 510 | 538 | 567 | 597 | 627 | 658 | 689 | 722 |
| 167.5 | 145 | 160 | 175 | 191 | 208 | 226 | 245 | 264 | 284 | 304 | 326 | 348 | 371 | 394 | 418 | 443 | 469 | 495 | 522 | 550 | 579 | 608 | 638 | 669 | 700 |
| 170 | 141 | 155 | 170 | 186 | 202 | 220 | 237 | 256 | 275 | 295 | 316 | 338 | 360 | 383 | 406 | 430 | 455 | 481 | 507 | 534 | 562 | 590 | 620 | 649 | 680 |
| 172.5 | 136 | 150 | 165 | 180 | 197 | 213 | 231 | 249 | 267 | 287 | 307 | 328 | 349 | 372 | 394 | 418 | 442 | 467 | 493 | 519 | 546 | 573 | 602 | 631 | 660 |
| 175 | 133 | 146 | 160 | 175 | 191 | 207 | 224 | 242 | 260 | 279 | 298 | 319 | 339 | 361 | 383 | 406 | 430 | 454 | 479 | 504 | 530 | 557 | 585 | 613 | 642 |
| 177.5 | 129 | 142 | 156 | 170 | 186 | 201 | 218 | 235 | 253 | 271 | 290 | 310 | 330 | 351 | 372 | 395 | 418 | 441 | 465 | 490 | 516 | 542 | 568 | 596 | 624 |
| 180 | 125 | 138 | 152 | 166 | 180 | 196 | 212 | 228 | 246 | 263 | 282 | 301 | 321 | 341 | 362 | 384 | 406 | 429 | 452 | 477 | 501 | 527 | 553 | 579 | 607 |

**$S$ = 51,700 kPa**

**$P$ = MAWP kPa**

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

**$p$ = staybolt spacing, mm**

**$d$ = Minimum diameter of corroded staybolt, mm**

**Table S2.10.4.1.a [Metric Units]**

**Maximum Allowable Working Pressure Based on the Load Carrying Capacity of a Single Corroded Iron Staybolt**

| Staybolt Spacing, in. | Actual Diameter of Corroded Steel Staybolts, in. | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.35 | 0.375 | 0.4 | 0.425 | 0.45 | 0.475 | 0.5 | 0.525 | 0.55 | 0.575 | 0.6 | 0.625 | 0.65 | 0.675 | 0.7 | 0.725 | 0.75 | 0.775 | 0.8 | 0.825 | 0.85 | 0.875 | 0.9 |
| 3.5 | 81 | 93 | 105 | 119 | 133 | 149 | 165 | 182 | 199 | 218 | 237 | 257 | 278 | 300 | 323 | 346 | 370 | 396 | 422 | 448 | 476 | 504 | 533 |
| 3.625 | 75 | 86 | 98 | 111 | 124 | 139 | 153 | 169 | 186 | 203 | 221 | 240 | 259 | 280 | 301 | 323 | 345 | 369 | 393 | 418 | 444 | 470 | 497 |
| 3.75 | 70 | 81 | 92 | 104 | 116 | 129 | 143 | 158 | 174 | 190 | 207 | 224 | 242 | 261 | 281 | 302 | 323 | 345 | 367 | 390 | 415 | 439 | 465 |
| 3.875 | 66 | 76 | 86 | 97 | 109 | 121 | 134 | 148 | 163 | 178 | 193 | 210 | 227 | 245 | 263 | 282 | 302 | 323 | 344 | 366 | 388 | 411 | 435 |
| 4 | 62 | 71 | 81 | 91 | 102 | 114 | 126 | 139 | 153 | 167 | 182 | 197 | 213 | 230 | 247 | 265 | 284 | 303 | 323 | 343 | 364 | 386 | 408 |
| 4.125 | 58 | 67 | 76 | 86 | 96 | 107 | 119 | 131 | 143 | 157 | 171 | 185 | 200 | 216 | 232 | 249 | 267 | 285 | 303 | 323 | 343 | 363 | 384 |
| 4.25 | 55 | 63 | 71 | 81 | 90 | 101 | 112 | 123 | 135 | 148 | 161 | 174 | 189 | 204 | 219 | 235 | 251 | 268 | 286 | 304 | 323 | 342 | 362 |
| 4.375 | 52 | 59 | 67 | 76 | 85 | 95 | 105 | 116 | 128 | 139 | 152 | 165 | 178 | 192 | 207 | 222 | 237 | 253 | 270 | 287 | 305 | 323 | 341 |
| 4.5 | 49 | 56 | 64 | 72 | 81 | 90 | 100 | 110 | 121 | 132 | 143 | 156 | 168 | 182 | 195 | 209 | 224 | 239 | 255 | 271 | 288 | 305 | 323 |
| 4.625 | 46 | 53 | 60 | 68 | 76 | 85 | 94 | 104 | 114 | 125 | 136 | 147 | 159 | 172 | 185 | 198 | 212 | 227 | 241 | 257 | 273 | 289 | 306 |
| 4.75 | 44 | 50 | 57 | 65 | 72 | 81 | 89 | 99 | 108 | 118 | 129 | 140 | 151 | 163 | 175 | 188 | 201 | 215 | 229 | 243 | 258 | 274 | 290 |
| 4.875 | 42 | 48 | 54 | 61 | 69 | 77 | 85 | 94 | 103 | 112 | 122 | 133 | 143 | 155 | 166 | 178 | 191 | 204 | 217 | 231 | 245 | 260 | 275 |
| 5 | 40 | 45 | 52 | 58 | 65 | 73 | 81 | 89 | 98 | 107 | 116 | 126 | 136 | 147 | 158 | 170 | 182 | 194 | 207 | 220 | 233 | 247 | 261 |
| 5.125 | 38 | 43 | 49 | 55 | 62 | 69 | 77 | 85 | 93 | 102 | 111 | 120 | 130 | 140 | 151 | 161 | 173 | 184 | 197 | 209 | 222 | 235 | 249 |
| 5.25 | 36 | 41 | 47 | 53 | 59 | 66 | 73 | 81 | 89 | 97 | 105 | 114 | 124 | 133 | 143 | 154 | 165 | 176 | 187 | 199 | 211 | 224 | 237 |
| 5.375 | 34 | 39 | 45 | 50 | 57 | 63 | 70 | 77 | 84 | 92 | 101 | 109 | 118 | 127 | 137 | 147 | 157 | 168 | 179 | 190 | 202 | 214 | 226 |
| 5.5 | 33 | 38 | 43 | 48 | 54 | 60 | 67 | 74 | 81 | 88 | 96 | 104 | 113 | 122 | 131 | 140 | 150 | 160 | 171 | 182 | 193 | 204 | 216 |
| 5.625 | 31 | 36 | 41 | 46 | 52 | 58 | 64 | 70 | 77 | 84 | 92 | 100 | 108 | 116 | 125 | 134 | 143 | 153 | 163 | 174 | 184 | 195 | 207 |
| 5.75 | 30 | 34 | 39 | 44 | 49 | 55 | 61 | 67 | 74 | 81 | 88 | 95 | 103 | 111 | 120 | 128 | 137 | 147 | 156 | 166 | 176 | 187 | 198 |
| 5.875 | 29 | 33 | 37 | 42 | 47 | 53 | 58 | 64 | 71 | 77 | 84 | 91 | 99 | 107 | 115 | 123 | 131 | 140 | 150 | 159 | 169 | 179 | 189 |
| 6 | 27 | 32 | 36 | 40 | 45 | 51 | 56 | 62 | 68 | 74 | 81 | 88 | 95 | 102 | 110 | 118 | 126 | 135 | 143 | 153 | 162 | 172 | 182 |
| 6.125 | 26 | 30 | 34 | 39 | 44 | 49 | 54 | 59 | 65 | 71 | 77 | 84 | 91 | 98 | 105 | 113 | 121 | 129 | 138 | 146 | 155 | 165 | 174 |
| 6.25 | 25 | 29 | 33 | 37 | 42 | 47 | 52 | 57 | 62 | 68 | 74 | 81 | 87 | 94 | 101 | 109 | 116 | 124 | 132 | 141 | 149 | 158 | 167 |
| 6.375 | 24 | 28 | 32 | 36 | 40 | 45 | 50 | 55 | 60 | 66 | 71 | 78 | 84 | 90 | 97 | 104 | 112 | 119 | 127 | 135 | 143 | 152 | 161 |
| 6.5 | 23 | 27 | 31 | 34 | 39 | 43 | 48 | 53 | 58 | 63 | 69 | 75 | 81 | 87 | 94 | 100 | 107 | 115 | 122 | 130 | 138 | 146 | 155 |
| 6.625 | 23 | 26 | 29 | 33 | 37 | 41 | 46 | 51 | 56 | 61 | 66 | 72 | 78 | 84 | 90 | 97 | 103 | 110 | 118 | 125 | 133 | 141 | 149 |
| 6.75 | 22 | 25 | 28 | 32 | 36 | 40 | 44 | 49 | 54 | 59 | 64 | 69 | 75 | 81 | 87 | 93 | 100 | 106 | 113 | 121 | 128 | 136 | 143 |
| 6.875 | 21 | 24 | 27 | 31 | 35 | 39 | 43 | 47 | 52 | 56 | 61 | 67 | 72 | 78 | 84 | 90 | 96 | 103 | 109 | 116 | 123 | 131 | 138 |
| 7 | 20 | 23 | 26 | 30 | 33 | 37 | 41 | 45 | 50 | 54 | 59 | 64 | 70 | 75 | 81 | 87 | 93 | 99 | 105 | 112 | 119 | 126 | 133 |

**$S$ = 11,300 psi**

**$P$ = MAWP psi**

$$P = \frac{\pi \left[\frac{d}{2}\right]^2 S}{1.1 \times p^2}$$

**$p$ = staybolt spacing, in.**

**$d$ = Minimum diameter of corroded staybolt, in.**

**Table S2.10.4.1.b [US Customary Units]**

**Maximum Allowable Working Pressure Based on the Load Carrying Capacity of a Single Corroded Steel Staybolt**

| Staybolt Spacing, mm | Actual Diameter of Corroded Steel Staybolts, mm | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 10.5 | 11 | 11.5 | 12 | 12.5 | 13 | 13.5 | 14 | 14.5 | 15 | 15.5 | 16 | 16.5 | 17 | 17.5 | 18 | 18.5 | 19 | 19.5 | 20 | 20.5 | 21 | 21.5 | 22 |
| 90 | 688 | 758 | 832 | 909 | 990 | 1074 | 1162 | 1253 | 1348 | 1446 | 1547 | 1652 | 1760 | 1872 | 1987 | 2106 | 2228 | 2353 | 2482 | 2614 | 2750 | 2889 | 3032 | 3178 | 3328 |
| 92.5 | 651 | 718 | 788 | 861 | 937 | 1017 | 1100 | 1186 | 1276 | 1368 | 1465 | 1564 | 1666 | 1772 | 1881 | 1993 | 2109 | 2228 | 2350 | 2475 | 2604 | 2735 | 2870 | 3009 | 3150 |
| 95 | 617 | 680 | 747 | 816 | 889 | 964 | 1043 | 1125 | 1209 | 1297 | 1388 | 1483 | 1580 | 1680 | 1783 | 1890 | 1999 | 2112 | 2228 | 2346 | 2468 | 2593 | 2721 | 2852 | 2987 |
| 97.5 | 586 | 646 | 709 | 775 | 844 | 915 | 990 | 1068 | 1148 | 1232 | 1318 | 1407 | 1500 | 1595 | 1693 | 1794 | 1898 | 2005 | 2115 | 2228 | 2343 | 2462 | 2584 | 2708 | 2835 |
| 100 | 557 | 614 | 674 | 737 | 802 | 870 | 941 | 1015 | 1092 | 1171 | 1253 | 1338 | 1426 | 1516 | 1609 | 1706 | 1804 | 1906 | 2010 | 2118 | 2228 | 2340 | 2456 | 2574 | 2695 |
| 102.5 | 530 | 584 | 641 | 701 | 763 | 828 | 896 | 966 | 1039 | 1114 | 1193 | 1274 | 1357 | 1443 | 1532 | 1623 | 1717 | 1814 | 1914 | 2016 | 2120 | 2228 | 2338 | 2450 | 2566 |
| 105 | 505 | 557 | 611 | 668 | 727 | 789 | 854 | 921 | 990 | 1062 | 1137 | 1214 | 1293 | 1375 | 1460 | 1547 | 1637 | 1729 | 1824 | 1921 | 2021 | 2123 | 2228 | 2335 | 2445 |
| 107.5 | 482 | 531 | 583 | 637 | 694 | 753 | 814 | 878 | 945 | 1013 | 1084 | 1158 | 1234 | 1312 | 1393 | 1476 | 1561 | 1649 | 1740 | 1833 | 1928 | 2025 | 2125 | 2228 | 2332 |
| 110 | 460 | 507 | 557 | 609 | 663 | 719 | 778 | 839 | 902 | 968 | 1036 | 1106 | 1178 | 1253 | 1330 | 1410 | 1491 | 1575 | 1662 | 1750 | 1841 | 1934 | 2030 | 2128 | 2228 |
| 112.5 | 440 | 485 | 532 | 582 | 634 | 688 | 744 | 802 | 862 | 925 | 990 | 1057 | 1126 | 1198 | 1272 | 1348 | 1426 | 1506 | 1589 | 1673 | 1760 | 1849 | 1941 | 2034 | 2130 |
| 115 | 421 | 464 | 510 | 557 | 606 | 658 | 712 | 767 | 825 | 885 | 947 | 1012 | 1078 | 1146 | 1217 | 1290 | 1364 | 1441 | 1520 | 1601 | 1684 | 1770 | 1857 | 1947 | 2038 |
| 117.5 | 403 | 445 | 488 | 533 | 581 | 630 | 682 | 735 | 791 | 848 | 908 | 969 | 1033 | 1098 | 1166 | 1235 | 1307 | 1381 | 1456 | 1534 | 1614 | 1695 | 1779 | 1865 | 1952 |
| 120 | 387 | 426 | 468 | 511 | 557 | 604 | 654 | 705 | 758 | 813 | 870 | 929 | 990 | 1053 | 1118 | 1184 | 1253 | 1324 | 1396 | 1471 | 1547 | 1625 | 1706 | 1788 | 1872 |
| 122.5 | 371 | 409 | 449 | 491 | 534 | 580 | 627 | 676 | 727 | 780 | 835 | 892 | 950 | 1010 | 1073 | 1137 | 1202 | 1270 | 1340 | 1411 | 1484 | 1560 | 1637 | 1716 | 1796 |
| 125 | 356 | 393 | 431 | 471 | 513 | 557 | 602 | 650 | 699 | 749 | 802 | 856 | 912 | 970 | 1030 | 1092 | 1155 | 1220 | 1287 | 1355 | 1426 | 1498 | 1572 | 1648 | 1725 |
| 127.5 | 343 | 378 | 415 | 453 | 493 | 535 | 579 | 624 | 671 | 720 | 771 | 823 | 877 | 933 | 990 | 1049 | 1110 | 1173 | 1237 | 1303 | 1370 | 1440 | 1511 | 1584 | 1658 |
| 130 | 330 | 363 | 399 | 436 | 475 | 515 | 557 | 601 | 646 | 693 | 741 | 792 | 844 | 897 | 952 | 1009 | 1068 | 1128 | 1190 | 1253 | 1318 | 1385 | 1453 | 1523 | 1595 |
| 132.5 | 317 | 350 | 384 | 420 | 457 | 496 | 536 | 578 | 622 | 667 | 714 | 762 | 812 | 864 | 917 | 971 | 1028 | 1086 | 1145 | 1206 | 1269 | 1333 | 1399 | 1466 | 1535 |
| 135 | 306 | 337 | 370 | 404 | 440 | 477 | 516 | 557 | 599 | 642 | 688 | 734 | 782 | 832 | 883 | 936 | 990 | 1046 | 1103 | 1162 | 1222 | 1284 | 1348 | 1413 | 1479 |
| 137.5 | 295 | 325 | 356 | 390 | 424 | 460 | 498 | 537 | 577 | 619 | 663 | 708 | 754 | 802 | 851 | 902 | 954 | 1008 | 1063 | 1120 | 1178 | 1238 | 1299 | 1362 | 1426 |
| 140 | 284 | 313 | 344 | 376 | 409 | 444 | 480 | 518 | 557 | 597 | 639 | 683 | 727 | 774 | 821 | 870 | 921 | 972 | 1026 | 1080 | 1137 | 1194 | 1253 | 1313 | 1375 |
| 142.5 | 274 | 302 | 332 | 363 | 395 | 429 | 463 | 500 | 538 | 577 | 617 | 659 | 702 | 747 | 793 | 840 | 889 | 939 | 990 | 1043 | 1097 | 1153 | 1209 | 1268 | 1327 |
| 145 | 265 | 292 | 321 | 350 | 381 | 414 | 448 | 483 | 519 | 557 | 596 | 636 | 678 | 721 | 766 | 811 | 858 | 907 | 956 | 1007 | 1060 | 1113 | 1168 | 1224 | 1282 |
| 147.5 | 256 | 282 | 310 | 339 | 369 | 400 | 433 | 467 | 502 | 538 | 576 | 615 | 655 | 697 | 740 | 784 | 829 | 876 | 924 | 973 | 1024 | 1076 | 1129 | 1183 | 1239 |
| 150 | 248 | 273 | 299 | 327 | 356 | 387 | 418 | 451 | 485 | 520 | 557 | 595 | 634 | 674 | 715 | 758 | 802 | 847 | 894 | 941 | 990 | 1040 | 1092 | 1144 | 1198 |
| 152.5 | 239 | 264 | 290 | 317 | 345 | 374 | 405 | 436 | 469 | 503 | 539 | 575 | 613 | 652 | 692 | 733 | 776 | 820 | 864 | 911 | 958 | 1006 | 1056 | 1107 | 1159 |
| 155 | 232 | 256 | 280 | 307 | 334 | 362 | 392 | 422 | 454 | 487 | 522 | 557 | 593 | 631 | 670 | 710 | 751 | 793 | 837 | 881 | 927 | 974 | 1022 | 1072 | 1122 |
| 157.5 | 225 | 248 | 272 | 297 | 323 | 351 | 379 | 409 | 440 | 472 | 505 | 539 | 575 | 611 | 649 | 688 | 727 | 768 | 810 | 854 | 898 | 943 | 990 | 1038 | 1087 |
| 160 | 218 | 240 | 263 | 288 | 313 | 340 | 368 | 396 | 426 | 457 | 489 | 523 | 557 | 592 | 629 | 666 | 705 | 745 | 785 | 827 | 870 | 914 | 959 | 1006 | 1053 |
| 162.5 | 211 | 233 | 255 | 279 | 304 | 330 | 356 | 384 | 413 | 443 | 475 | 507 | 540 | 574 | 610 | 646 | 683 | 722 | 761 | 802 | 844 | 886 | 930 | 975 | 1021 |
| 165 | 205 | 226 | 248 | 271 | 295 | 320 | 346 | 373 | 401 | 430 | 460 | 491 | 524 | 557 | 591 | 626 | 663 | 700 | 738 | 778 | 818 | 860 | 902 | 946 | 990 |
| 167.5 | 199 | 219 | 240 | 263 | 286 | 310 | 335 | 362 | 389 | 417 | 447 | 477 | 508 | 540 | 574 | 608 | 643 | 679 | 717 | 755 | 794 | 834 | 875 | 918 | 961 |
| 170 | 193 | 212 | 233 | 255 | 277 | 301 | 326 | 351 | 378 | 405 | 434 | 463 | 493 | 525 | 557 | 590 | 624 | 660 | 696 | 733 | 771 | 810 | 850 | 891 | 933 |
| 172.5 | 187 | 206 | 226 | 248 | 270 | 292 | 316 | 341 | 367 | 394 | 421 | 450 | 479 | 510 | 541 | 573 | 606 | 641 | 676 | 712 | 749 | 787 | 825 | 865 | 906 |
| 175 | 182 | 200 | 220 | 240 | 262 | 284 | 307 | 331 | 356 | 382 | 409 | 437 | 466 | 495 | 526 | 557 | 589 | 622 | 656 | 691 | 727 | 764 | 802 | 841 | 880 |
| 177.5 | 177 | 195 | 214 | 234 | 255 | 276 | 299 | 322 | 346 | 372 | 398 | 425 | 453 | 481 | 511 | 541 | 573 | 605 | 638 | 672 | 707 | 743 | 780 | 817 | 856 |
| 180 | 172 | 190 | 208 | 227 | 248 | 269 | 290 | 313 | 337 | 361 | 387 | 413 | 440 | 468 | 497 | 526 | 557 | 588 | 621 | 654 | 688 | 722 | 758 | 795 | 832 |

**$S$ = 78,000 kPa**

**$P$ = MAWP kPa**

$$P = \frac{\pi \left[\frac{d}{2}\right]^2 S}{1.1 \times p^2}$$

**$p$ = staybolt spacing, mm**

**$d$ = Minimum diameter of corroded staybolt, mm**

**Table S2.10.4.1.b [Metric Units]**

**Maximum Allowable Working Pressure Based on the Load Carrying Capacity of a Single Corroded Steel Staybolt**

## Explanation:

Since 2007, Table S2.10.4.1 itemizing the maximum allowable load for staybolts (currently on page 141) in NBIC has changed almost yearly. The current equation is written (after typographical corrections) as:

$$P = \frac{\pi d^2 TS}{FS \times 4 \times p^2}$$

Where:

*P* = Maximum allowable working pressure (psi)
*d* = minimum diameter of corroded staybolt (inches)
*p* = maximum staybolt pitch (inches)
*TS* = tensile strength (7,500psi)
*FS* = factor of safety (1.1)

This equation has a variety of errors:

- *TS* as it is used here should be corrected to maximum allowable stress (assumed to be taken from Table PG-23.3 from ASME 1971). This value was consistent in all ASME editions prior to ASME 1971 addenda.
  - ASME 1971: 7,500psi (steel)
  - ASME 1971 addenda: 11,300psi (SA-31 steel)
  - ASME 2002: 15,200psi (SA-36 steel)
- *FS* as it is defined here is not a factor of safety, but is intended to be a simple multiplier of 1.1 found in ASME PG-49.1. This multiplier was introduced in the ASME 1971 addenda and exists today. This multiplier did not exist prior to the 1971 addenda.
- The equation mixes two different generations of equations and their coefficients from different eras of ASME (pre- and post- 1971 addenda). This mixture is inconsistent with ASME and should be deemed incorrect.

## ASME Equation

ASME 1971 (pre-addenda) PFT-27.1, PG-49.1 define the following equation:

$$P = \frac{\pi\left[\frac{d}{2}\right]^2 S}{p^2 - \pi\left[\frac{d}{2}\right]^2}, \text{ S = 7,500}$$

Where:

*P* = Maximum allowable working pressure
*d* = diameter at bottom of thread (PG-49.2)
*S* = maximum allowable stress (Table PG-23.3) (7,500 psi)
*p* = maximum staybolt pitch (inches) (PFT-27.1 states "full pitch dimensions" which we simplify to maximum staybolt dimensions)

ASME 1971 (post-addenda) defines the following equation:

$$P = \frac{\pi\left[\frac{d}{2}\right]^2 S}{1.1 \times \left(p^2 - \pi\left[\frac{d}{2}\right]^2\right)}, \text{ S = 11,300}$$

given the same definitions as above, but S = 11,300 instead of 7,500.

**ASME 1971 Addenda granted a net *increase* of allowable staybolt pressure of ~35%. No change in material specification for steel staybolts was made, but allowance for iron staybolt material was dropped.** Logic would dictate that the lower allowable load was only applicable to iron staybolts.

The assumed steel staybolt material (SA-31) is assumed to have a tensile strength (TS) of 50,000-60,000.

**ASME 1914:**



SPECIFICATIONS FOR STAYBOLT STEEL

REQUIREMENTS FOR ROLLED BARS

63 Steel for staybolts shall conform to the requirements for Boiler Rivet Steel specified in Pars. 40 to 62, except that the tensile properties shall be as follows:

| | |
|---|---|
| Tensile strength, lb. per sq. in. | 50,000-60,000 |
| Yield point, min., lb. per sq. in. | 0.5 tens. str. |
| Elongation in 8 in., min., per cent | 1,500,000 / Tens. str. |

Also with the exception that the permissible variations in gage shall be as follows:

*Permissible Variations in Gage.* The bars shall be truly round within 0.01 in. and shall not vary more than 0.005 in. above, or more than 0.01 in. below the specified size.

**Cdn Interprov. Rules, 1931:**

SPECIFICATIONS FOR STAYBOLT STEEL

**Solid or Hollow Staybolts**

72. Steel for solid or hollow bars for staybolts shall conform to the requirements for boiler rivet steel, except as follows:

*Tension Tests*—The bars shall conform to the following requirements as to tensile properties:

| | |
|---|---|
| Tensile strength, maximum, pounds per square inch | 60,000 |
| Yield point minimum pounds per square inch | 26,000 |
| Elongation in 8 inches minimum per cent | 1,500,000 / Tensile strength |

*Variation in Gauge*—Solid or hollow bars for staybolts, not exceeding 1¼ inch in diameter, which are to be threaded as rolled, shall be truly round within 0.01 inch and shall not vary more than 0.005 inches under or more than 0.01 inches over.

All other bars for staybolts shall conform to the specified tolerances for steel bars.

Given these rules, our factors of safety for steel staybolts are are:

- ASME 1914 - 1971 pre-addenda = $\frac{50{,}000}{7{,}500} = FS = 6.67{:}1$
- ASME 1971 post-addenda = $\frac{50{,}000}{\left(\frac{11{,}300}{1.1}\right)} = FS = 4.87{:}1$
- Current NBIC = $\frac{50{,}000}{\left(\frac{7{,}500}{1.1}\right)} = FS = 7.33{:}1$
- Canadian Historic Code = $\frac{50{,}000}{8{,}000} = FS = 6.25{:}1$

## Recommendations:

- Drop removal of staybolt area from sheet area because sheet thicknesses and staybolt diameters will vary due to corrosion
    - Pre-addenda equation becomes

$$P = \frac{\pi\left[\frac{d}{2}\right]^2 S}{p^2}, \text{ S = 7,500}$$

    - Post-addenda equation becomes

$$P = \frac{\pi\left[\frac{d}{2}\right]^2 S}{1.1 \times p^2}, \text{ S=11,300}$$

- Apply pre-addenda equations to iron staybolts or staybolts of unknown material. This rule satisfies historic loading limits for this material (6:1 safety factor or better). Reference to PG-23.3 is necessary for correct stress values for through-stays and diagonal stays.

- Apply post-addenda equations to staybolts which are known to be of steel material. This rule is consistent with ASME's choice to apply a higher loading factor for steel material. It also remains at least a ~5:1 safety factor.

**Subject:** 2010 Edition, Part 2, Supplement 2, S2.10.2 – Define Deteriorated Rivet Heads

**File Number:** NB11-1603

**Prop. Page:** 133

**Proposal:** Update text in S2.10.2 to include guidelines for decayed rivets.

**Current Wording:**

**S2.10.2 RIVETS**

When the diameter of the rivet holes in the longitudinal joints of a boiler is not known, the diameter of rivets, after driving, may be ascertained from the Table S2.10.2.

**Proposed Wording:**

**S2.10.2 Rivets and Rivet Heads**

When the diameter of the rivet holes in the longitudinal joint of a boiler is not known, the diameter of the rivets, after driving, may be ascertained from Table S2.10.2.

**TABLE S2.10.2**
**Sizes for Rivets Based on Plate Thickness**

| Thickness of Place, inches (mm) | Diameter of Rivet after Driving, inches (mm) |
|---|---|
| 1/4 (6) | 11/16 (17) |
| 9/32 (7) | 11/16 (17) |
| 5/16 (8) | 3/4 (19) |
| 11/32 (9) | 3/4 (19) |
| 3/8 (10) | 13/16 (21) |
| 13/32 (10) | 13/16 (21) |
| 7/16 (11) | 15/16 (24) |
| 15/32 (12) | 15/16 (24) |
| 1/2 (13) | 15/16 (24) |
| 9/16 (14) | 1-1/16 (27) |
| 5/8 (16) | 1-1/16 (27) |

**Rivet Head Types**

Finished rivet heads are shown in NBIC Part 3, Figure S2.13.13.4.

Note that a riveted seam may have more than one type of rivet to, for example, provide necessary clearance during operation, or for provision for equipment assembly and maintenance.

### S2.10.2.1 Inspection of Corroded Rivets

A riveted seam or joint is very redundant by design. Therefore, the following guidelines apply when generalized corrosion is present and consistent on a group of adjacent rivets (typically 4 or more), and not to individual rivets. The inspector must consider the frequency and consistency of corroded rivet heads, and condition, location, and type of riveted joint (and how it may fail) in determining allowable corrosion.

a. Visually identify all connections containing rivets which show signs of significant corrosion.

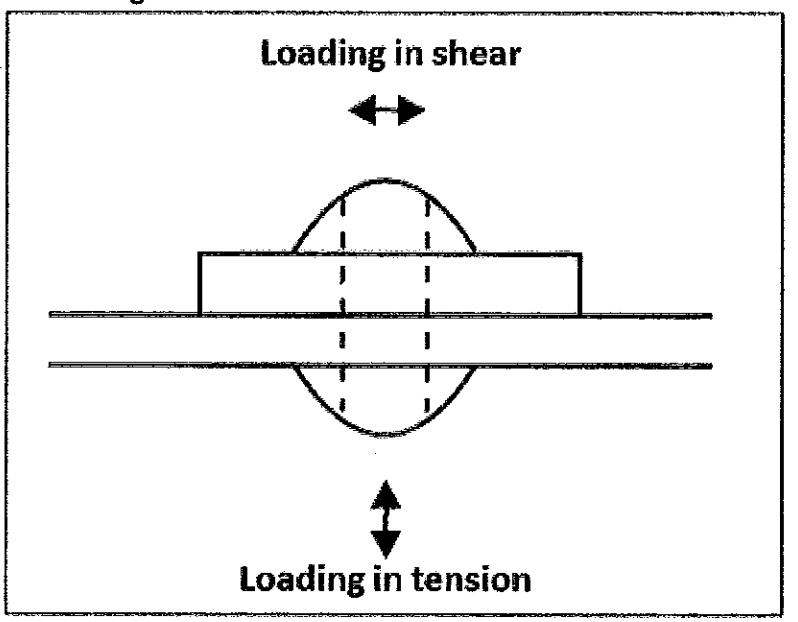
b. Categorize each connection as the type which loads the rivets in one of three possible modes (pure shear, pure tension, or combined shear and tension). Refer to Figure S2.10.2.

c. A leak around a rivet head may be indicative of a rivet which is loose, broken, or otherwise failing to provide adequate clamping force and will require further inspection.
    i. A rivet shall be deemed loose if it can be felt to move after being struck on the side of the head in a direction approximately perpendicular to its shank with a 40oz. engineer's hammer.
    ii. NBIC Part 3, S2.13.13 defines procedures to address a leak around a rivet head.

d. Allowable corrosion:
    i. For rivets in pure shear load, the amount of measured head deterioration shall not exceed 80% of its total head volume. Where rivets have countersunk heads, the head diameter must be equal or greater than 65% of the original head diameter. Severe head corrosion will require further evaluation of the condition and thickness of the plate at the joint.
    ii. For rivets in pure tension, the amount of measured head deterioration shall not exceed 35% of its total head volume. Where rivets have countersunk heads, the head diameter must be equal or greater than 85% of original head diameter. Application of this value shall take into consideration the consistency and frequency of adjacent rivets showing excessive corrosion.

iii. For connections subjected to combined shear and tension loads, the amount of measured head deterioration shall not exceed 60% of its total head volume. Where rivets have countersunk heads, the head diameter must be equal or greater than 75% of original head diameter. Application of this value shall take into consideration the consistency and frequency of adjacent rivets showing excessive corrosion.

**Figure S2.10.2**




The condition of the plate surrounding the rivets including general wastage, pitting, and the condition of the caulking edge, must be considered.

## *Explanation*

Supplement 1 (Locomotives) has a guideline for deteriorated rivet head acceptance/ rejection [5]. Supplement 2 (Historical Boilers) does not have such a guideline. This report itemizes concerns and errors in Supplement 1 guidelines, and proposes a new Supplement 2 guideline.

## Supplement 1 Errors & Omissions

1.) No guidelines for rivets in shear.
2.) S1.4.2.1.L wording is unclear / self-contradictory. The first sentence discusses wastage, and the 2nd sentence discusses remaining height at shank diameter, both using 0.25D.

## Discussion

[1, 9] state "U.S. Navy rules require the repair or replacement of rivets when head thickness has been reduced by 25% for 40.8lb [1-inch thick] plate and smaller and by 20% in plate over this weight."

[8] is heavily referenced, and states that current practice is to replace all rivets in connections subject to tensile or tensile-shear loading that have heads corroded to the point of losing 50% or more of their projection beyond the shank. An original copy of this publication could not be sourced, but this wording is consistent among all papers referencing this work.

[2] performs FEA on a 7/8" button head rivet, and recommends that the measured amount of head deterioration shall not exceed 35% of its total head volume.

Caveats:

- [2] assumes A502 grade rivets, other reports do not appear to specify the grade of rivet. Historical boilers are using A-31 grade rivets.
- All referenced work assumes no change to the load of the rivets. NBIC is unique where the standard will degrade MAWP based on boiler condition, thus changing the load imposed on the rivet. However, FEA in [2] shows a rather sharp increase in stress when deterioration surpasses 35%. This increase is far greater than the reduction due to change in MAWP. The paper reports that measurements have shown rivet clamping force approaches yield load of the rivet.
- Where mentioned, only button head rivet designs are discussed in reference materials.

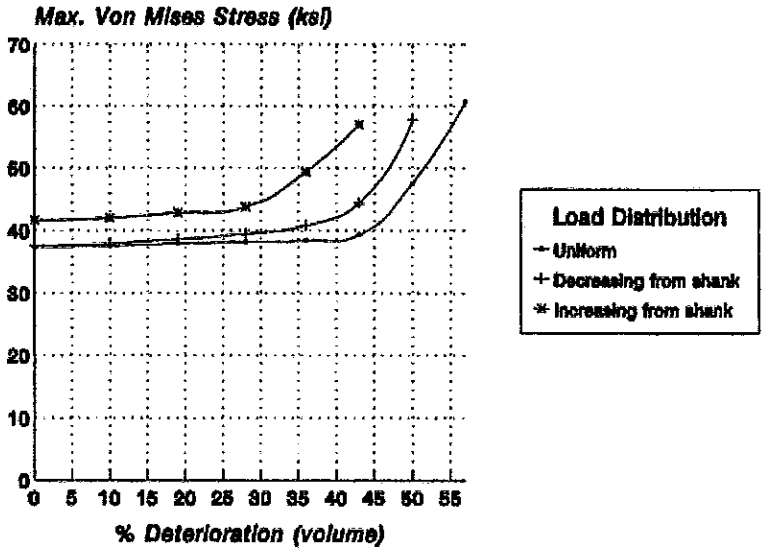



**Figure 12 - Max. Stress Vs. Loss of Head Volume (Uniform Model)**

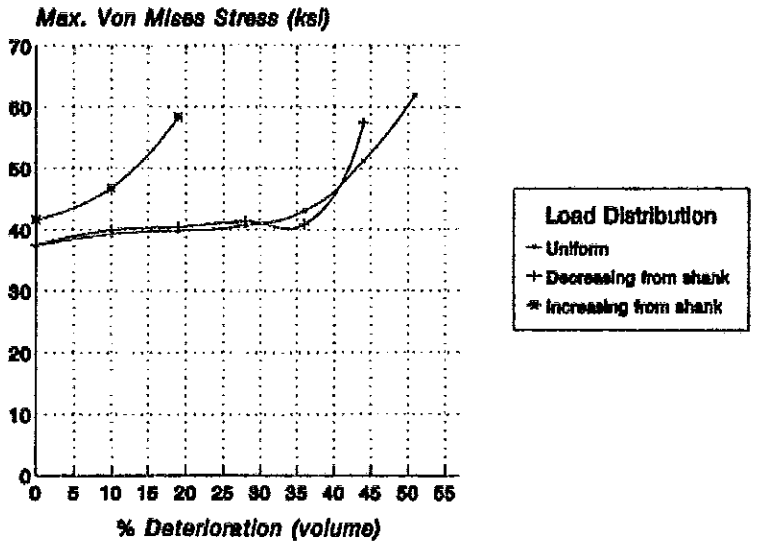
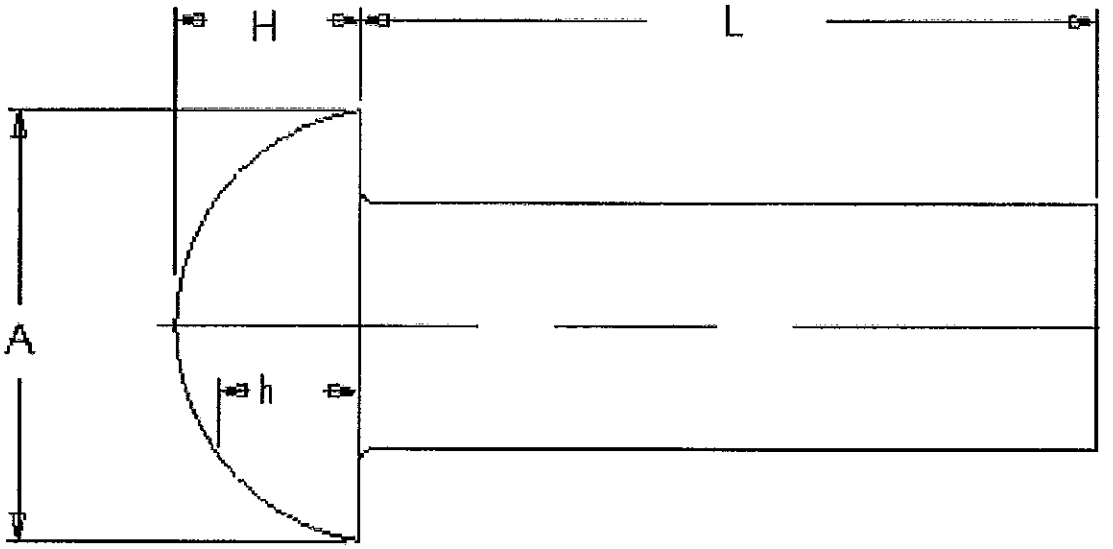



**Figure 13 - Max. Stress Vs. Loss of Head Volume (Non-Uniform Model)**

## New Button Head Rivet Dimensions

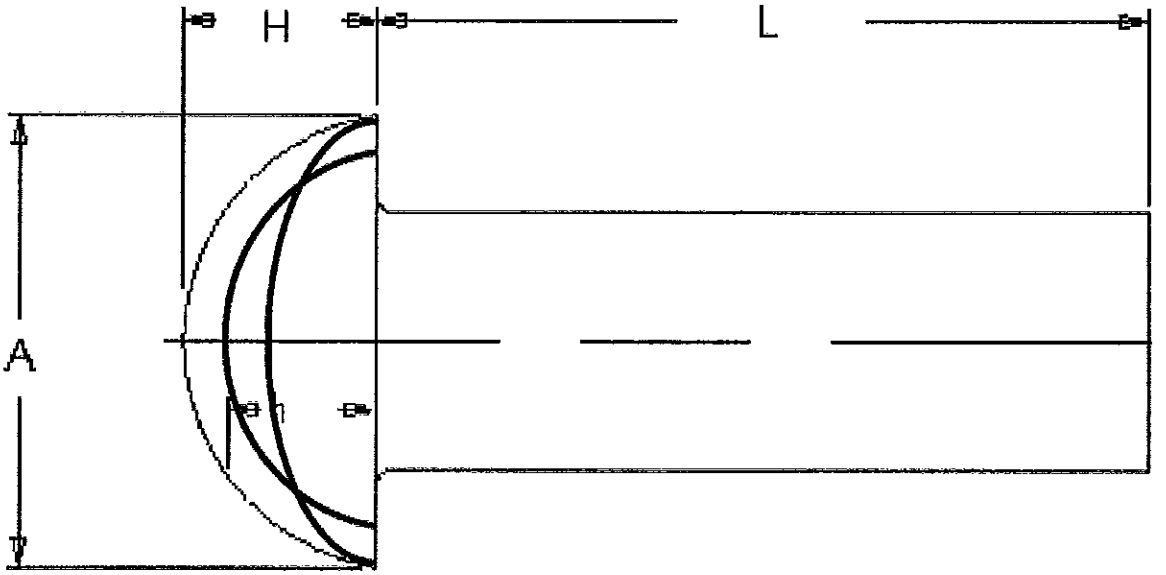
Values are taken from [6]. Calculated values below are based on equations from [7].




| Shank Diameter | A Head Diameter | H Head Height | h Height at Shank Circumference (new) | Head Volume |
|---|---|---|---|---|
| 0.500 | 0.875 | 0.375 | 0.298 | 0.140 |
| 0.625 | 1.094 | 0.469 | 0.372 | 0.274 |
| 0.750 | 1.312 | 0.562 | 0.446 | 0.473 |
| 0.875 | 1.531 | 0.656 | 0.521 | 0.752 |
| 1.000 | 1.750 | 0.750 | 0.595 | 1.123 |
| 1.125 | 1.969 | 0.844 | 0.670 | 1.600 |
| 1.250 | 2.188 | 0.938 | 0.745 | 2.200 |
| 1.375 | 2.406 | 1.031 | 0.818 | 2.918 |
| 1.500 | 2.625 | 1.125 | 0.893 | 3.790 |
| 1.625 | 2.844 | 1.219 | 0.968 | 4.820 |
| 1.750 | 3.062 | 1.312 | 1.041 | 6.013 |

## Deteriorated Button Head Rivet Dimensions

We will consider two types of generalized deterioration. All red values will represent even deterioration at the crown of the head, where the base of the rivet head remains intact. All blue values represent equal deterioration around the rivet head.




## NBIC S1.4.2.1: minimum h = 0.25 * shank diameter

Assuming even deterioration at the rivet head crown, but no deterioration at the edge of the rivet head (red line), **60%** of rivet head material is removed before the rivet must be replaced.

Assuming even deterioration (blue line) throughout the rivet head, **52.5%** of material is removed before the rivet must be replaced.

## US Navy [1, 9]: minimum H = 0.75 * original H

Assuming even deterioration at the rivet head crown, but no deterioration at the edge of the rivet head (red line), **31.5%** of rivet head material is removed before the rivet must be replaced.

Assuming even deterioration throughout the rivet head, **55%** of material is removed before the rivet must be replaced.

[8] is calculated in the same manner, except **H = 0.5 * original H**. Assuming even deterioration at the rivet head crown, but no deterioration at the edge of the rivet head (red line), **57.5%** of rivet head material is removed before the rivet must be replaced. However, assuming even deterioration throughout the rivet head, deterioration enters the rivet shank so these values are not considered. Given this result, [8] will not be further considered until a copy is attained to determine how to interpret its guidelines.

## US Army [2]: minimum head volume = 0.65 * original head volume

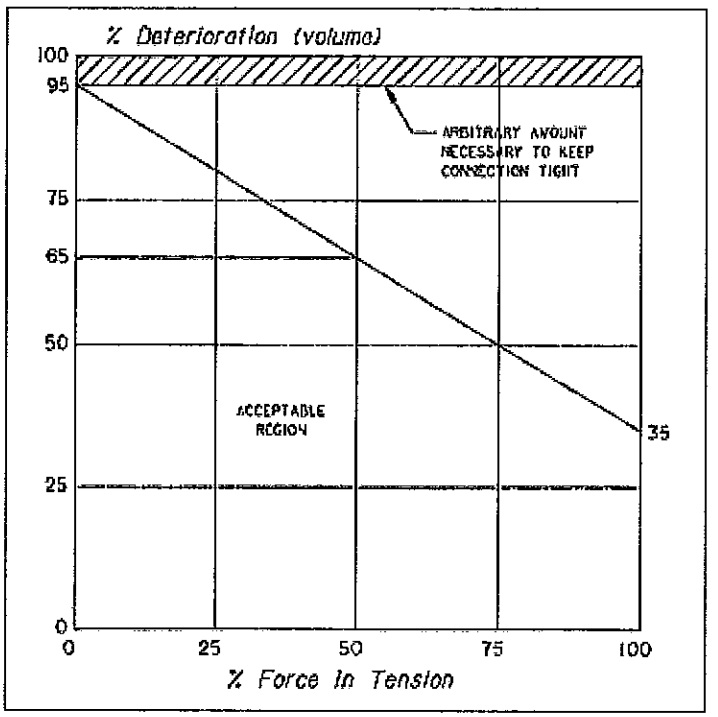
Assuming even deterioration at the rivet head crown, but no deterioration at the edge of the rivet head (red line), to obtain 35% removal of head volume, 'h' must only reduce by **20%** of its original height. Using NBIC S1.4.2.1 metrics, 'h' must be **40%** or greater than shank diameter.

Assuming even deterioration throughout the rivet head, to obtain **35%** removal of head volume, 'h' must only reduce by **17.5%** of its original height. Using NBIC S1.4.2.1 metrics, 'h' must be **46%** or greater than shank diameter.

## Discussion

The FEA results [2] assumed even corrosion around the entire rivet head. These conclusions (35% volume removal) are similar to the rule-of-thumb U.S. Navy guidelines [1, 9] (31.5%) when corrosion is maximum at the crown of the rivet head. Given this consistency, this draft targets a maximum 35% volume removal threshold for rivets in pure tension.

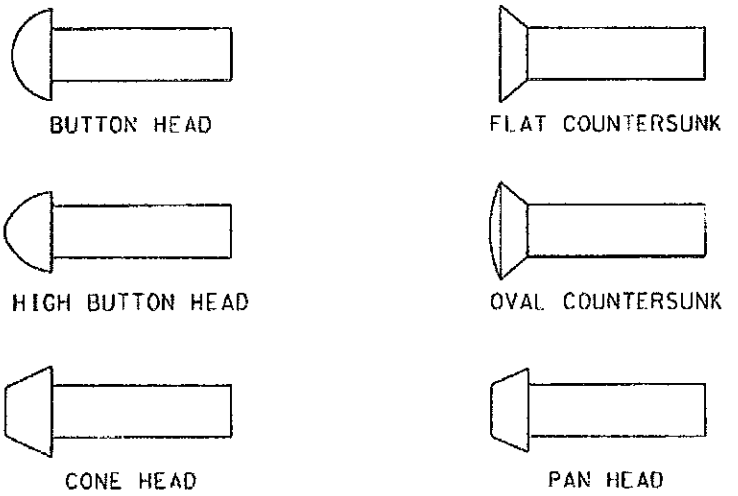
[2] also suggested that for rivets in pure shear, rivets do not need to be replaced as long as the corrosion has not extended into the shank and that the rivet is not loose. Furthermore, the ratio of total head volume removed may linearly scale from 35% (for 100% tension) to 95% (for 100% shear). Refer to below figure from [2].




However, in practicality, one must expect the plate to deteriorate with the rivet head. For example, when a flat countersunk rivet head is 20% of its original volume, the adjoining plate is 33% of its original thickness. So, in practice, it is reasonable to expect a repair that replaces both plate and rivets when severe rivet head decay is present.

Regardless of the type of corrosion, NBIC S1.4.2.1 allows more corrosion than all other approaches for rivets in pure tension. Research and references to peer reviewed documents for NBIC S1.4.2.1 is unknown so cannot be considered. However, due to the difficulties in determining the ratio of shear/tension load on a specific rivet, this draft

adopts the rule to apply equal 50/50% shear/tension. Given the above text, allowable head corrosion for rivets in combined shear/tension is 60%; consistent with NBIC S1.4.2.1.




We assume equal allowable wastage regardless of rivet head type because all known construction codes assume equal allowable loading regardless of rivet head type.

## *References*

[1] "Atlantic Area Best Practices: Rivet Inspection Guidance", U.S. Department of Transportation, United States Coast Guard, 2000.
[2] "Rivet Replacement Analysis", Erich Edward Reichle, U.S. Army Corps of Engineers, 1999.
[3] "Inspection, Evaluation, and Repair of Hydraulic Steel Structures", U.S. Army Corps of Engineers, 2001.
[4] "Guidelines for Assessing Condition of Riveted Spillway Gates", REMR Technical Note CS-ES-1.12, 1994
[5] NBIC Supplement 1, Part 2, 2010.
[6] ASME B18.1.2: American National Standard Large Rivets
[7] http://en.wikipedia.org/wiki/Spherical_cap
[8] "Rivet Replacement Criteria", Fazio, A.E., and R.N. Fazio, Second Bridge Engineering Conference. Washington, D.D. Transportation Research Board. Vol 1, TRR-950
[9] "Procedures For Hull Inspection and Repair on Vessels Built of Riveted Construction", U.S. Department of Transportation, United States Coast Guard, 2001.

The issue I want to address is the lack of inspection on propane tanks that have been out of service for a period of time, sometimes even 10 yrs or more, that are "rebuilt, refurbished or revitalized" and placed back into service without an internal inspection or hydrostatic testing. These tanks are purchased from anyone who has excess tanks in their possession. These tanks are in all manner of conditions. Some have had all the valves removed and stand open to the elements.

There are dozens of companies "refurbishing" tanks. Some have little or no experience in the propane industry and are nothing more than paint body shops. To my knowledge there are only two companies doing these types of "refurbs" that have their "R" stamp. The normal "refurb" service is sand blast, visual inspect the outside surface (if at all), paint and replace some valving.

There are a several issues that I think need to be addressed:

1. There is no way of knowing if these tanks were ever used in anhydrous ammonia service during their lifetime.

    - Changing a tank from propane service to anhydrous ammonia service has been a common practice in the past.
    - There have been multiple accidents involving fatalities from tanks being changed for one service to the other.
    - Stress corrosion cracking and odor fade can occur
    - In NFPA 58 2011 edition in 5.2.1.5 this conversion of service is no longer allowed.

2. Tanks have had their valves removed, allowing them to be susceptible to internal oxidation.

    - Oxidation is the primary cause of odor fade.
    - There have been documented cases where odor fade has been the cause in fatal accidents.
    - There was a national recall on old tanks that were converted from aboveground use to underground use.
        - These tanks were found to have had odor fade issues because of internal oxidation.
        - 11,000 units were involved

3. No one knows the integrity of the vessel.

    - 95% plus (estimate) of the tanks being sold as "refurb" never get hydrostatically tested.

Proposed Verbiage

**S7.9 Special Consideration for LPG Tanks Being Renewed By a Commercial Source.**

Since new LPG tanks have had major cost increases, "refurbished" LPG tanks have become more available on the commercial market. Because the history on some of these tanks is unknown special attention should be given to inspection and repair before returning any of these tanks back to service.

1) All tanks must have a name plate that is firmly attached and legible with an ASME Code symbol, U1A Data Report and a National Board and/or jurisdictional registration number, if required.
2) All coatings must be removed to clean bare steel.
3) All valves and gauges will be removed and inspected for signs of anhydrous ammonia use.
    a. If the tank has been used for anhydrous ammonia service a distinctive blue-green corrosion will be present on the brass valves. There may also be an ammonia odor around the tank or valve area. If any of these signs are present the tank must not be returned to LPG service, under the guidelines of NFPA 58 5.2.1.5 and all valves and gauges must be discarded.
4) A complete external inspection should be completed under the guidelines of NBIC S7.6-8.5

If any defects are found beyond the limits the defect should be repaired under NBIC Part 3, Repairs and Alterations by qualified personnel or discarded.

The main reason for these additions to supplement 7 is "refurb" companies are popping up everywhere and most have no understanding of pressure vessels.

Proposed Verbiage

**S7.9 Requirements for ~~Special Consideration for~~ LPG Tanks Either Used or Will Be Used in Different Service Conditions ~~Being Renewed By a Commercial Source~~.**

~~Since new LPG tanks have had major cost increases, "refurbished" LPG tanks have become more available on the commercial market. Because the history on some of these tanks is unknown special attention should be given to inspection and repair before returning any of these tanks back to service.~~

The following requirements apply to LPG tanks that either have been used or will be used in service conditions other than LPG service.

1) All tanks must have a name plate that is firmly attached and legible with an ASME Code symbol, U1A Data Report and a National Board and/or jurisdictional registration number, if required.
2) All coatings must be removed to clean bare steel.
3) All valves and gauges will be removed and inspected for signs of anhydrous ammonia use.
    a. If the tank has been used for anhydrous ammonia service a distinctive blue-green corrosion will be present on the brass valves. There may also be an ammonia odor around the tank or valve area. If any of these signs are present the tank must not be returned to LPG service, under the guidelines of NFPA 58 5.2.1.5 and all valves and gauges must be discarded.
4) A complete external inspection ~~shall~~should be completed under the guidelines of the NBIC, Part 2, Supplement 7, ~~NBIC~~ S7.6 and Supplement 8, ~~8.~~5 [gwg1]

~~If any defects are found beyond the limits the defect should be repaired under NBIC Part 3, Repairs and Alterations by qualified personnel or discarded.~~

The main reason for these additions to supplement 7 is "refurb" companies are popping up everywhere and most have no understanding of pressure vessels.

NB12-0604

Request for Code Change

NBIC Part 2, Forms NB-6 and NB-7

Statement of Need: These forms need to be changed to become current with a majority of Jurisdictional Requirements

Make the following changes to forms NB-6 and NB-7

Owner-Change to Object Location
Owner Street Address Change to Object Street Address
Owner City Change to Object Location City

User Name Change to Mail Invoice
User Street Address to Invoice Street Address
User City to Invoice Address City

New Block:
Certificate Address
Certificate City
Certificate State and Zip Code

## 5.3.5 BOILER-FIRED PRESSURE VESSELS REPORT OF INSPECTION FORM (NB-6) A11

### FORM NB-6 BOILER-FIRED PRESSURE VESSEL
#### REPORT OF INSPECTION
**Standard Form for Jurisdictions Operating Under the ASME Code**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | DATE INSPECTED MO \| DAY \| YEAR | CERT EXP DATE MO \| YEAR | CERTIFICATE POSTED ☐ Yes ☐ No | OWNER NO. | JURISDICTION NUMBER | NAT'L BD NO. ☐ OTHER NO. ☐ |
| 2 | OWNER Object Location | | | NATURE OF BUSINESS | KIND OF INSPECTION ☐ Int ☐ Ext | CERTIFICATE INSPECTION ☐ Yes ☐ No |
| | OWNER'S STREET ADDRESS NUMBER Object Street Address | | | OWNER'S CITY Object Location City | | ZIP |
| 3 | USER'S NAME—OBJECT LOCATION Mail Invoice to: | | | SPECIFIC LOCATION IN PLANT | OBJECT LOCATION - COUNTY | |
| | USER'S STREET ADDRESS NUMBER Invoice Street Address | | | OWNER'S CITY Invoice Address City | STATE | ZIP |
| 4 | TYPE ☐ FT ☐ WT ☐ CI ☐ Other _____ | | YEAR BUILT | MANUFACTURER | | |
| 5 | USE ☐ Power ☐ Process ☐ Steam Htg ☐ HWH ☐ HWS ☐ Other _____ | | | FUEL | METHOD OF FIRING | PRESSURE GAGE TESTED ☐ Yes ☐ No |
| 6 | PRESSURE ALLOWED MAWP _____ This Inspection _____ Prev. Inspection _____ | | | SAFETY-RELIEF VALVES Set at _____ Total Capacity _____ | | HEATING SURFACE OR BTU (Input/Output) |
| 7 | IS CONDITION OF OBJECT SUCH THAT A CERTIFICATE MAY BE ISSUED? ☐ Yes ☐ No (If no, explain fully under conditions) | | | | PRESSURE TEST ☐ Yes _____ psi Date _____ ☐ No | |
| 8 | CONDITIONS: With respect to the internal surface, describe and state location of any scale, oil or other deposits. Give location and extent of any corrosion and state whether active or inactive. State location and extent of any erosion, grooving, bulging, warping, cracking or similar condition. Report on any defective rivets, bowed, loose or broken stays. State condition of all tubes, tube ends, coils, nipples, etc. Describe any adverse conditions with respect to pressure gage, water column, gage glass, gage cocks, safety valves, etc. Report condition of setting, linings, baffles, supports, etc. Describe any major changes or repairs made since last inspection. | | | | | |

Certificate Address:

Certificate City: | Certificate State, Zip Code:

| | |
|---|---|
| 9 | REQUIREMENTS: (List Code Violations) |
| 10 | NAME AND TITLE OF PERSON TO WHOM REQUIREMENTS WERE EXPLAINED:<br>I HEREBY CERTIFY THIS IS A TRUE REPORT OF MY INSPECTION<br>SIGNATURE OF INSPECTOR IDENT NO. EMPLOYED BY IDENT NO. |

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Ave., Columbus, OH 43229 NB-6 Rev. 5

SECTION 5

A11 **5.3.6 PRESSURE VESSELS REPORT OF INSPECTION FORM (NB-7)**

## FORM NB-7 PRESSURE VESSELS
### REPORT OF INSPECTION
**Standard Form for Jurisdictions Operating Under the ASME Code**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | DATE INSPECTED MO \| DAY \| YEAR | CERT EXP DATE MO \| YEAR | CERTIFICATE POSTED ☐Yes ☐No | OWNER NO. | JURISDICTION NUMBER | NAT'L BD NO.☐ OTHER NO.☐ | |
| 2 | OWNER Object Location | | | | NATURE OF BUSINESS | KIND OF INSPECTION ☐Int ☐Ext | CERTIFICATE INSPECTION ☐Yes ☐No |
| | OWNER'S STREET ADDRESS Object Street Address | | | | OWNER'S CITY Object Location City | | ZIP |
| 3 | USER'S NAME – OBJECT LOCATION Mail Invoice to: | | | | SPECIFIC LOCATION IN PLANT | OBJECT LOCATION - COUNTY | |
| | USER'S STREET ADDRESS Invoice Street Address | | | | USER'S CITY Invoice City | STATE | ZIP |
| 4 | TYPE ☐ AIR TANK ☐ WATER TANK ☐ OTHER | | | YEAR BUILT | MANUFACTURER | | |
| 5 | USE ☐ STORAGE ☐ PROCESS ☐ HEAT EXCHANGE ☐ OTHER | | | | SIZE | PRESSURE GAGE TESTED ☐Yes ☐No | |
| 6 | PRESSURE ALLOWED THIS INSPECTION _____ PREVIOUS INSPECTION _____ | | | SAFETY RELIEF VALVES SET AT _____ TOTAL CAPACITY | | EXPLAIN IF PRESSURE CHANGED | |
| 7 | IS CONDITION OF OBJECT SUCH THAT A CERTIFICATE MAY BE ISSUED? ☐ YES ☐ NO (IF NO, EXPLAIN FULLY UNDER CONDITIONS) | | | | PRESSURE TEST ☐ YES _____ PSI DATE _____ ☐ NO | | |
| 8 | CONDITIONS: With respect to the internal surface, describe and state location of any scale, oil, or other deposits. Give location and extent of any corrosion and state whether active or inactive. State location and extent of any erosion, grooving, bulging, warping, cracking, or similar condition. Report on any defective rivets, bowed, loose or broken stays. State condition of all tubes, tube ends, coils, nipples, etc. Describe any adverse conditions with respect to pressure gage, water column, gage glass, gage cocks, safety valves, etc. Report condition of setting, linings, baffles, supports, etc. Describe any major changes or repairs made since last inspection. | | | | | | |
| | Certificate Address: | | | | | | |
| | Certificate City: | | | | Certificate State, Zip Code: | | |
| 9 | REQUIREMENTS: (LIST CODE VIOLATIONS) | | | | | | |
| 10 | NAME AND TITLE OF PERSON TO WHOM REQUIREMENTS WERE EXPLAINED: | | | | | | |
| | I HEREBY CERTIFY THIS IS A TRUE REPORT OF MY INSPECTION _____ SIGNATURE OF INSPECTOR | | | IDENT NO. | EMPLOYED BY | | IDENT NO. |

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Ave., Columbus, OH 43229 NB-7 Rev. 3

### 5.3.6-a FORM NB-7 (BACK)

## PRESSURE VESSEL — REPORT OF INSPECTION — (EXTENSION SHEET)

| DATE INSPECTED | | OWNER-USER | | | | | | LOCATION | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OWNER'S NO. | JURISDICTION NO. | NB ASME OR STD. NO. | INT | EXT | *CERT – NO. OF YEARS | TYPE OF OBJECT | YEAR BUILT | MADE BY | ALLOW. PRESS. | TEMP. OF | R.V.S.V. SETTING |
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* In this column show the number of years for which the inspector authorizes the issuance of the certificate.

(Back)

## Requested Revisions and Additions

## CURRENT WORDING – NBIC Part 2, SECTION 5 5.2 – 5.2.3

### 5.2 REPLACEMENT OF STAMPING DURING INSERVICE INSPECTION

### 5.2.1 AUTHORIZATION

a) When the stamping on a pressure-retaining item becomes indistinct or the nameplate is lost, illegible, or detached, but traceability to the original pressure-retaining item is still possible, the Inspector shall instruct the owner or user to have the stamped data replaced. All re-stamping shall be done in accordance with the original code of construction, except as modified herein. Requests for permission to re-stamp or replace nameplates shall be made to the Jurisdiction in which the pressure-retaining item is installed. Application must be made on the Replacement of Stamped Data Form, NB-136 (see 5.3.2). Proof of the original stamping and other such data, as is available shall be furnished with the request. 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.

b) When there is no Jurisdiction, the replacement of stamped data shall be authorized and witnessed by a National Board Commissioned Inspector and the completed Form NB-136 (see 5.3.2) shall be submitted to the National Board.

### 5.2.2 REPLACEMENT OF STAMPED DATA

a) The re-stamping or replacement of data shall be witnessed by a National Board Commissioned Inspector and shall be identical to the original stamping.

b) The Re-stamping or replacement of a code symbol stamp shall be performed only as permitted by the governing code of construction.

c) Replacement nameplates shall be clearly marked "replacement".

### 5.2.3 REPORTING

Form NB-136 shall be filed with the Jurisdiction (if required) or the National Board by the owner or user together with a facsimile of the stamping or nameplate, as applied, and shall also bear the signature of the National Board Commissioned Inspector who witnessed the replacement.

# PROPOSED CHANGES– NBIC Part 2, SECTION 5, 5.2 – 5.2.3

## 5.2 REPLACEMENT OF STAMPING ~~DURING INSERVICE INSPECTION~~OR NAMEPLATE

### 5.2.1 AUTHORIZATION

a) When the stamping on a pressure-retaining item becomes indistinct or the nameplate is lost, illegible, or detached, but traceability to the original pressure-retaining item is still possible, the Inspector shall ~~instruct~~ require ~~the owner or user to shall have~~ the nameplate or stamped data to be replaced. All re-stamping shall be done in accordance with the original code of construction, except as modified herein. ~~Requests for permission to re-stamped or replaced nameplates shall be made to the Jurisdiction in which the pressure-retaining item is installed. Application~~ Documentation must be made on the Replacement of Stamped Data Form, NB-136 (see 5.3.2). Proof of the original stamping and other such data, as is available shall be furnished ~~with the request~~ to the Inspector (not required for the reattachment of nameplates that are partially attached). ~~Permission from the Jurisdiction~~ Completion of an NB-136 is not required for the reattachment of nameplates that are partially attached. Notification of re-stamping or replacement nameplates shall be made to the Jurisdiction in which the pressure-retaining item is installed. When traceability cannot be established, the Jurisdiction shall be contacted.

b) When there is no Jurisdiction, the replacement of stamped data shall be authorized and ~~witnessed~~ verified by a National Board Commissioned Inspector and the completed Form NB-136 (see 5.3.2) shall be submitted to ~~t~~The National Board.

### 5.2.2 REPLACEMENT OF STAMPED DATA OR NAMEPLATE

a) The re-stamping or replacement of ~~data~~ a nameplate shall be ~~witnessed~~ verified and accepted by a National Board Commissioned Inspector. ~~and shall be identical to the original stamping.~~

b) The ~~R~~re-stamping or replacement of a code symbol stamp shall be performed only as permitted by the governing code of construction.

c) Replacement nameplates shall be clearly ~~marked~~ stamped "~~replacement~~REPLACEMENT".

### 5.2.3 REPORTING

Form NB-136 shall be filed with the Jurisdiction (if required) and ~~or t~~The National Board by the owner or user ~~together with~~ documenting a facsimile of the stamping or nameplate, as applied, and shall also bear the signature of the National Board Commissioned Inspector who ~~witnessed~~ verified the replacement.

## PROPOSED NEW WORDING– NBIC Part 2, SECTION 5, 5.2 – 5.2.3

### 5.2 REPLACEMENT OF STAMPING OR NAMEPLATE

### 5.2.1 AUTHORIZATION

a) When the stamping on a pressure-retaining item becomes indistinct or the nameplate is lost, illegible, or detached, but traceability to the original pressure-retaining item is still possible, the Inspector shall require the nameplate or stamped data to be replaced. All re-stamping shall be done in accordance with the original code of construction, except as modified herein. Documentation must be made on the Replacement of Stamped Data Form, NB-136 (see 5.3.2). Proof of the original stamping and other such data, as is available shall be furnished to the Inspector (not required for the reattachment of nameplates that are partially attached). Completion of an NB-136 is not required for the reattachment of nameplates that are partially attached. Notification of re-stamping or replacement nameplates shall be made to the Jurisdiction in which the pressure-retaining item is installed. When traceability cannot be established, the Jurisdiction shall be contacted.

b) When there is no Jurisdiction, the replacement of stamped data shall be authorized and verified by a National Board Commissioned Inspector and the completed Form NB-136 (see 5.3.2) shall be submitted to The National Board.

### 5.2.2 REPLACEMENT OF STAMPED DATA OR NAMEPLATE

a) The re-stamping or replacement of a nameplate shall be verified and accepted by a National Board Commissioned Inspector.

b) The re-stamping or replacement of a code symbol stamp shall be performed only as permitted by the governing code of construction.

c) Replacement nameplates shall be clearly stamped "REPLACEMENT".

### 5.2.3 REPORTING

Form NB-136 shall be filed with the Jurisdiction (if required) and The National Board by the owner or user documenting a facsimile of the stamping or nameplate, as applied, and shall also bear the signature of the National Board Commissioned Inspector who verified the replacement.

# NB-136 REPLACEMENT OF STAMPED DATA FORM

in accordance with provisions of the *National Board Inspection Code*

Submitted to:

(name ~~of jurisdiction~~)

(address)

(telephone no.)

Submitted by

(name of owner or certificate holder)

(address)

(telephone no.)

1. Manufactured by (name and address)
2. Manufactured for (name and address)
3. Location of Installation (address)
4. Date Installed
5. Previously installed at
6. Manufacturer's Data Report Attached ☐No ☐Yes
7. Item registered with National Board ☐No ☐Yes, NB Number
8. Item identification Year built

   Type Dimensions

   Mfg. Serial no. Jurisdiction no.

   MAWP psi Safety relief valve set at psi
9. Complete ~~the reverse side of~~ this report with a true facsimile of the legible portion of the nameplate or:
10. If nameplate is lost or illegible, traceability documentation shall be ~~attached~~ available to the Inspector identifying the stamping or nameplate to the object ~~to~~ and the Manufacturer's Data Report (if available) referenced on this form.

~~11. I request authorization to replace the stamped data and/or nameplate on the above described pressure retaining item in accordance with the rules of the *National Board Inspection Code* (NBIC).~~

~~Owner or User's nOrganization Name~~

~~Signature~~ ~~Date~~

~~Title~~

~~12. Authorization is granted to replace the stamped data or to replace the nameplate of the above described pressure retaining item.~~

~~Signature~~ ~~Date~~

~~(chief inspector or authorized representative)~~

~~Jurisdiction~~

The following is a true facsimile of the legible portion of the item's existing nameplate, (if applicable). Please print. Where possible, also attach a rubbing of the nameplate.

The following is a true facsimile of the item's replacement nameplate

ADDED

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*. ~~Attached is a facsimile or rubbing of the stamping or nameplate.~~

Name of Owner or User or Certificate Holder _____

Signature _____ Date _____
(Authorized representative)

Witnessed by _____ Employer _____
(Name of inspector)

Signature _____ Date _____ NB Commission _____
(Name of inspector)

# NB-136 REPLACEMENT OF STAMPED DATA FORM

in accordance with provisions of the *National Board Inspection Code*

Submit to:

(name)

(address)

(telephone no.)

Submitted by

(name of owner or certificate holder)

(address)

(telephone no.)

1. Manufactured by _____ (name and address)
2. Manufactured for _____ (name and address)
3. Location of Installation _____ (address)
4. Date Installed _____
5. Previously installed at _____
6. Manufacturer's Data Report Attached ☐No ☐Yes
7. Item registered with National Board ☐No ☐Yes, NB Number _____
8. Item identification Year built _____

   Type _____ Dimensions _____

   Mfg. Serial no. _____ Jurisdiction no. _____

   MAWP _____ psi Safety relief valve set at _____ psi
9. Complete this report with a true facsimile of the legible portion of the nameplate or:
10. If nameplate is lost or illegible, traceability documentation shall be available to the Inspector identifying the stamping or nameplate to the object and the Manufacturer's Data Report (if available) referenced on this form.

The following is a true facsimile of the legible portion of the item's existing nameplate, (if applicable). Please print. Where possible, also attach a rubbing of the nameplate.

The following is a true facsimile of the item's replacement nameplate

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*.

Name of Owner or User or Certificate Holder _____

Signature _____ Date _____
(Authorized representative)

Witnessed by _____ Employer _____
(Name of inspector)

Signature _____ Date _____ NB Commission _____
(Name of inspector)

# CURRENT NB-136 FORM

## NB-136 REPLACEMENT OF STAMPED DATA FORM

in accordance with provisions of the *National Board Inspection Code*

Submitted to

_____
(name of jurisdiction)

_____
(address)

_____

_____
(telephone no.)

Submitted by

_____
(name of owner)

_____
(address)

_____

_____
(telephone no.)

1. Manufactured by _____
(name and address)
2. Manufactured for _____
(name and address)
3. Location of Installation _____
(address)
4. Date Installed _____
5. Previously installed at _____
6. Manufacturer's Data Report Attached ☐No ☐Yes
7. Item registered with National Board ☐No ☐Yes, NB Number _____
8. Item identification Year built _____

   Type _____ Dimensions _____

   Mfg. Serial no. _____ Jurisdiction no. _____

   MAWP _____ psi Safety relief valve set at _____ psi
9. Complete the reverse side of this report with a true facsimile of the legible portion of the nameplate.
10. If nameplate is lost or illegible, documentation shall be attached identifying the object to the Manufacturer's Data Report referenced on this form.

11. I request authorization to replace the stamped data and/or nameplate on the above described pressure-retaining item in accordance with the rules of the *National Board Inspection Code* (NBIC).

    Owner or User's name _____

    Signature _____ Date _____

    Title _____

12. Authorization is granted to replace the stamped data or to replace the nameplate of the above described pressure-retaining item.

    Signature _____ Date _____
    (chief inspector or authorized representative)

    Jurisdiction _____

Inspection

The following is a true facsimile of the legible portion of the item's nameplate. Please print. Where possible, also attach a rubbing of the nameplate.

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*. Attached is a facsimile or rubbing of the stamping or nameplate.

Name of Owner or User _____

Signature _____ Date _____
(Authorized representative)

Witnessed by _____ Employer _____
(Name of inspector)

Signature _____ Date _____ NB Commission _____
(Name of inspector)