



THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD INSPECTION CODE SUBCOMMITTEE REPAIRS & ALTERATIONS

Minutes

Meeting of January 14, 2026
New Orleans, LA

These minutes are subject to approval and are for committee use only. They are not to be duplicated or quoted for other than committee use.

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

1. Call to Order

The meeting was called to order at 8:00 a.m. Central Time in Lafitte AB on the 1st floor of the hotel by Chair Moore.

2. Roll call of Members and introduction of Visitors

Secretary Hellman took roll of members and visitors. ([Attachment 1](#))

3. Check for a Quorum

A quorum was established with all 21 of the SG R&A members present (R. Collins as Alternate for B. Morelock – Same employer/interest category)

4. Announcements

- This meeting marks the end of Cycle C for the 2027 NBIC edition.
 - Last cycle for LBs.
- The National Board will be hosting a reception on Wednesday evening from 5:30 p.m. to 7:30 p.m. at The Hard Rock Café on Bourbon Street.
- The National Board will be hosting breakfast and lunch on Thursday for those attending the Main Committee meeting. Breakfast will be served from 7:00 a.m. to 8:00 a.m. in the Atrium on the 2nd floor of the hotel, and lunch will be served at the same location from 11:30 a.m. to 12:30 p.m.
- Meeting schedules, meeting room layouts, and other helpful information can be found on the National Board website under the **NBIC** tab → NBIC Meeting Information.
- Remember to add any attachments that you'd like to show during the meeting (proposals, reference documents, powerpoints, etc.) to the NBIC SharePoint site (nationalboard.sharepoint.com/sites/NBIC) **prior to the meeting.**
 - Note that access to the NBIC SharePoint site is limited to committee members only.
 - ALL powerpoint attachments/presentations must be sent to the NBIC Secretary for approval prior to the meeting.
 - Contact Jonathan Ellis (nbicsecretary@nbbi.org) for any questions regarding NBIC SharePoint access.
- When possible, please submit proposals in Word format showing “strike through/underline.” Project Managers: please ensure any proposals containing text from previous NBIC editions are updated with text from the most current edition.
- If you'd like to request a new Interpretation or Action item, do so on the National Board Business Center.
 - Anyone, member or not, can request a new item.
- As a reminder, anyone who would like to be considered for membership of a group or committee:
 - Should attend at least two meetings prior to being put on the agenda for membership consideration. The nominee may be placed on the agenda for voting during their third meeting, pending the Chair's approval.
 - The nominee must submit the formal request along with their resume to the NBIC Secretary **PRIOR TO** the meeting. nbicsecretary@nbbi.org
 - If elected by the membership, the member will serve a term of three years.
- Thank you to everyone who registered online for this meeting. The online registration is very helpful for planning our reception, meals, room setup, etc. It is also a good way to make sure we have the most up-to-date contact information. Please continue to use the online registration for each meeting.
- NBBI Committee Code of Conduct requirements review.

5. Awards and Special Recognition

- Mr. Linn Moedinger – 10 years on SC R&A

6. Adoption of the Agenda – Agenda has been revised 1/13/26 to incorporate action taken at the TG and SG levels. Added Action Items: A25-83, A25-84, A25-85. The Agenda was unanimously approved (UA) as revised.

7. Approval of the Minutes of the July 2025 Meeting

A motion was made and seconded to adopt the agenda and was unanimously approved (UA).

8. Review of Rosters

a. Membership Nominations

- i. Mr. Jeremy Smith (General Interest) was nominated for membership to the INTERP TG and was UA.
- ii. Mr. Tom White (User) was nominated for membership to the SC R&A and was UA.
- iii. Mr. Robert Derby (Labor) and Mr. Aziz Khssassi (Jurisdictional Authority) were approved by the SC in July 2025, but not considered at MC. A re-affirmation of the SC to add them to the membership was UA.

b. Membership Reappointments

- i. The following **TG Interpretations** memberships were UA for reappointment: Mr. Jon Ferreira.
- ii. The following **TG NR** memberships were UA for reappointment: Mr. Tom Roberts, Mr. Ben Schaefer, and Mr. Bryan Toth.
- iii. The following **Subgroup R&A** memberships were UA for reappointment: Mr. Louis Dutra, Mr. Aziz Khssassi, and Mr. Walt Sperko
- iv. The following **Subcommittee R&A** memberships were UA for reappointment: Ms. Pat Becker.

c. Officer Nominations - None

d. Resignations

- i. The following Subgroup members are resigning from SG R&A: Mr. Craig Hopkins, Mr. Marty Toth, Mr. Tom White.

9. Presentations

Ms. Melissa Wadkinson shared a presentation on Proof Testing ([Attachment 2](#))

10. Interpretations

Item Number: I25-40	NBIC Location: Part 3, 2.5.3.2	Attachment 3
General Description: Fillet welds using alternative welding method #2 Subgroup: Repairs and Alterations Task Group: P. Becker (PM), J. Siefert Explanation of Need: Welding on non-pressure parts (P11B Pads) to the outside of a VIII Div 1 P11B Pressure Vessel. Welding method #4 speaks specifically about fillet welds, when welding method #2 does not specifically reference fillet welds. Is this a potential oversight and it can be done, or is it written this way to exclude fillet welds using welding method #2? July 2025 Meeting Action: Progress report. INTERP TG Jan 2026 Meeting Action: P. Becker presented a proposal to answer the question if fillet welds are exempted from Welding Method #2 with a “No”. The proposal was Unanimously Approved (UA). SC R&A Jan 2026 Meeting Action: T. Seime presented. J. Siefert asked if this could be revised to include all welding methods (in lieu of only Method #2). The proposal was revised to state fillet welds are not excluded from any of the Alt. Weld Methods. The proposal was UA as revised. MC – Voice Vote - UA		

New Interpretations Requests:

Item Number: I25-66	NBIC Location: Part 3, S6.19.4	Attachment 4
General Description: Registering R-1 Forms for D.O.T. Cargo Tanks Subgroup: Repairs and Alterations Task Group: T. Seime (PM) Explanation of Need: Request ruling on if R-1 forms, including repairs of a routine nature, relating to repairs of D.O.T. cargo tanks built under ASME VIII code need to be registered with the national board & if they require a unique registration number for each individual form. INTERP TG Jan 2026 Meeting Action: T. Seime presented a proposal to state S6.19.4 requires all Form “R” Reports to be registered with the NB. The proposal was UA. SC R&A January 2026 Meeting Action: T. Seime presented a proposal that was UA. MC – Voice Vote - UA		

11. Action Items

a. Task Group Graphite

Item Number: A24-67	NBIC Location: Part 3, S3.3	Attachment 5
General Description: Replacement Parts for Graphite Pressure Vessels Subgroup: Graphite Task Group: A Viet (PM), J. Wince, S. Mehrez Explanation of Need: Clarifying requirements for use of graphite pressure vessel replacement parts for repairs or alterations. July 2025 Meeting Action: A. Viet presented a PR. The proposal was revised by the SC, and A. Viet will take these changes to the Graphite TG for consideration. SC R&A January 2026 Meeting Action: A. Viet presented a proposal from the Graphite TG for a vote. The proposal was UA. MC – Voice Vote - UA		
Item Number: A25-62	NBIC Location: Part 3, S3.5.4	Attachment 6
General Description: Revise Part 3, S3.5.4 for clarity Subgroup: Graphite Task Group: A Viet (PM) Explanation of Need: Clarify the intent of the cement procedure to make acquiring materials more efficient. SC R&A January 2026 Meeting Action: A. Viet presented a proposal from the Graphite TG for a vote. The proposal was UA. MC – Voice Vote - UA		
Item Number: I25-63	NBIC Location: Part 3, S3.5.4	Attachment 7
General Description: Field Plugging - Intent Interpretation for Part 3, S3.5.4 f) Subgroup: Graphite Task Group: A Viet Explanation of Need: Clarify S3.5.4f, concerning tube plugging kit materials. SC R&A January 2026 Meeting Action: A. Viet presented a proposal from the Graphite TG for a vote. The intent interp was UA. (see A25-62) MC – Voice Vote - UA		

b. Task Group FRP

There are currently no open FRP items related to Part 3.

c. Task Group Historical

Item Number: A20-25	NBIC Location: Part 3, S2.13	No Attachment
General Description: Repair Procedure for Fire Boxes		
Subgroup: SG Historical		
Task Group: M. Wahl (PM), R. Forbes, T. Dillon, L. Moedinger, C. Jowett, & F. Johnson		
Explanation of Need: In NBIC Part 3, S2.13.10.3, S2.13.11 do not define what to do at a riveted joint. On the tubesheet, or firedoor sheet, where it is flanged to rivet to the firebox, the repairs are silent on what to do at the riveted joint.		
July 2025 Meeting Action: T. Seime presented a PR.		
SC R&A Jan. 2026 Meeting Action: T. Seime presented a PR.		
MC – PR		

d. Task Group Locomotive

Item Number: 24-77	NBIC Location: Part 3, S1.2.3k)	Attachment 8
General Description: Clarify Alteration for transition from rigid to flexible bolts.		
Subgroup: TG Locomotive		
Task Group: M. Ray (PM), W. Fengler, T. Botti, J. Churchill		
Explanation of Need: This is omission from the code.		
July 2025 Meeting Action: T. Seime presented a PR, as there was no one from TG Locomotive to speak on this item. This may be LB to SC if requested.		
Update: This was balloted to and approved by SC R&A. The proposal is ready for Main Committee.		
SC R&A Jan. 2026 Meeting Action: Reviewed and discussed. No changes made.		
MC – Voice Vote - UA		

Item Number: 24-79	NBIC Location: Part 3, S1.1.1 b)	No Attachment
General Description: Value of Default Tensile Strength Subgroup: TG Locomotive Task Group: M. Ray (PM) Explanation of Need: FRA mandates default of 50,000 psi but boilers built after 1921 have better than 55,000 psi steel.		
July 2025 Meeting Action: T. Seime presented a PR, as there was no one from TG Locomotive to speak on this item. This may be LB to SC if requested. Update: This was balloted to SC R&A, but the ballot failed. The proposal will be sent back to TG Locomotive for further worker. SC R&A Jan. 2026 Meeting Action: L. Moedinger presented a PR . MC – PR		

Item Number: 24-81	NBIC Location: Part 3, Table S1.1.3.1	No Attachment
General Description: Revise Table S1.1.3.1, Part 3, Section 6 Subgroup: TG Locomotive Task Group: R. Franzen (PM), T. Botti Explanation of Need: Need alternate material for Hollow Cylindrical Pressure Retaining Parts. Propose SA-106-B which is hollow seamless pipe to be used for super heater ball end parts. The new line-item title in the table would be "SH Unit Ball Ends", material options would be SA-106-B, SA-675, SA-696. Change first line item from Boiler Tubes & Flues, Arch Tubes, Superheater Units, change to Boiler Tubes & Flues, Arch Tubes, Superheater Units & Tubing. See other changes in table in RED.		
February 2025 TG Locomotive Meeting Action: Ms. Metzmaier reported that this item was omitted from the SC R& A January 2025 agenda. The proposal will be sent to letter ballot to the SC R&A for vote. No action was taken by the TG. July 2025 Meeting Action: T. Seime presented a PR. This may be LB to SC if requested. Update: This was balloted to SC R&A, but the ballot failed. The proposal will be sent back to TG Locomotive for further worker. SC R&A Jan. 2026 Meeting Action: L. Moedinger presented a PR . MC – PR		

Item Number: 24-106	NBIC Location: Part 3, S1.2.2	Attachment 9
General Description: S1.2.2 Threaded Staybolts, change wording concerning reduced body staybolts Subgroup: TG Locomotive Task Group: None Assigned Submitted by: R. Franzen Explanation of Need: Clarification on staybolts over 8" long is needed whether they need telltale holes or not in rigid, flexible, radial and crown bolts.		
July 2025 Meeting Action: T. Seime presented a PR, as there was no one from TG Locomotive to speak on this item. This may be LB to SC if requested. Update: This was balloted to and approved by SC R&A. The proposal is ready for Main Committee. SC R&A Jan. 2026 Meeting Action: L. Moedinger presented an update that this is. Ready for MC vote. MC – Voice Vote - UA		

Item Number: 25-17	NBIC Location: Part 3, S1.2	No Attachment
General Description: Part 3, S1.2 revisions Subgroup: TG Locomotive Task Group: T. Botti (PM) Submitted by: T. Botti Explanation of Need: This action item is to clean up S1.2 to more clearly convey requirements of the various locomotive staybolt designs. This action is intended as a cleanup of existing information; if requirements are added or removed they will be covered by further action items.		
Update: Failed SC LB No Quorum 1/9/26 (8-2-0) SC R&A Jan. 2026 Meeting Action: L. Moedinger presented a PR and will take back to TG. MC – PR		

e. NR Task Group

Item Number: A23-60	NBIC Location: Part 3, 1.6	No Attachment
General Description: Endorsements required for Nuclear Inspectors based on Category of work Subgroup: NR TG Task Group: C. Dinic (PM), A. Triplett, A. Khssassi Explanation of Need: Endorsements required for Nuclear Inspectors based on Category of work (1, 2, or 3) SC R&A July 2025 Meeting Action: R. Spuhl presented a PR. NR TG January 2026 Meeting Action: This was item was put on hold pending progress on new ANIA document for non-ASME Category 3 activities. SC R&A Jan. 2026 Meeting Action: R. Spuhl presented a PR. A24-92 has already took care of some of these concerns. Still on hold. MC – PR		

Item Number: A24-09	NBIC Location: Part 3, 1.6.1 – 1.6.5	No Attachment
General Description: Update and revise NR Scope in 1.6.1 - 1.6.5 Subgroup: NR TG Task Group: R. Spuhl (PM), J. Hayes, A. Khssassi Explanation of Need: Scope and update and revision to 1.6.1 - 1.6.5. NR TG January 2026 Meeting Action: R. Spuhl presented a PR. A revised proposal was presented. A revision to the NBIC text and the NB-417 was proposed to remove from the NBIC and put into the NB-417 the timeframe for an NR Cert Holder to receive a Cert if they have an active N-type ASME certificate (similar to the change in NB-415). The NBIC currently states 12 months; the proposed revision would delete the NBIC reference and add to the NB-417 the time frame to match ASME Cert. periods based solely on a Manual Review. SC R&A Jan. 2026 Meeting Action: R. Spuhl presented a PR MC – PR		

Item Number: A25-48	NBIC Location: Part 3, 1.6.2.1	Attachment 10
General Description: Move Table 1.6.2.1 references into the text or glossary Subgroup: NR TG Task Group: R. Spuhl (PM) Explanation of Need: The Task group believes most if not all of the Acronyms are already in the body of the book and/or glossary and this table can be removed. NR TG Jan. 2026 Meeting Action: A motion was made and seconded to delete the acronym table 1.6.2.1 and open two new action items to define “Code” and “NQA-1” After discussion a vote was taken and motion unanimously passed. SC R&A Jan. 2026 Meeting Action: R. Spuhl presented a proposal that was UA. MC – Voice Vote - UA		

f. Subgroup Repairs & Alterations

Item Number: A21-53	NBIC Location: Part 3, S8.5 a)	Attachment 11
General Description: Post Repair Inspection of weld repairs to CSEF steels Subgroup: Repairs and Alterations Task Group: P. Gilston (PM), E. Cutlip, A. Triplett Explanation of Need: The requirement for Inspector involvement in post-repair inspections to CSEF weld repairs is to ensure future safe operation of the boiler. This is a function of the inservice Authorized Inspection Agency, not the Repair Inspector, whose duties end with completion of repair documentation. SG R&A Jan. 2026 Meeting Action: P. Gilston presented Rev 6 of the proposal. Slight editorial changes were made and the item was UA as revised. SC R&A July 2026 Meeting Action: P. Gilston presented a proposal that was revised at the SC to indicate the re-write of the paragraphs. The proposal was UA as revised. MC – to be LB to MC		

Item Number: A23-21	NBIC Location: Part 3, 3.3.4.9	No Attachment
General Description: Boiler tube plug guidelines and inclusion or watertube boilers Subgroup: Repairs and Alterations Task Group: S. Lombardo (PM), P. Gilston, A. Triplett, T. White, J. Ferreira, L. Dutra Explanation of Need: Currently both firetube and watertube boilers require a boiler tube be plugged when replacement of a tube is not practicable at the time the defective tube is detected. SG R&A Jan. 2026 Meeting Action: P. Gilston presented a PR. L. Dutra added to the TG SC R&A Jan. 2026 Meeting Action: P. Gilston presented a PR. MC – PR		

Item Number: A23-35	NBIC Location: All Parts, 9.1	Attachment 12
General Description: Definition of "non-load bearing attachment" (All Parts) Subgroup: Repairs and Alterations Task Group: T. White (PM), A. Khssassi, P. Lentzer, J. Walker Explanation of Need: The term "nonload bearing attachment" is used as a basis for determining a routine repair but is not defined in the NBIC. July 2025 Meeting Action: T. White presented a PR. SG R&A Jan. 2026 Meeting Action: A. Khssassi presented a proposal with changes to 3.3.2 e) 2) to add a description of “non-load bearing attachments”. Sect. VIII Div. 2 defines this term already and P. Shanks asked if this definition can be used. A. Khssassi revised the proposal (Rev 5) and after much discussion and revisions, the item was Approved with 2 negs (J. Siefert, B. Schaefer) SC R&A Jan. 2026 Meeting Action: T. White presented a proposal that was revised by the SC. The proposal was Approved w/ 3 Neg. (B. Schaefer, P. Shanks, J. Siefert) and 1 Abstain (M. Toth). MC – to be LB to MC		

Item Number: A23-61	NBIC Location: Part 3, S9.3	No Attachment
General Description: Revise NBIC R-2 Report and guide Subgroup: Repairs and Alterations Task Group: B. Schaefer (PM), T. LeBeau, S. Marks Explanation of Need: Updates to the R-2 Report and the guide for completing R Report. SC R&A July 2025 Meeting Action: B. Schaefer presented a PR. SG R&A Jan. 2026 Meeting Action: B. Schaefer presented a PR. Additional changes to the R Form and Guide are being made and will be presented later. SC R&A Jan. 2026 Meeting Action: B. Schaefer presented a PR MC – PR		

Item Number: A23-77	NBIC Location: Part 3, 4.2 a)	Attachment 13
General Description: Performance of Original NDE During Repairs and Alterations Subgroup: Repairs and Alterations Task Group: T. White (PM), S. Frazier, J. Walker, R. Collins, P. Becker, P. Lentzer, A. Triplett Explanation of Need: The existing language in Part 3, Section 4, Paragraph 4.2.a does not provide enough guidance or flexibility for Repair Organizations and owners to prescribe appropriate NDE for repairs/alterations to existing welds. Based on the limited, often non-specific documentation typically available to these entities during NBIC repairs and alterations, additional allowances and direction should be provided. SC R&A July 2025 Meeting Action: A. Triplett presented a PR. SG R&A Jan. 2026 Meeting Action: A. Triplett presented a proposal that combined A23-36, A23-59, and A23-77 and the current 2025 NBIC text. Specific changes regarding not having RI prior approval was removed and additional editorial changes were made. The proposal was UA as revised. SC R&A Jan. 2026 Meeting Action: A. Triplett presented a proposal that was revised and UA. MC – Voice Vote - UA		

Item Number: A24-17	NBIC Location: Part 3, 5.7.5 b)	Attachment 14
General Description: Specific Requirements For Stamping And Nameplates Subgroup: Repairs and Alterations Task Group: B. Schaefer (PM), A. Khssassi, J. Ferreira and T. LeBeau Explanation of Need: 2023 ASME Section VIII-Div 1 UG-119(c)(5) has been revised to allow for the use of mechanical etching or laser annealing on nameplates. SC R&A July 2025 Meeting Action: B. Schaefer presented a proposal that was revised and Approved w/1 Neg (K. Moore). Update: Failed MC LB (4-11-1) SG R&A Jan. 2026 Meeting Action: B. Schaefer presented. Stacy Marks discussed another item (A25-51) addresses some of this in the 1.5 of Part 3. Instead of combining these items into a single proposal, Stacy Marks was made the PM for both items to ensure they are compatible and meet the intent of the NBIC. B. Shaefer (newly elected VC this meeting) was removed from the TG as the PM. After revisions, the proposal was UA. SC R&A Jan. 2026 Meeting Action: S. Marks presented the proposal, which was revised and UA MC – Voice Vote - UA		
Item Number: A24-18	NBIC Location: Part 3, 9.1	No Attachment
General Description: Definition of Controlled Fill Subgroup: Repairs and Alterations Task Group: P. Gilston (PM), A. Triplett, R. Collins, F. Johnson Explanation of Need: Interpretation item I 23-79 addresses the use of the term ‘controlled fill’ in relation to welding method 6. The term is used in 2.5.3 d in relation to welding method 6 and more specifically in Supplement 8. Supplement 8 gives a lot of detail in schematics about a controlled fill in terms of weld bead placement, its use in controlling heat input etc., but in Welding Method 6 the term is not specifically used, but direction for welding is given, typically preheats are specified, electrode size for SMAW, and the use of stringer beads only. SC R&A July 2025 Meeting Action: P. Gilston presented a PR, as the proposal that was UA by the SG, and will go to a LB to Parts SG 1, 2, and 4. Update: A proposal went out for vote but was not approved. A revised proposal will be presented to all four subgroups during the January 2026 meeting. SG R&A Jan. 2026 Meeting Action: P. Gilston presented a proposal that was UA by the SG. This will go to All SG’s via LB. (Parts 1, 2, 4) SC R&A Jan. 2026 Meeting Action: P. Gilston presented a PR, as this will be LB to all SGs. MC – PR		

Item Number: A24-20	NBIC Location: Part 3, 9.1	No Attachment
General Description: Define "Engineered Repairs" and "Engineered Alterations" Subgroup: Repairs and Alterations Task Group: M. Schaser (PM), B. Ray, R. Underwood, B. Boseo, D. Marek, J. Siefert, P. Becker Explanation of Need: The new supplement dealing with "Engineered Repairs and Alterations" (A21-45) will impact Part 3 Section 1, the NB-415, QRRs, the application process for Certificate Holders, and other documents to be determined. Defining "Engineered Repairs" and "Engineered Alterations" clarify the intent for these new scopes. SC R&A July 2025 Meeting Action: M. Schaser presented a PR SG R&A Jan 2026 Meeting Action: M. Schaser presented a motion to Close w/No Action. - UA SC R&A Jan. 2026 Meeting Action: M. Schaser presented a motion to Close w/No Action - UA MC – Voice Vote to Close w/No Action - UA		

Item Number: A24-21	NBIC Location: Part 3, 9.1	No Attachment
General Description: Engineered Repairs and Alterations - Section 1 Scope and Manual reqs Subgroup: Repairs and Alterations Task Group: M. Schaser (PM), B. Ray, R. Underwood, B. Boseo, D. Marek, J. Siefert, P. Becker Explanation of Need: The scope of "Engineered Repairs and Alterations" (A21-45) needs to be clarified in 1.4.1 d) and reflected in the scope statement requirements for manuals in 1.5.1 a). SC R&A Jan. 2025 Meeting Action: M. Schaser presented a PR SG R&A Jan. 2026 Meeting Action: M. Schaser presented a proposal that was discussed regarding defining “Advanced Repairs” vs “Basic Repairs”. After lengthy discussion on S11 and how current Cert. Holders would receive this change, the proposal was ultimately voted on. The proposal was Approved with 2 Negs (T. Seime and L. Dutra). SC R&A Jan. 2026 Meeting Action: M. Schaser presented a proposal. After discussion the SC felt that the title of S11 may need to be revised, and “Advanced Repairs & Alts” be defined as an Action Item prior to considering this proposal. – this was a PR. MC – PR		

Item Number: A24-96	NBIC Location: Part 3, 5.5 a)	Attachment 15
General Description: Add examples of repairs and alterations specific to Electrochemical Stacks Subgroup: Repairs and Alterations Task Group: A. Triplett (PM), R. Collins, R. Miletti Explanation of Need: With inclusion and initial deployments of electrochemical stacks as U Stamped pressure vessels under ASME BPVC Section VIII Division 1 and Code Case 3078, these stacks are starting to be shipped and registered with the National Board. Some basic examples of allowed repairs are needed to help guide an understanding of limitations for electrochemical stacks. SC R&A July 2025 Meeting Action: A. Triplett presented, and this will be sent to SG LB once the proposal can be revised to remove Code Case references and review by an ECS expert. This was a PR. Update: Passed SG R&A LB 10/31/25 (18-0-0) SG R&A Jan. 2026 Meeting Action: A. Triplett presented a proposal that was revised and UA SC R&A Jan. 2026 Meeting Action: A. Triplett presented this will go to SC LB for a vote. MC – PR		

Item Number: A24-98	NBIC Location: Part 3, 2.5.2	Attachment 16
General Description: Review and revise the PWHT Requirements in 2.5.2 Subgroup: Repairs and Alterations Task Group: P. Gilston (PM), M. Schaser, W. Sperko Explanation of Need: Simplify PWHT requirements in 2.5.2. SC R&A July 2025 Meeting Action: P. Gilston presented a PR. Update: SC R&A Rvw & LB closed 12/31/25 w/ 2 comments. SG R&A Jan. 2026 Meeting Action: P. Gilston presented that revisions based on the comments will be discussed at SC. SC R&A Jan. 2026 Meeting Action: P. Gilston presented a proposal that was UA. MC Jan. 2026 Meeting Action: – To be LB to MC		

Item Number: A25-18	NBIC Location: Part 3, 5.7.5	No Attachment
General Description: Requirements for Stamping and Nameplates Subgroup: Repairs and Alterations Task Group: B. McGuire (PM), L. Baker Explanation of Need: which contains critical identification information. However, HRSG boilers differ in that they have multiple master nameplates for different sections (e.g., HP, LP, economizer), all located on the outer casing of the boiler. Currently, NBIC repair nameplates do not provide a way to indicate which specific section was repaired. This limitation creates confusion for future inspections and maintenance, as there is no clear indication of which section underwent repairs. Adding a requirement for repair nameplates to include the specific HRSG boiler section being repaired will enhance clarity and traceability. July 2025 Meeting Action: B. McGuire presented a proposal that was revised based on discussion, however the proposal Failed the SC vote (20 members present – only 12 approvals obtained – 14 needed). Added Lane Bake to the task group. SG R&A Jan. 2026 Meeting Action: B. McGuire presented a PR – To be LB to SG and SC SC R&A Jan. 2026 Meeting Action: B. McGuire presented a PR MC – PR		

Item Number: A25-20	NBIC Location: Part 3, 3.3.4.6	No Attachment
General Description: Adoption of reinforcement/fillet welded patches from PCC-2 Subgroup: Repairs and Alterations Task Group: M. Schaser (PM), B. Boseo, D. Marek, B. Ray, P. Becker, G. Galanes Explanation of Need: Oil refineries are scant on shutdown opportunities and vital to the fuel needs of the community. At times inspection departments will detect corrosion on an in-service piece of equipment and be unable to clean it up for internal entry without a planned outage. Fillet welded patches are a safer alternative to external weld metal build up, or fitness for service. July 2025 Meeting Action: M. Schaser presented a PR. Brent Ray and Stacy Marks (on ASME Committees) both offered to supply PCC and other ASME references if the SC needs to review the material proposals will be referencing. SG R&A Jan. 2026 Meeting Action: M. Schaser presented a PR. Discussion on adding “external” to the ‘welded lap patch’ term to clarify these are lap patches holding pressure via a fillet weld was had. “Encapsulation” was referenced as a type of “lap patch” and that OUIO’s use this PCC-2 type of activity regularly. This will be LB to the SG. SC R&A Jan. 2026 Meeting Action: M. Schaser presented a PR MC – PR		

Item Number: A25-21	NBIC Location: Part 3, S11.2.3 and S11.3.2	Attachment 17
General Description: Synchronize/Revise Repairs & Alterations of VIII-2, VIII-3 PRIs Subgroup: Repairs and Alterations Task Group: R. Collins (PM) Explanation of Need: Mr. Tim Gardner, NBBI Senior Staff Engineer/Training Instructor, plans to create an online course for repairs of ASME Sect VIII-2 and VIII-3 PRIs but the current requirements in S11.2.3 and S11.3.2 (formerly 3.3.5 and 3.4.5) do not seem to be in agreement. July 2025 Meeting Action: R. Collins presented a PR UPDATE: Failed SC LB – No Quorum (12-1-0) SG R&A Jan. 2026 Meeting Action: R. Collins presented an update that this will be presented for a vote at the SC R&A Meeting. SC R&A Jan. 2026 Meeting Action: R. Collins presented a proposal that was UA. MC – Voice Vote - UA		

Item Number: A25-22	NBIC Location: Part 3, Table 2.5.1	Attachment 18
General Description: Revise Part 3, Table 2.5.1 Subgroup: Repairs and Alterations Task Group: L. Dutra (PM), G. Galanes Explanation of Need: There have been changes to materials in the ASME Code that have made a review/revision of Table 2.5.1 necessary. If anything, the obsolete group numbers should be deleted. It will be up to the committee to decide whether to add the missing P/group numbers and the associated temperatures. July 2025 Meeting Action: L. Dutra presented a PR. SG R&A Jan. 2026 Meeting Action: L. Dutra presented a proposal deleting Table 2.5.1 and revising text to clarify the min. temp. for pre-heat shall be IAW the OCC or the Alt Weld Methods shall be IAW Part 3, 2.5.3. The proposal was revised and UA. SC R&A Jan. 2026 Meeting Action: L. Dutra presented a proposal that was revised and Approved with 1 neg (P. Gilston) MC – Voice Vote - UA		

Stacy Marks is now an Alternate for P. Shanks

Item Number: A25-25	NBIC Location: Part 3, S11.2.2	Attachment 19
General Description: Repair of PRIs Without Complete Removal of Defect Subgroup: Repairs and Alterations Task Group: T. LeBeau (PM), M. Schaser, R. Collins, J. Hayes, K. Derrick Explanation of Need: To clarify this repair activity can be used for welded or non-welded repairs. This proposal will remove reference to welded repairs in S11.2.2 and only refer to "repair." July 2025 Meeting Action: T. LeBeau presented a PR; M. Schaser, R. Collins, J. Hayes, K. Derrick were added to the TG. SG R&A Jan. 2026 Meeting Action: T. LeBeau presented a proposal that was UA SC R&A Jan. 2026 Meeting Action: T. LeBeau presented a proposal that was UA MC – Voice Vote - UA		
Item Number: A25-26	NBIC Location: Part 3, 3.2.2 and 5.7.4	No Attachment
General Description: Stamping of non-ASME Parts and Distribution of Form R-3 Subgroup: Repairs and Alterations Task Group: P. Gilston (PM) Explanation of Need: Part 3 does not address the distribution of the R-3 and provides no specific details on how to stamp non-ASME parts fabricated by the R Certificate Holder. July 2025 Meeting Action: P. Gilston presented a proposal that was UA. UPDATE: Passed MC LB 1/7/26 (18-0-0)		

Item Number: A25-29	NBIC Location: Part 3, 2.5.3 and 3.3	Attachment 20
General Description: Referencing for Weld Metal, Filler Metal etc. Subgroup: Repairs and Alterations Task Group: P. Gilston (PM) Explanation of Need: Within Part 3, welding consumables are referred to in several different ways e.g., filler metal, weld metal etc. This item is to review these references and identify if a single reference description is beneficial for users of the Code. July 2025 Meeting Action: P. Gilston presented a PR UPDATE: SG R&A Rvw & Cmt LB closed 12/31/25 w/ 4 comments. SG R&A Jan. 2026 Meeting Action: P. Gilston presented a proposal that was revised based on the LB Comments. The Proposal was UA. SC R&A Jan. 2026 Meeting Action: P. Gilston presented a proposal to be LB to SC and then MC MC – PR		

New Action Items:

Item Number: A25-43	NBIC Location: Part 3, New Supplement	No Attachment
General Description: General Requirements for Mechanical Repairs Subgroup: Repairs and Alterations Task Group: T. McBee (PM), K. Moore, S. Frazier, G. Galanes, R. Troutt, J. Hayes, J. Ferreira, S. Marks Explanation of Need: A new supplement is needed to provide guidance for firms who would like to engage in mechanical repairs utilizing their R Certificate. SG R&A January 2026 Meeting Action: T. McBee asked for TG members. The following were added to the TG: K. Moore, S. Frazier, G. Galanes, R. Troutt, J. Hayes, J. Ferreira, S. Marks SC R&A January 2026 Meeting Action: T. McBee presented a PR. MC – PR		

Item Number: A25-44	NBIC Location: Part 3, 4.4.1	Attachment 21
General Description: Initial Service Leak Tests Subgroup: Repairs and Alterations Task Group: J. Ferreira (PM), L. Dutra, H. Fee Explanation of Need: To clarify when an Initial Service Leak Test is permissible and that it differs from In-Service leak tests. SG R&A January 2026 Meeting Action: J. Ferreira presented a proposal. A discussion was held on Part 3, 4.4.1 c), Initial Service Leak Test (ISLT) and how this is being misused. B31 Codes were referenced as the only CoC allowing ISLT, however “R” Cert Holders are incorrectly ‘testing’ repairs by placing the unit in-service to verify leak tightness. Discussion on if the verbiage of ISLT in 4.4.1 c) or adding this to the glossary were held. TG drafted a proposal to delete 4.4.1 c) which was UA. SC R&A January 2026 Meeting Action: J. Ferreira presented the proposal which was UA. MC – Voice Vote - UA		

Item Number: A25-50	NBIC Location: Part 3, S11.3.1	No Attachment
General Description: Expand the scope of Encapsulation Subgroup: Repairs and Alterations Task Group: B. Boseo (PM), P. Gilston, K. Derrick, M. Schaser Explanation of Need: Now that Supplement 11 has been approved, the scope of Encapsulation can now be expanded. UPDATE: Failed SG LB 11/11/25 (12-2-5) SG R&A January 2026 Meeting Action: B. Boseo presented a proposal that was revised based on the SG LB comments. The proposal was discussed regarding the rationale for exempting fire-tube boilers specifically from encapsulation. This was a PR. Phil Gilston was added to the TG as he is on the 2/3 TG. Kiwi Derrick and Matt Schaser were also added. SC R&A January 2026 Meeting Action: B. Boseo presented a proposal that was revised based on the SG comments. This was a PR. MC – PR		

Item Number: A25-51 NBIC Location: Part 3, 1.5.1 (see 24-17)	Attachment 22
General Description: NBIC Part 3, 1.5.1 q) R-Stamp Controls Subgroup: Repairs and Alterations Task Group: Stacy Marks (PM), L. Baker, S. Frazier Explanation of Need: With the newly allowed marking methods which give alternatives to hard stamping there is a requirement to describe the marking controls in the QMS. This revision will guide industry on expectations. SG R&A January 2026 Meeting Action: Stacy Marks presented a proposal addressing controls and custody, which was revised and UA SC R&A Jan. 2026 Meeting Action: Stacy Marks presented the proposal, which was revised and UA MC – Voice Vote - UA	

Paul Shanks returned to the membership.

Item Number: A25-53 NBIC Location: Part 3, 3.3.4.2	Attachment 23
General Description: Supplement 11 Reference Clean Up Subgroup: Repairs and Alterations Task Group: L. Baker (PM), T. LeBeau, A. Triplett Explanation of Need: References to 3.3.4.8 need to be corrected to S11.2.2 in: -Table 1.5.1 row a) and b) -3.3.4.1 -3.3.4.2 a) -3.3.4.2 d) -S2.13 c) -S7.4 a) -Table S9.2 Reference (19) -Table S9.3 Reference (20) Also -the reference in 2.5.3.2 d) 4) b needs to be changed from 3.3.5 to S11.2.3 -the reference in S11.3.1 a) states: "Except as required in 3.4.3 c) 1)...", this should now reference S11.3.1 c) 1). SG R&A January 2026 Meeting Action: L. Baker presented a proposal to correct references now pointing to S11. The proposal was UA. SC R&A January 2026 Meeting Action: L. Baker presented a proposal that was UA MC – Voice Vote - UA	

Item Number: A25-59	NBIC Location: Part 3, S11.1	No Attachment
General Description: Supplement 11 Scope Updates Subgroup: Repairs and Alterations Task Group: M. Schaser (PM), B. Boseo Explanation of Need: Updating the scope of Supplement 11 to include additional guidance and limitations as well as updating the subsection and paragraphs to remove “Engineering” and replace with “Advanced”. SG R&A January 2026 Meeting Action: M. Schaser presented a proposal with new S11 scope verbiage. The proposal was discussed and additional work is needed. This was a PR. SC R&A January 2026 Meeting Action: M. Schaser presented a PR. MC – PR		

Item Number: A25-60	NBIC Location: Part 3, 3.4.1	No Attachment
General Description: Pressure Test Exemption per Part 3 Paragraph 3.4.1 d) Subgroup: Repairs and Alterations Task Group: M. Schaser (PM), H. Fee, M. Vogt, K. Derrick Explanation of Need: Update wording in Part 3, paragraph 3.4.1.d to be consistent and more robust. SG R&A January 2026 Meeting Action: M. Schaser presented a proposed change with the additional verbiage. The proposal was UA as revised. SC R&A January 2026 Meeting Action: M. Schaser presented a PR, as the PM feels there is more work needed. This will likely be LB to SG in the future. MC – PR		

Item Number: A25-75	NBIC Location: Part 3, S5.7.2	Attachment 24
General Description: Yankee Dryer alteration plan approval Subgroup: Repairs and Alterations Task Group: P. Shanks (PM), A. Khssassi, T. Seime Explanation of Need: Yankee dryer alteration plans have a different approval path than an alteration on other PRI's, there is no obvious technical need for the path to be different, and this different path has the potential to cause confusion and errors. SG R&A January 2026 Meeting Action: P. Shanks presented a proposal to have the AIA/OUIO accept the R&A plan for Yankee Dryers, in lieu of just the Repair Inspector. The proposal was UA. SC R&A January 2026 Meeting Action: P. Shanks presented a proposal for vote, which was UA. MC – Voice Vote - UA		

Item Number: A25-83	NBIC Location: Part 3, 2.5.3.4	Attachment 25
General Description: Edits to NBIC Part 3, 2.5.3.4 Welding Method 4 Subgroup: Repairs and Alterations Task Group: J. Siefert Explanation of Need: Siefert to present this <i>general discussion item</i> at the SG meeting for discussion on next action(s) SG R&A January 2026 Meeting Action: J. Siefert presented a proposal which was revised by the SG. - UA as revised. SC R&A January 2026 Meeting Action: J. Siefert presented a proposal that was revised at the SC. The proposal was UA as revised. MC – Voice Vote - UA		

Item Number: A25-84	NBIC Location: Part 3, 2.5.3	No Attachment
General Description: Edits to NBIC Part 3, 2.5.3 Subgroup: Repairs and Alterations Task Group: J. Siefert Explanation of Need: Siefert to present this <i>general discussion item</i> at the SG meeting for discussion on next action(s) SG R&A January 2026 Meeting Action: J. Siefert presented a proposal that will go to a LB to SG and SC R&A. SC R&A January 2026 Meeting Action: J. Siefert presented a PR MC – PR		

Item Number: A25-85	NBIC Location: Part 3, 2.5.3.6; S8	Attachment 26
General Description: Inclusion of Grade 92 into 2.5.3.6 and Supplement 8 Subgroup: Repairs and Alterations Task Group: J. Siefert Explanation of Need: Siefert to present this <i>general discussion item</i> at the SG meeting for discussion on next action(s) SG R&A January 2026 Meeting Action: J. Siefert presented a proposal that was UA. SC R&A January 2026 Meeting Action: J. Siefert presented a proposal that was UA MC – Voice Vote - UA		

12. Future Meetings

- July 13-16, 2026 – Salt Lake City, UT
- January 11-14, 2027 – Nashville, TN

13. Adjournment @ 2:11 PM by Acting Chair Toth.

Respectfully submitted,

Terrence Hellman

Terrence Hellman

SC R&A Secretary

SC R&A - Jan 2026

Full Name	Here	Email Address	Company Name	Registration Type	Member
Moore, Kathy	x	kathymoore@joemoorecompany.com	Joe Moore & Company, Inc.	In-person	Chair
Becker, Patricia	x	pbecker@epri.com	EPRI	In-person	M
Boseo, Brian	x	bmboseo@burnsmcd.com	Burns & McDonnell	In-person	M
Carlson, Michael	x	camx235@ini.wa.gov	State of Washington	In-person	M
Frazier, Steve	x	steve.frazier@seattle.gov	City of Seattle	In-person	M
Gilston, Philip	x	philip_gilston@hsb.com	Hartford Steam Boiler	In-person	M
Hopkins, Craig	x	CHOPKINS@SEATTLEBOILER.COM	Seattle Boiler Works, Inc.	In-person	M
McBee, Timothy	x	Timothy.McBee@tuvsud.com	ARISE Boiler Inspection and Insurance Company RRG	In-person	M
Miletti, Ray	x	rmiletti@babcock.com	Babcock & Wilcox	In-person	M
Quisenberry, Michael	x	michael@spartan-mech.com	Spartan Boiler & Mechanical	In-person	M
Schaefer, Ben	x	bschaefer@aep.com	American Electric Power (AEP)	In-person	M
Seime, Trevor	x	tsseime@nd.gov	State of North Dakota	In-person	M
Shanks, Paul	x	paul.shanks@tuvsud.com	Arise Boiler Inspection and Insurance company Risk Reduction Group	In-person	M
Siefert, John	x	jsiefert@epri.com		In-person	M
Spuhl, Raymond	x	raymond_spuhl@hsb.com	The Hartford Steam Boiler Inspection and Insurance Company	In-person	M
Toth, Marty	x	mtoth@boiscontraininggroup.com	ECS Consulting & The Boisco Training Group	In-person	M
Valdez, Richard	x	rvaldez@prim.com	Rick Valdez	In-person	M
Moedinger, Linn	x	linnm@supernet.com	Strasburg RR	Remote	M
Sekely, Jim	x	jsekely@comcast.net	Welding Services, Inc.	Remote	M
Morelock, Brian					M
Collins, Riley	x	rileycollins@eastman.com	Eastman Chemical Company	In-person	M -Alternate for B. Morelock
Baker, Lane	x	LBaker@us.tuv.com	TUV Rheinland AIA services LLC	In-person	
Bates, Johnathon	x	jbates@boilermakers.org	Boilermakers	In-person	
Chatham, Everett	x	echatham@becht.com	Becht	In-person	
Derby, Robert	x	rderby@uanet.org	United Association ITF	In-person	
Derrick, Kiwi	x	kiwi.derrick@chevron.com	Chevron	In-person	
Devanney, Michael		michael.devanney@ct.gov	State Of Connecticut	In-person	
Dutra, Louis	x	Ldutra@emcor.net	EMCOR Mesa energy systems	In-person	
Ferreira, Jon	x	jonathan_ferreira@hsb.com	The Harford Steam Boiler Inspection and Insurance Company	In-person	
Galanes, George	x	ggalanes@diamondtechnicalservices.com	DTS, Inc.	In-person	
Hayes, John	x	jhayes@ccsboiler.com	Combustion & Control Solutions Inc.	In-person	
Marks, Stacey	x	stacey.marks@bureauveritas.com	BVI&I	In-person	
Misiewicz, Ken	x	kmisiewicz@pleuneservice.com	Pleune Service Company	In-person	
Pearson, Tyler	x	wpearson@propanetank.com	Quality Steel Corporation	In-person	
Pischke, Michael		mpischke@nationalboard.org	NBBI	In-person	
Reamey, Raymond	x	rreamey@turner-industries.com	Turner Industries Group, L.L.C.	In-person	
Rockwood, Ralph		ralph_rockwood@hsb.com	HSB	In-person	
Schaser, Matt	x	mschaser@e2g.com	The Equity Engineering Group, Inc.	In-person	
Schultz, Christopher	x	CSCHULTZLU30@GMAIL.COM	United Association	In-person	
Simmons, Timothy	x	Tsimmons@boilermakers.org	IBB	In-person	
Smith, Rex	x	RSmith@aialc.org	Authorized Inspection Associates, LLC	In-person	
Sperko, Walter	x	wsperko@bellsouth.net	Sperko Engineering	In-person	
Theriot, Kyle		ktheriot@smith-tank.com	Smith Tank & Steel, Inc.	In-person	
Thompson, Alex	x	Alex.thompson@iconboiler.com	ICON Boiler, Inc.	In-person	
Troutt, Rob	x	rttxconsulting@gmail.com	RTTX Consulting, LLC	In-person	
Underwood, Bob	x	robert_underwood@hsb.com	Hartford Steam Boiler	In-person	
Vogt, Mark	x	mark.vogt@vistracorp.com	VISTRA	In-person	
Wadkinson, Melissa		mwadkinson@icloud.com	Fulton Thermal Corporation	In-person	
Warburton, David		David.Warburton@myfloridacfo.com	State of Florida	In-person	
White, Thomas	x	thomas.white@nrg.com	NRG Energy	In-person	
aziz, khssassi	x	aziz_khssassi@rbq.gouv.qc.ca	Régie du Bâtiment du Québec	Remote	
Ball, Joe	x			Remote	
Beirne, Tom	x	TBeirne@nationalboard.org		Remote	
Burns, Mike	x	MBurns@nationalboard.org		Remote	
Chiasson, Nancy	x	nancypchiasson@gov.pe.ca	Government of Prince Edward Island	Remote	
Creaser, Eben	x			Remote	
Crihan, Iulian Mihail	x	IulianMihail.Crihan@rbq.gouv.qc.ca		Remote	
Dacanay, Julius		julius.i.dacanay@hawaii.gov	State of Hawaii	Remote	
Dexter, David (DE)	x	dexterde@dow.com		Remote	
Dunk, Aaron	x	Aaron.Dunk@cna.com		Remote	
Flores, Patric		patricrene95@gmail.com	Roto-Versal	Remote	
Grace, Jeremy	x	jeremy.grace@chemours.com		Remote	
Hadley, James	x			Remote	
Haney, JR		clifford.haney@tuvsud.com	Arise	Remote	
hebert, dustin		dustin.hebert@danos.com	danos	Remote	
Jessick, Jerry	x	JJessick@fusion-etc.com		Remote	
Kataria, Bhargav		bhargav.kataria@navinta.com	NAVINTA III INC.	Remote	
Khssassi, Aziz	x	Aziz_Khssassi@rbq.gouv.qc.ca		Remote	
Lombardo, Steven		steven.lombardo@ge.com	GE Vernova	Remote	
Mcquire, Robert	x	robert.b.mcquire@gevernova.com		Remote	
Mirjalali, John		jmiralali@intellihot.com	Intellihot inc.	Remote	
Newell, Grayson	x	gnewell@nationalboard.org		Remote	
Nutter, Brandon K	x	Brandon.K.Nutter-1@dupont.com		Remote	
Rose, Dave	x	drose@tinsp.com		Remote	
SATHASIVAM, VINOTH KUMAR		VINO2488@GMAIL.COM	PROMINENT TEAM CONSULTANCY - L.L.C	Remote	
Shah, M. A.		boilersandpressurevessels9@gmail.com	AIS	Remote	
Smith, Roger	x	roger.smith@bureauveritas.com		Remote	
Speck-Kern, Edward	x	edward.speck-kern@fpl.com	Florida Power & Light Co.	Remote	
Stimson, Rob	x	rob.stimson@ks.gov		Remote	
thakor, patel	x	thakorpatel1@gmail.com		Remote	
Thomas, Cathy M	x	cmthomas@babcock.com		Remote	
Triplett, Andrew	x	triplettai@ornl.gov	UT-Battelle, LLC	Remote	
Viers, Bob	x	rviers@nationalboard.org		Remote	
Viet, Aaron	x	aaronv@cgthermal.com		Remote	
Wagner, Thomas	x	thomas.wagner@fm.com	FM	Remote	
Weaver, Tracy L	x	tlweaver@babcock.com		Remote	
Yingna Mengouo, Hervé		site-inspection@petrocertif.com	Seb Energy Ltd / Seb Institute of Welding and Technology (SIWET)	Remote	
Amato, Joel	x	jamato@nationalboard.org	NBBI	Staff	
Burpee, John		jhbtab3@gmail.com	NBBI	Staff	
Cochran, Lee		lcochran@nationalboard.org	NBBI	Staff	
Cunkari, Raju	x	cunkariraju@outlook.com	NBBI	Staff	
Goossens, Greg	x	ggoossens@nationalboard.org	NBBI	Staff	
Hellman, Terrence	x	thellman@nationalboard.org	NBBI	Staff	
Ponce, Luis	x	lponce@nationalboard.org	NBBI	Staff	
Rogers, Christa		crogers@nationalboard.org	NBBI	Staff	
Scribner, Gary	x	btcwo@aol.com	NBBI	Staff	
Fee, Hagan	x			In-person	

LeBeau, Tim	x			In-person	
Melfi, Teresa	x			In-person	

Overview of the Requirements for Proof Testing

ASME Section I, Section IV and Section VIII, Div. 1

NBIC MEETING JANUARY 2026

Outline

Section I

Section IV

- Heating Boilers
- Water Heaters

Section VIII, Div. 1

Key Interpretations

Summary Points

Discussion

There is a lot of information here so I am not going to speak to every point on the slides. I have tried to include code references for your information.
I will address highlights of proof testing in each code but will not cover all aspects.

ASME Section I

Code reference PG-18 and A-22

A-22 Scope

- Proof tests may only be used to establish MAWP when the thickness cannot be determined by means of design rules in Section I.
- The MAWP of all other elements or component parts shall not be greater than that determined by means of the applicable design rules

A-22.2 Tests

- Yield test
- Burst test
- A retest is allowed on a duplicate part if errors are obvious in the results

As a reminder, Appendix A is a nonmandatory appendix but if A-22 is used, the requirements are mandatory.

When performing any proof tests, safety of testing personnel should be given serious consideration, especially when conducting burst tests.

ASME Section I

A-22.3 Pressure

- Pressure parts used in the testing shall not previously have been subjected to a pressure greater than 1.5 times the desired MAWP adjusted for design temperature (A-22.8).
- Strain measurement test and the displacement measuring test
 - Hydrostatic test pressure is applied gradually until approximately $\frac{1}{2}$ of the desired MAWP is reached.
 - Thereafter, the test pressure is increased in steps of approximately one-tenth or less of the anticipated MAWP.
 - The pressure is held stationary at the end of each increment for sufficient time to allow observations required by the test procedure and shall be released to zero to permit determination of any permanent strain or displacement after any pressure increment that indicates an increase in strain or displacement over the previous equal pressure increment.

Note the requirement in A-22.8 that the test pressure/MAWP must be adjusted for temperature.

ASME Section I

A-22.4 Critical Areas

- The inspector may require a brittle coating to be applied on all areas of probable high stress concentrations
- The surfaces shall be suitably clean before the coating is applied

Measurements must be taken on the most critical areas.

Strain should be measured as they apply to membrane stresses and to bending stresses within the following range. It is recognized that highly localized stresses may exist in pressure parts designed and fabricated in accordance with the rules in Section I insofar as practicable the design rules have been written to hold such stresses at a safe level.

ASME Section I

A-22.5 Yield and Tensile Strength

- For proof tests based on yielding, the yield strength of the material in the part tested shall be determined in accordance with the method prescribed in the applicable material specification and as described in ASTM E8.
- For proof tests based on bursting, the tensile strength instead of the yield strength shall be similarly determined.
- Yield or tensile strength so determined shall be the average from 3 or 4 specimens cut from the part tested after the test is complete.
- The specimens shall be cut from a location where the stress during the test has not exceeded the yield strength.
- The specimens shall not be oxygen cut.
- When excess stock from the same piece of wrought material is available and has been given the same PWHT as the pressure part, the specimens may be cut from the excess stock.
- Section I provides some alternative methods for evaluation of proof test results if the yield and tensile strength are not determined using test specimens.

For proof tests based on yielding, the strain and displacement measuring tests, the yield strength (or yield point for those materials which exhibit that type of yield behavior indicated by a “sharp-knead” portion of the stress strain diagram).....

ASME Section I

A-22.6.1 Procedure Strain Measurement Test

- Used for pressure parts under internal pressure, constructed of material permitted to be used under the rules of Section I.
- Strains measure in the direction of maximum stress by means of strain gages capable of indicating strains to 0.00005 in./in.
- After each increment of pressure has been applied, readings of the gauges and hydrostatic test pressures are recorded. The pressure is released and any permanent strain at each gage shall be determined after any pressure increment that indicates an increase in strain for this increment over the previous equal pressure increment.
- Two curves of strain against test pressure shall be plotted for each gage line as the test progresses, one showing the strain under pressure and one showing permanent strain when the pressure is removed.
- The test may be discontinued when the test pressure reaches the value H (see equations in A-22.6.1.4) justify the working pressure but shall not exceed the pressure at which the plotted points for the most highly strained gage line reaches the value given for the material used (A-22.6.1.3)
- The MAWP for other temperatures shall be determined as provided in A-22.8.

The code provides the maximum permanent strain for various materials. For low carbon alloys it is 0.2%. Formulas for determining the MAWP are also given in the code for the strain measurement test.

ASME Section I

A-22.6.2 Displacement Measuring Test

- Used for pressure parts under internal pressure, constructed of materials having a definitely determinable yield point.
- Displacement shall be measured at the most highly stressed parts by measuring devices capable of measuring to 0.001 in.
- This displacement may be measured between two diametrically opposed reference points in a symmetrical structure or between a reference point and a fixed base point.
- After each increment of pressure has been applied, readings of displacement and hydrostatic test pressures are recorded. The pressure is released and any permanent displacement shall be determined after any pressure increment that indicates an increase in measured displacement for this increment over the previous equal pressure increment.
- Two curves of displacement against test pressure shall be plotted for each reference point as the test progresses, one showing displacement under pressure and one showing permanent displacement when the pressure is removed.
- The application of pressure shall be stopped when it is evident that the curve through the points representing the displacement under pressure has deviated from a straight line.
- The pressure coincident with the proportional limit of the material shall be determined by noting the pressure at which the curve representing displacement under pressure deviates from a straight line. Equations in A-22.6.2.4 are used to determine the MAWP.
- The MAWP at other temperatures shall be determined as provided in A-22.8

ASME Section I

A-22.6.3 Bursting Test

- Used for pressure parts under internal pressure when constructed of any material permitted to be used under the rules of Section I.
- MAWP of any component or part proof tested by this method shall be established by a hydrostatic test to failure by rupture of a full-size sample of such pressure part.
- Alternatively, the test may be stopped at any pressure before rupture that will satisfy the requirement for the MAWP.
- The item so tested shall not be used for code construction.
- Equations in A-22.6.3.2 based on the type of material to be tested.

ASME Section I

A-22.6.3 Bursting Test continued

- For parts constructed from materials other than cast iron
 - $P = \frac{B}{4} \times \frac{S}{(S_a \text{ or } S_m)}$, where
 - P = MAWP, psi
 - B = bursting test pressure
 - S = specified minimum tensile strength
 - S_a = average tensile strength of test specimens
 - S_m = maximum tensile strength of range of specification
 - Example: SA-516 GR70. Minimum tensile is 70,000 psi, maximum tensile is 90,000 psi. Some materials such as SA-240 do not have a maximum tensile so the average must be determined.
- For materials except cast and nodular iron, the MAWP at other temperatures shall be determined per A-22.8

ASME Section I

A-22.7 Parts Subject to Collapse

- Parts of the boiler normally subject to collapse for which rules are not provided shall withstand without excessive deformation a hydrostatic test not less than 3 times the desired MAWP
 - A boiler part that is subject to collapse must be hydrostatically tested to 450 psig to have a MAWP of 150 psig
- The MAWP at other than the test temperature shall be determine as provided in A-22.8

ASME Section I

A-22.8 Higher Temperatures

- The MAWP of pressure parts that are designed for temperatures at which the allowable stress of the material is less than that of the test temperature shall be determined by the following equation
- $P_o = P_t \frac{S_o}{S_t}$, where
- P_o = MAWP at design temperature
- P_t = MAWP at test temperature
- S_o = stress value at design temperature (BPV II Part D, Table 1A or 1B)
- S_t = stress value at test temperature (PPV II Part D, Table 1A or 1B)

ASME Section 1

A-22.9 Duplicate Parts

- When MAWP is established by proof test, duplicate parts of the same materials, design and construction need not be proof tested but shall be given a hydrostatic test at 1.5 times the MAWP.
- The dimensions and minimum thickness of the structure to be tested should not vary materially from those actually used.
- A geometrically similar part may be qualified by a series of tests covering the complete size range of the pressure part

ASME Section I

A-22.10

- Tests to establish the MAWP for pressure parts shall be witnessed and **approved** by an Authorized Inspector

ASME Section I

A-22.11 Test Gages

- An indicating gage shall be connected directly to the pressure part. If the gage is not readily visible to the operator controlling the test, an additional gage shall be provided that is visible to the operator.
- For large pressure parts, a recording gage is recommended.
- Pressure gages shall meet the requirements of PG-99.4
- All gages used in proof testing shall be calibrated

ASME Section IV – Heating Boilers

Heating Boilers (15 psig steam, hot water 250F max. temp and or 160 psig MAWP)

- Code reference HG-100 and HG-500
- HG-501 Proof testing can only be used when there are no rules in Section IV
- HG-501.1 Types of tests
 - Tests based on yielding of the parts
 - If the proof tested part shows no evidence of permanent yielding it may be marked with the Certification Mark
 - Tests based on bursting of the part
 - The Certification Mark shall not be applied to the part proof tested under burst-test provisions
 - Retests shall be allowed on a duplicate part if errors or irregularities are obvious in the test results

ASME Section IV – Heating Boilers

HG-501.4 - Pressure application similar requirements to Section I

HG-501.5 - Critical areas the Inspector may require a lime wash or other brittle coating to be applied

HG-501.6 - Yield and tensile strength

- Requirements are similar to those in Section I, yield or tensile is determined from an average of 3 or 4 specimens cut from the part tested after the test is completed.
- Alternatively, if excess stock of the same wrought material is available, specimens may be cut from stock.
- For the requirements for cast pressure parts see HG-501.6 (c)

ASME Section IV – Heating Boilers

HG-502.1 Strain Measurement Test – requirements are similar to those in Section I

HG-502.2 Displacement Measurement Test – requirements are similar to those in Section I

HG-502.3 Bursting Tests – may be used for pressure parts under internal pressure when constructed of **any material** permitted to be used under the rules of Section IV.

- $P = \frac{B}{5} \times \frac{S}{(S_a \text{ or } S_m)}$, where
 - P = MAWP, psi
 - B = bursting test pressure
 - S = specified minimum tensile strength
 - S_a = average tensile strength of test specimens
 - S_m = maximum tensile strength of range of specification
 - Example: SA-516 GR70. Minimum tensile is 70,000 psi, maximum tensile is 90,000 psi. Some materials such as SA-240 do not have a maximum tensile so the average must be determined.

Note the difference in the burst test formula between Section I and Section IV. If we had a vessel with a desired MAWP of 150 psig and we were burst testing based on SA-516 GR 70 and we use the maximum tensile in the formula, for Section I, the minimum hydro pressure is 772 psig and for Section IV it would be 965 psig.

ASME Section IV – Heating Boilers

HG-502.4 Brittle Coating Test

- Internal pressure, materials having a definitely determinable yield point
- Components tested coated with lime wash or other brittle coating per HG-501.5
- Pressure applied per HG-501.4
- The application of pressure is stopped at the first signs of yielding as evidenced by flaking of the brittle coating.
- Calculate MAWP using formulas in HG-502.4

ASME Section IV – Heating Boilers

HG-503 Parts subject to collapse – like Section I, hydrostatic testing at 3 x MAWP

HG-504 Duplicate parts – similar requirements to those in Section I

HG-505 Test Gages – similar requirements to those in Section I

HG-506 – Tests to establish the design pressure of the pressure parts shall be witnessed and **accepted** by an Authorized Inspector.

Note: Unlike Section I, there are no requirements to correct for temperature.

Note that Section I says tests must be approved by the AI

ASME Section IV – Water Heaters

Water Heater

- Boilers not exceeding 160 psig and 210 Deg. F
- Provided with corrosion resistant lining or corrosion resistant materials

ASME Section IV – Water Heaters

HLW-501 the required thickness for pressure parts and MAWP for vessels that are not based on the formulas in Article 3 of Part HLW shall be established by proof test.

- Application of pressure to a full size sample vessel
- Material in excess of the material thicknesses or of higher strengths than the specified parts of proof test vessel(s) shall be acceptable for production parts.
- Specific requirements for vessels from a series

Note that HLW is a little different from the other codes when determining if a proof test shall be used.

ASME Section IV – Water Heaters

HLW-502

- Previously applied pressure not to exceed 1.5 x the anticipated MAWP
- Outer surface of the vessel to be suitably cleaned and a brittle coating applied.
- The application of pressure is similar to the procedures for heating boilers.
- Yield strength is determined from an average of three specimens cut from the vessel after testing or for excess stock of the same piece of wrought material.
- Equations in HLW-502 are used to determine the MAWP.

Section IV – Water Heaters

HLW-502.2 Test Gauges – similar requirements to those in other codes

HLW-503 – Parts subject to collapse are tested at 3 x MAWP

HLW-504 – Witnessing, Recording and Certifying

- Tests to establish the MAWP by proof testing shall be witnessed by the Manufacturer's personnel designate to be responsible for the examination
- The tests shall be witnessed and accepted by the Authorized Inspector
- Proof tests are recorded on Form HLW-8

Code Case 2937 allows burst testing to determine MAWP of HLW Water Heaters and Storage Tanks

Section VIII, Div. 1

Code reference U-2 (g)(1)(-b) and UG-101

Proof testing can only be used where design rules do not exist in this division

Section VIII, Div. 1

UG-101

- Consideration of the use of proof tested constructions based on past editions requires the Manufacturer to determine if code changes were made that must be evaluated
- Provisions for proof tests reports based on a previous owner
- Provisions for Manufacturers owned by the same entity
- Proof tests shall be witnessed by and acceptable to the Authorized Inspector
- The vessel used in proof testing shall not have been subjected to a pressure greater than 1.3 x the MAWP adjusted for the operating temperature
- Specific rules for duplicate parts – much more in depth than Section I or Section IV as well as geometrically similar parts

Section VIII, Div. 1

UG-101 continued

- The procedure for the application of pressure for the strain and displacement tests is similar to procedure used in Section I and Section IV.
- **Corrosion allowance – the thickness of the pressure vessel that is to be proof tested should be the corroded thickness.**
- Determination of Yield and Tensile Strengths
 - Use 3 or 4 specimens from the part tested after the test is complete or they may be cut from excess stock of the same material used for the test vessel.
 - Alternative methods are provided
- **A temperature correction is required as was required in Section I**

Section VIII, Div. 1

UG-101 continued

- A brittle coating test procedure exists
- Burst test procedure is similar to Section I, however, the formula considers the efficiency of the welded joint.
- Strain Measurement and Displacement Measurement procedures are available
- Parts subject to collapse shall withstand a hydrostatic test pressure without excessive deformation at not less than 3 x the MAWP. Refer to the text for the additional conditions.
- Test gages shall be calibrated

Key Interpretations

Q: Can the yield or tensile strength values on the MTR be used for the average yield or tensile?

R: No – See Interpretations, I-22-09 and IV-23-01, however BPV VIII Div. 1, permits the tensile strength reported on the MTR to be used for burst testing.

Q: May a proof test be transferred between stamp holders?

A: See interpretation VIII-01-01-65, note there are provisions in the 2025 code for transfer of ownership and Manufacturers owned by the same entity. BPV I and BPV IV do not address these issues.

Summary Points

Section I, Section IV and Section VIII Div. 1 have similar but different requirements

- Different types of proof tests are permitted
- Interpretations are specific to the code of construction
- Code cases may be applicable

The data report should indicate if proof testing was used

Recent Request for Interpretation

Proposed Question

In the case of non-welded cast iron pressure vessel heads originally constructed and designed by proof testing per the rules of ASME Section VIII Division 1, can a 'R' Certificate holder perform a burst test per UCI-101 / UCD-101 in lieu of calculations to support the Rerate of an existing pressure vessel, when the 'R' Holder does not hold an ASME 'U' authorization?

Proposed Reply

Yes, a 'R' Holder can perform proof testing in lieu of calculation in cases where the design is not able to be validated by calculation.

Committee's Question 1

When re-rating a pressure vessel as an alteration whose MAWP was determined via proof test in accordance with its the original code of construction, may proof testing be performed for re-rating in lieu of design calculations?

Committee's Reply 1

Yes, provided all other requirements of NBIC Part 3, 3.4.1 are met.

Rationale

UCI-101 for the avg tensile strength requires testing results of three test bars from the same ladle or 3 test specimens from the part
UCD-101 has the same requirements

Discussion

Why is it important to understand proof tests?

What happens with interpretation requests regarding proof tests?

Should any statements be made in Part 3 regarding proof tests?

NBIC Interpretation Item I25-40
Submitted by Westmor Industries
6/30/2025



**THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	Fillet welds using alternative welding method #2
NBIC Location:	2023 NBIC, Part 3, 2.5.3.2
Statement of Need:	Welding on non-pressure parts (P11B Pads) to the outside of a VIII Div 1 P11B Pressure Vessel.
Background Information:	Welding method #4 speaks specifically about fillet welds, when welding method #2 does not specifically reference fillet welds. Is this a potential oversight and it can be done, or is it written this way to exclude fillet welds using welding method #2.
Proposed Question:	Can you perform fillet welds using Welding method #2?
Proposed Reply:	Yes or no. If yes, consider including verbiage in 2.5.3.2 I) that references fillet welds. Similar to how paragraph 2.5.3.4 g)5) is written regarding welding method #4.
Committee's Question:	Are fillet welds excluded from use in <u>the alternative</u> Welding Methods <u>in Part 3, 2.5.3.#2?</u>
Committee's Reply:	No.
Rationale:	<Additional clarification for response>

NBIC Interpretation Item I25-66
 Submitted by Stephen Kovacic
 12/3/2025



**THE NATIONAL BOARD
 OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	Registering R-1 Forms for D.O.T. Cargo Tanks
NBIC Location:	2025 NBIC Part 3, S6.19.4
Statement of Need:	Request ruling on if R-1 forms, including repairs of a routine nature, relating to repairs of D.O.T. cargo tanks built under ASME VIII code need to be registered with the national board & if they require a unique registration number for each individual form.
Background Information:	N/A
Proposed Question:	Do NBIC Part 3 - Supplement 6 - S6.19.4 requirements for registering "R" forms, specifically R-1 forms, supersede the Registration For Repairs statement in NBIC Part 3 - Section 5 - 5.5.1?
Proposed Reply:	Yes or no.
Committee's Question:	Per NBIC Part 3, S6.19.4, must all Form "R" Reports for DOT transport tanks be registered with the National Board?
Committee's Reply:	Yes
Rationale:	

Item 24-67

S3.2 REPAIRS

c) The materials used in making repairs or alterations shall conform to the requirements of the original code of construction except as provided in NBIC Part 3, S3.2 j). The "R" Certificate Holder is responsible for verifying identification of existing materials from original data, drawings, or unit records and identification of the materials to be installed. Where material strength properties are used in supporting calculations, replacement part materials used for repairs shall meet or exceed the original strength values.

Note: Coefficient of thermal expansion for graphite materials can vary. Therefore, in spring-loaded graphite equipment, differential thermal expansion should be considered.

S3.4 ALTERATIONS

- a) ~~a)~~ The requirements provided in this section shall apply, insofar as they are applicable to the materials discussed herein. Completed alterations shall be subjected to a pressure test that is no less than operating pressure and no more than maximum allowable working pressure. The test pressure shall be maintained for a minimum of 30 minutes.~~subjected to a pressure test not less than that required by the code of construction. The test pressure shall be maintained for a minimum of 30 minutes. The pressure shall be reduced to MAWP and maintained for inspection.~~
- b) All re-ratings shall be pressure tested in accordance with the original code of construction. The test pressure shall be maintained for a minimum of 30 minutes prior to inspection by the Inspector. Where the test pressure exceeds the MAWP of the item, the test pressure shall be reduced to the MAWP for inspection. Hold-time shall be as necessary to conduct the inspection.

c**b)** Alteration of the spring design (e.g., change in stiffness or the initial compression) of a graphite shell-and-tube heat exchanger shall be done only after revised calculations have been prepared in accordance with the "R" Certificate Holder's Quality Control-Management System and accepted by the Inspector. When the standard governing the original construction is any edition of the ASME Code, the calculations shall comply with Section VIII, Div. 1 2019 Edition or later.

d**e)** The nameplate shall be applied in accordance with Section 5 of this part. The letter "G" shall be applied to the nameplate under the "R" stamp when graphite alterations are made. The alternate procedure defined in 5.10 may be used in lieu of the stamping and nameplate attachment requirements of NBIC Part 3, Section 5.

S3.5.4 PLUGGING OF LEAKING OR DAMAGED TUBES OR BLOCK HOLES

a) The material used for plugging ~~tubes~~ shall comply with the requirements of the ASME Boiler and Pressure Vessel Code (ASME BPV Code), Section VIII, Division 1, Part UIG.

...

f) As an alternative to S3.5.4 e) any "R" Certificate Holder, with or without the Graphite ("G") Designator included on their "R" Certificate of Authorization, may install graphite plugs [for a single repair operation](#), provided the "R" Certificate Holder ~~obtains the concurrence of the Inspector and~~ utilizes a ~~tube~~ plugging [qualification](#) kit provided by an ASME Certificate Holder authorized to use the "G" Designator. The kit shall include the following items:

~~1) Certified graphite plugs and certified cement ingredients, both accompanied by the appropriate documentation (e.g., ASME Manufacturer's Partial Data Report).~~

[12\)](#) The qualified cementing procedure of the ASME Certificate Holder authorized to use the "G" Designator, and a step-by-step procedural checklist that shall be followed explicitly. The cementing procedure shall address the entire ~~tube~~ plugging process including [materials](#), -plug configuration, ~~tube~~ hole cleaning and preparation, mixing and application of the cement, application of the plugs, securing the plugs during the curing process, controlling the curing process, and leak testing, thereby meeting the requirements of S3.3.

[32\)](#) Additional materials and the cementing procedure shall be provided and used to prepare a demonstration plug joint prior to performing the repair being performed. This demonstration plug joint shall be tested by a twist (torsional) test designed to demonstrate acceptable application and curing of the cement (Figure S3.5.4). The test procedure shall include acceptance criteria, which may be based on a principle of breakage of part of the test piece. A successful twist test, in conjunction with the completed procedural checklist, shall serve as a valid cement technician certification for a single repair operation. The twist test shall be witnessed by the Inspector. The "R" Certificate Holder shall review the material certifications, including verification that the shelf life of the cement has not been exceeded. They shall also ensure that the certified cement technician has completed the qualification demonstration, and has access to the cementing procedure and checklist. Prior to accepting the repair plan, the Inspector shall review and verify that the qualified cementing procedure has been completed and that the other elements of the certified kit have been provided by the ASME Certificate Holder authorized to use the "G" Designator, have been administered and completed prior to his acceptance. The "R" Certificate Holder shall note the installation of cemented graphite plugs in accordance with S3.5.4 in the "Description of Work" section of Form R-1. The "G" Designator shall not be applied to the vessel when this alternative repair is performed. The "R" Certificate Holder shall identify and document the location of the plugs on the Form R-1.

h) When cementing the plug(s), one shall ensure 100% of individual plugs, as well as the inside diameter of the hole(s') opening(s), are coated with cement. ~~The plugs shall be inserted one by one, against each other, into each end of the holes(s) being plugged.~~

NBIC Interpretation Item I25-62
 Submitted by Task Group Graphite
 7/29/2025



**THE NATIONAL BOARD
 OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	Field Plugging
NBIC Location:	2025 NBIC, Part 3, S3.5.4 f)
Statement of Need:	Clarify S3.5.4f, concerning tube plugging kit materials.
Background Information:	As written in S3.5.4f all plugging materials shall be included in the kit. It is possible to have left over material that should be available for future use. It is also possible to need more materials than initially expected.
Proposed Question:	Is it the intent of S3.5.4f) 1) to require that only materials provided in the kit may be used during the repair operation?
Proposed Reply:	No. Any certified material may be used provided that it is in accordance with S3.5.4 f).
Committee's Question:	Is it the intent of S3.5.4f) 1) to require that only materials provided in the kit may be used during the repair operation?
Committee's Reply:	No. Any certified material may be used provided that it is in accordance with S3.5.4 f).
Rationale:	See Item 25-62

NBIC Action Item A24-17
 Submitted by <NAME> (Email)
 Submitted on



**THE NATIONAL BOARD
 OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	Clarify Alteration for transition from rigid to flexible bolts.
NBIC Location:	Part 3, S1.2.3 k)
Statement of Need:	
Background Information:	This is omission from the code.

Proposed Text:

S1.2.3 BALL SOCKET-TYPE FLEXIBLE STAYBOLTS, SLEEVES, AND CAPS

- i) Substitution of one type of flexible staybolt sleeve by another type shall be considered a repair, provided it does not affect the pressure retaining capability in accordance with Part 3, 3.4.4.
- j) Where necessary for boiler expansion, ball socket-type flexible staybolts shall be positioned in such a manner as to not interfere with boiler expansion. Where individual bolts are replaced, care should be taken to ensure that the stress load of the new bolt is compatible to the loading on adjacent bolts.

Note: Some locomotive boiler designs positioned the bolts by backing the bolt head away from the sleeve socket bottom a certain amount.

- k) When the installation of a flexible staybolt and/or sleeve affects the pressure retaining capability, in accordance with Part 3, 3.4.4, the change shall be considered an alteration.

NBIC Action Item 24-106

Submitted by R. Franzen

Submitted on



**THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	S1.2.2 Threaded Staybolts, change wording concerning reduced body staybolts
NBIC Location:	Part 3, S1.2.2
Statement of Need:	Clarification on staybolts over 8" long is needed whether they need telltale holes or not in rigid, flexible, radial and crown bolts
Background Information:	

Proposed Text:

S1.2.2 THREADED STAYBOLTS

- b) All staybolts shorter than 8 in. (200 mm) in length shall have telltale holes. Staybolt telltale holes in existing staybolts shall be 3/16 in. (5 mm) to 7/32 in. (5.5 mm) in diameter and at least 1-1/4 in. (32 mm) deep in the outer end. When staybolts shorter than 8 in. (200 mm) or less in length are replaced, they shall be replaced with staybolts that have a telltale hole 3/16 in. (5 mm) to 7/32 in. (5.5 mm) in diameter their entire length, or with ones that have a 3/16 in. (5 mm) to 7/32 in. (5.5 mm) diameter hole in each end, drilled a minimum of 1-1/4 in. (32 mm) deep. On reduced body staybolts, shorter than 8 in. (200 mm) in length, the telltale hole shall extend beyond the fillet and into the reduced section of the staybolt. ~~Ball socket-type flexible staybolts may have telltale holes that extend from the threaded end of the bolt into the bolt head for a distance of one third the spherical bolt head diameter.~~
- g) Ball socket-type flexible staybolts may have telltale holes that extend from the threaded end of the bolt into the bolt head for a distance of one third the spherical bolt head diameter. Ball socket-type flexible staybolts shall not be braced for driving the staybolt by inserting a spacer under the cap.

TABLE 1.6.2.1

ACRONYMS	ASME	American Society of Mechanical Engineers
	Applicant	An Organization applying for "NR" Certificate of Authorization (new or renewal)
	GFR	Code of Federal Regulations
	Code	ASME Code of Construction, Section III, Division I, (NCA, NB, NC, ND, NE, NF, NG, and NH) or ASME Section XI Division I Rules for Inservice Inspection of Nuclear Power Plant Components as applicable.
	Jurisdiction	Enforcement Authority
	NB	National Board of Boiler and Pressure Vessel Inspectors
	NBIC	National Board Inspection Code
	NB-263, RCI-1	Rules for Commissioned Inspectors
	NCA	ASME Section III, Subsection NCA, General Requirements for Division 1 and Division 2
	NQA-1*	ASME Quality Assurance Requirements for Nuclear Facility Applications
	NR	Nuclear Repair
	"NR" CH	"NR" Certificate Holder
	QA	Quality Assurance
	QAI-1	ASME Qualifications for Authorized Inspection
	QAM	Quality Assurance Manual
	QAP	Quality Assurance Program
	QC	Quality Control
	WA	ASME Section III, Division 3, Subsection WA, General Requirements

Note:

*Edition(s) endorsed by the Regulatory Authority



THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

PROPOSED REVISION OR ADDITION

Item No. A21-53 Rev 06
Subject/Title Supplement 8 Weld and Post Repair Inspection of Creep Strength Enhanced Ferritic Steel Pressure Equipment
NBIC Location NBIC Part 3 Repairs and Alterations Supplement 8 S8.5 a)
Project Manager and Task Group Philip Gilston, Mark Horbaczewski
Source (Name/email) Mark Kincs / mark.r.kincs@xcelenergy.com
Statement of Need The requirement for Inspector involvement in post-repair inspections to CSEF weld repairs is to ensure future safe operation of the boiler. This is a function of the in service Authorized Inspection Agency, not the Repair Inspector, whose duties end with completion of repair documentation. As part of the Inservice Inspector pre-inspection activities is a requirement to review repairs/alterations (Part 2, 4.5.2 a) 7) to ascertain the history of the equipment being inspected. In the report of inspection forms NB-6 and NB-7 in section 10 comments to be addressed include verification of repairs.
Background Information The post-repair inspection requirements specified in S8.5 are unique. There is no other mention of such inspections elsewhere in NBIC–Part 3. Presumably, Welding Method 6 repairs don't require post-repair inspection due to the perceived low-level of associated risk (inside the boiler setting). Related SG Inspection item 22-06. This proposed revision is to ensure that there is correct and sufficient information for the "Inservice Inspector" to review and validate that the inspection plan is being followed. <u>Based on discussions in SG and SC meetings in July 2025 the following notes are provided for additional explanation of the intent of the proposal:</u> <u>1. The post repair inspection plan can be prepared at any time during the repair process, but before the R-Report is signed.</u> <u>2. The repair is agreed with the Repair Inspector, and if required the Jurisdiction. The repair plan shall be referenced in the remarks section of the R-Report.</u> <u>3. The post repair inspection plan will remain in place while the pressure part is in service. Inspection intervals can be revised based on gathered inspection data.</u> <u>4. The repair is defect free at its completion. The inspection plan is to ensure no new defects occur in the repair area, e.g., in the weld , HAZ etc..</u> <u>5. Once the pressure part is returned to service, the Inservice Inspector will review the R report, as part of their normal duties and verify the plan is being enacted. There is no requirement on the Inservice Inspector to observe any of the inspections, only to verify they are being performed.</u>

Rev 04 (Based on comments from SG Letter ballot)

S8.5 a), Revised opening of sentence eliminating specifically when the plan is prepared per Mr. Schaser.

S8.5 a), Revised the middle part of the first sentence from '...to ensure safe operation and margin to locate and monitor defect growth in the weld repair area based...' to '...to ensure safe operation by ensuring no new defects form in the weld repair area based...'.

S8.5 b), 're-inspection' has been revised to 'inspection' per Mr. Collins comment.

S8.5 b) iii, removed end of life requirement per Mr. Siefert.

S8.5 c), revised 'Post Inspection Repair Plan' to 'Post Repair Inspection Plan' per Mr. Khssassi.

S8.5 c), removed the words requiring the inspection plan to be attached to the R Report for submittal. The plan is still to be referenced in the 'Remarks'.

Rev 05

Notes added to the background to provide further clarity on timing of actions and roles of Inspectors.

Rev 06

Proposal substantially revised based on comments from Mr. Shanks and Mr. Boseo.

S8.5 POST REPAIR INSPECTION

- a) After the completion of weld repairs to CSEF steels, post inspection requirements shall be developed and implemented based on acceptance from the Inspector, and if applicable, the Jurisdiction.
- b) Post-repair inspection intervals and methods of examination shall be implemented to ensure safe operation and margin to locate and monitor defect growth in the weld repair area. The selected non-destructive examination method shall provide meaningful results and shall follow NBIC Part 3, Section 4.
- c) Post repair inspection shall be on-going until the component reaches end of life or is replaced. The Owner/User may revise the re-inspection interval based on inspection results from previous inspections.

S8.5 POST REPAIR INSPECTION

- a) A post repair inspection plan shall be developed by the owner or user prior to the completion of the weld repairs to ensure continued safe operation of the pressure retaining item.-
- b) The post repair inspection plan shall include but not be limited to:
 - i. Method of examination, the selected non-destructive examination method shall follow NBIC Part 3, Section 4.
 - ii. Examination intervals
- c) The post repair inspection plan shall be subject to review and acceptance by the Repair Inspector, and if required, the Jurisdiction.
- d) The post repair inspection plan shall be referenced in the Remarks section of the R report. The R report shall be registered with the National Board.
- e) The owner or user may revise the inspection interval based on inspection results from previous inspections.
- f) Post repair inspection shall be on-going until the component is removed or replaced.

VOTE							
Committee	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date

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THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

PROPOSED REVISION OR ADDITION

Item No.
23-35
Subject/Title
Definition of "non-load bearing attachment"
NBIC Location
Part 3: Repairs and Alterations; Sections 3; Paragraphs: 3.3.2 , e), 2)
Project Manager and Task Group
PM – Tom White, Aziz Khssassi
Source (Name/email)
Tom White/thomas.white@nrg.com
Statement of Need
The term "nonload bearing attachment" is used as a basis for determining a routine repair (Part 3: 3.3.2, e), 2) but the term is not defined. Defining "Nonload Bearing Attachment" by adding a sentence to Part 3: 3.3.2, e), 2) would alleviate the confusion. I would also at this time hyphenate "non-load".
Current Wording in Part 3:
3.3.2 ROUTINE REPAIRS
e) The following repairs may be considered as routine repairs and shall be limited to these categories:
1) Welded repairs or replacements of valves, fittings, tubes, or pipes NPS 5 (DN 125) in diameter and smaller, or sections thereof, where neither postweld heat treatment nor NDE other than visual is required by the original code of construction. This includes their attachments such as clips, lugs, skirts, etc., but does not include nozzles to pressure-retaining items; 2) The addition or repair of nonload bearing attachments to pressure-retaining items where postweld heat treatment is not required;
Background Information
A Certificate Holder replaces/repairs internal rails/supports for trays or bins that get rolled into an autoclave. These rails/supports are (typically) stitch welded along the inside of the shell. The Certificate Holder believes this is a non-load bearing attachment and performs this work as a routine repair. The attachment of internals is a loading design consideration for ASME Sect. VIII Div.1.
NBIC Interpretation 95-33 addresses this term in their reply to the interpretation. A "non-load bearing attachment" is a generally accepted design term referring to items that transmit an inconsequential load onto the pressure retaining boundary.
Definition in ASME B31.1 (2022) - Definition in PWHT Table 132.2-1 Note (7): Non-load carrying attachments are defined as items where no pressure loads or significant mechanical loads are transmitted through the attachment to the pipe or pressure-containing material.

Existing Text	Proposed New Text
3.3.2 ROUTINE REPAIRS	3.3.2 ROUTINE REPAIRS
e) The following repairs may be considered as routine repairs and shall be limited to these categories:	e) The following repairs may be considered as routine repairs and shall be limited to these categories:
1) Welded repairs or replacements of valves, fittings, tubes, or pipes NPS 5 (DN 125) in diameter and smaller, or sections thereof, where neither postweld heat treatment nor NDE other than visual is required by the original code of construction. This includes their attachments such as clips, lugs, skirts, etc., but does not include nozzles to pressure-retaining items; 2) The addition or repair of nonload bearing attachments to pressure-retaining items where postweld heat treatment is not required;	1) Welded repairs or replacements of valves, fittings, tubes, or pipes NPS 5 (DN 125) in diameter and smaller, or sections thereof, where neither postweld heat treatment nor NDE other than visual is required by the original code of construction. This includes their attachments such as clips, lugs, skirts, etc., but does not include nozzles to pressure-retaining items; 2) The addition or repair of non-load bearing attachments to pressure-retaining items where postweld heat treatment is not required. A non-load bearing attachment bears no pressure loads and no significant mechanical loads are transmitted through the attachment to the pressure-retaining material. The determination that a load is not significant shall be agreed upon by the owner, Inspector, and where required the Jurisdiction.

VOTE							
Committee	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date

AI 23-35

Title:	Definition of "non-load bearing attachment" (All Parts)
Background Information:	A Certificate Holder replaces/repairs internal rails/supports for trays or bins that get rolled into an autoclave. These rails/supports are (typically) stitch welded along the inside of the shell. The Certificate Holder believes this is a non-load bearing attachment and performs this work as a routine repair. The attachment of internals is a loading design consideration for ASME Sect. VIII Div.1.
Explanation of Need:	The term "non-load bearing attachment" is used as a basis for determining a routine repair but is not defined in the NBIC.
Date Opened:	6/5/2023
Date Closed:	

Non-load carrying attachments are defined as items where no pressure loads or significant mechanical loads are transmitted through the attachment to the pressure-retaining material.

Existing definitions in other Code books:

[ASME B31.1 \(2024\)](#) - Definition in PWHT [Table 132.2-1](#), Note (7):

(7) *Non-load-carrying attachments* are defined as items where no pressure loads or significant mechanical loads are transmitted through the attachment to the pipe or pressure-containing material.

[ASME B31.3 \(2024\)](#) - Definition in PWHT [Table 331.1.3-1](#), Note (7)

(7) *Non-load-carrying attachments* are defined as items where no pressure loads or significant mechanical loads are transmitted through the attachment to the pipe or pressure-containing material.

[ASME Section VIII Div.2 \(2025\)](#)

3.11.2.9 Postweld Heat Treatment Requirements for Materials in Low Temperature Service.

...
(b)(2)... *Lightly loaded attachments*, for this application, are defined as attachments in which the stress in the attachment weld does not exceed 25% of the allowable stress....

6.2.2.5 Tests of Welders and Welding Operators

...
(b) Welders and welding operators used in welding non-pressure-bearing attachments, that have essentially *no loadcarrying* function (such as extended heat transfer surfaces, insulation support pins, etc.), to pressure parts shall comply with the following....

[ASME Section VIII Div.1 \(2025\)](#)

UW-28 QUALIFICATION OF WELDING PROCEDURE

(a) Each welding procedure used in joining pressure parts to pressure parts or joining pressure parts to *loadcarrying* nonpressure parts, such as all permanent or temporary clips and lugs to pressure parts,

...
(c) The procedure used in welding non-pressure bearing attachments which have essentially *no loadcarrying* function (such as extended heat transfer surfaces, insulation support pins, etc.), to pressure parts shall meet the following requirements....

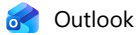
A23-35 Abstain

I see there are repetitive
text that is unnecessary and
could cause additional confusion

Marty Toth

▲ Notes

▼ Doodles



Outlook

Disapproval R&A SC - Item A23-35

From Benjamin Schaefer <bschaefer@aep.com>

Date Thu 1/15/2026 10:00 AM

To Terrence Hellman <THellman@nationalboard.org>

I voted disapprove because this change, in my opinion, does not add any additional clarity to the determination of if this is a "non-load bearing attachment".

I believe the Inspector and jurisdiction are still required to approve routine repairs per 1.3.1 b), including whether the item in question is a non-load bearing attachment.

1.3.1

AUTHORIZATION

- a) The Inspector's authorization to perform a repair or alteration shall be obtained by the repair organization prior to initiation of a repair or alteration to a pressure-retaining item. The Inspector shall determine that the repair or alteration methods are acceptable.
 - b) Subject to the acceptance of the jurisdiction, the Inspector may approve routine repairs prior to the start of work, provided the Inspector ensures the "R" Certificate Holder has adequately addressed routine repairs in their QMS.
-



item 23-35

From Shanks, Paul <Paul.Shanks@tuvsud.com>

Date Wed 1/14/2026 11:52 AM

To Terrence Hellman <THellman@nationalboard.org>

Kathy, Terry

The reason for my objection is as follows.

The added language is team leader bait as 'no pressure load' is massively vague as even a nameplate welded to the pressure boundary which will move under pressure thus is subject to stress because of that applied pressure. This approach also disregards the significant affect mechanical loads can have on the integrity of the PRI.

If we do anything I believe we should pick a limiting stress value (10% to 25% of allowable stress), this will require analysis to determine that stress intensity but in my opinion that is a reasonable cost to bear in order to be a routine repair and avoid the cost of the Inspector conducting an onsite inspection.

Best regards,

Paul Shanks

Senior Technical Specialist

Email address: Paul.Shanks@tuvsud.com

Phone: (330) 662-9303



Business address

ARISE Boiler Inspection and Insurance Company RRG

Grand Bay I, 7000 S. Edgerton Road

Suite 100

Brecksville, Ohio 44141

Follow ARISE on social media



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Negative on item 23-35

From Siefert, John <jsiefert@epri.com>

Date Tue 1/13/2026 3:32 PM

To Terrence Hellman <THellman@nationalboard.org>

Existing wording in item 23-35: *The addition or repair of non-load bearing attachments to pressure-retaining items where postweld heat treatment is not required. **A non-load bearing attachment bears no pressure loads and no significant mechanical loads are transmitted through the attachment to the pressure-retaining material. The determination that a load is not significant shall be agreed upon by the owner, Inspector, and where required the Jurisdiction.***

Proposed wording: *The addition or repair of non-load bearing attachments to pressure-retaining items where postweld heat treatment is not required. **The determination that an attachment is non-load bearing shall be agreed upon by the owner, Inspector, and where required the Jurisdiction.***

Reason for my negative is clarity and avoiding a potential request for future interpretation regarding how we will define what constitutes 'significant' in the existing proposal.

John Siefert, Ph.D.

Area Lead – Materials



1300 West WT Harris Blvd. | Charlotte, NC 28262

jsiefert@epri.com

Office: 704.595.2886 | Mobile: 704.804.4579

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PROPOSED REVISION OR ADDITION

Item No. A23-77	
Subject/Title Combined Changes to NDE Requirements for Repairs and Alterations	
NBIC Location Part: Repairs and Alterations; Section: 4; Paragraph: 4.2.a thru 4.2.b, 4.4	
Project Manager and Task Group PM – Thomas White, A. Triplett, P. Miller, P. Lentzer, R. Collins, S. Frazier, J. Walker, P. Becker	
Source (Name/Email) Andrew Triplett / triplettal@ornl.gov	
Statement of Need Multiple separate Action Items sought to revise various portions of the same paragraphs in Part 3, Section 4 (Items A23-36, A23-59, A23-77, and A23-04 [now included in 2025 Edition]). They have been incorporated into a single Item with the new 2025 wording, while modifying the format of these paragraphs slightly. Screenshots of the originally-proposed changes in A23-36, A23-59, and A23-77 are on Pages 3 and 4.	
Background Information At the January 2024 SG R&A meeting, it was proposed that instead of proceeding with separate Action Items seeking to revise the same paragraphs in Part 3, Section 4, it would be best to consolidate these into a single Item for this purpose, allowing for much easier integration into the NBIC.	
Existing Text (2025 Edition) 4.2 NONDESTRUCTIVE EXAMINATION a) All nondestructive examination (NDE) requirements, except for NDE personnel qualification requirements, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Where this is not possible or practicable, or where there is insufficient information available to determine the original NDE requirements, alternative NDE methods that provide meaningful results to verify the integrity of the repair or alteration, if acceptable to the Inspector, and were required, jurisdiction where the pressure-retaining item is installed, may be used, provided that all other requirements of this section are met. For welds that were subject to volumetric NDE during construction, repairs may be made to the base material and welded joints without volumetric examination under the following conditions: 1. The repair depth does not exceed the lesser of 1/8 in. (3 mm) or 25% of the nominal base material thickness; 2. The aggregate repair length is no longer than 6 in. (150 mm); and 3. The repair cavity and each layer of deposited weld, including the final weld surface, have been examined by magnetic particle (MT) or liquid penetrant (PT).	Proposed Text (2025 Edition, A23-36, A23-59, A23-77) 4.2 NONDESTRUCTIVE EXAMINATION a) All nondestructive examination (NDE) requirements, except for NDE personnel qualification requirements, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Where this is not possible or practicable, or where there is insufficient information available to determine the original NDE requirements, alternative NDE methods that provide meaningful results to verify the integrity of the repair or alteration, if acceptable to the Inspector, and where required, jurisdiction where the pressure-retaining item is installed, may be used, provided that all other requirements of this section are met. ~~a)-1) When volumetric NDE is required by the original code of construction~~ ~~For welds that were subject to volumetric NDE during construction~~ , repairs may be made to the base material and welded joints without volumetric examination under the following conditions: ~~4.-a.~~ The repair depth does not exceed the lesser of 1/8 in. (3 mm) or 25% of the nominal base material thickness; ~~2.-b.~~ The aggregate repair length is no longer than 6 in. (150 mm); and ~~3.-c.~~ The repair cavity and each layer of deposited weld, including the final weld surface, have been examined by magnetic particle (MT) or liquid penetrant (PT).

b) When volumetric NDE is required by the original code of construction but is not possible or practicable, progressive PT or MT examination as described in paragraph 4.2 b) 1), below, may be used. This alternative NDE method is subject to the acceptance of the Inspector, owner, and when required, jurisdiction where the pressure-retaining item is installed, provided all other requirements of this section are met.

1) Progressive PT or MT examination shall be performed on each layer of the weld to be examined, including the final weld. Before MT or PT is performed, the surface of each layer of weld shall be properly prepared for examination. The final weld may be examined with or without grinding. The NDE report shall include the number of layers examined. This alternative NDE method shall be documented in the "Remarks" section of the applicable Form "R" Report.

4.4 EXAMINATION AND TEST FOR REPAIRS AND ALTERATIONS

The following requirements shall apply to all repairs and alterations to pressure-retaining items:

- a) The integrity of repairs, alterations, and replacement parts used in repairs and alterations shall be verified by examination or test.
- b) Testing methods used shall be suitable for providing meaningful results to verify the integrity of the repair or alteration. Any insulation, coatings, or coverings that may inhibit or compromise a meaningful test method shall be removed, to the extent identified by the Inspector.
- c) The "R" Certificate Holder is responsible for all activities relating to examinations and tests of repairs and alterations.
- d) Examinations and tests to be used shall be subject to the acceptance of the Inspector, and where required, the jurisdiction.

~~b) a) 2) When volumetric NDE is required by the original code of construction and volumetric examination but is not possible or practicable, progressive PT or MT examination as described in paragraph 4.2 b) 1), below, may be used in lieu of volumetric examination, provided all the following conditions are met: This alternative NDE method is subject to the acceptance of the Inspector, owner, and when required, jurisdiction where the pressure-retaining item is installed, provided all other requirements of this section are met.~~

~~4) a. The Inspector, owner, and where required the jurisdiction where the pressure-retaining item is installed, have accepted the use of this alternative NDE method.~~

~~b. Progressive PT or MT examination shall be performed on each layer of the weld to be examined, including the final weld.~~

~~c. Before MT or PT is performed, the surface of each layer of weld shall be properly prepared for examination, except that - The final weld may be examined with or without grinding.~~

~~d. The NDE report shall include the number of layers examined.~~

~~e. This alternative NDE method shall be documented in the "Remarks" section of the applicable Form "R" Report.~~

4.4 EXAMINATION AND TEST FOR REPAIRS AND ALTERATIONS

The following requirements shall apply to all repairs and alterations to pressure-retaining items:

- a) The integrity of repairs, ~~alterations,~~ and replacement parts used in repairs ~~and alterations~~ shall be verified by examination or test, ~~in accordance with 4.4.1.~~
- ~~b) The integrity of alterations and replacement parts used in alterations shall be verified by examination or test, in accordance with 4.4.2.~~
- ~~b) c) Examination or~~ Testing methods used shall be suitable for providing meaningful results to verify the integrity of the repair or alteration. Any ~~impediment that compromises or limits a test method, such as~~ insulation, coatings, ~~oxidation,~~ or coverings ~~that may inhibit or compromise a meaningful test method,~~ shall be removed, to the extent ~~identified by acceptable to~~ the Inspector.
- ~~e) d) The "R" Certificate Holder is responsible for all activities relating to examinations and tests of repairs and alterations.~~
- ~~d) e) Examinations and tests to be used shall be subject to the acceptance of the Inspector, and where required, the jurisdiction.~~

VOTE:

COMMITTEE	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date

A23-36 PROPOSED CHANGES to 2023 NBIC; Part 3:**4.2 NONDESTRUCTIVE EXAMINATION**

a) Nondestructive examination (NDE) requirements, including technique, extent of coverage, procedures, personnel qualification, and acceptance criteria, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Weld repairs and alterations shall be subjected to the same nondestructive examination requirements as the original welds. **Where this is not possible or practicable, alternative NDE methods that provide meaningful results to verify the integrity of the repair or alteration may be used provided acceptable to the Inspector, and if required, the Jurisdiction where the pressure-retaining item is installed, where required, accept the alternative NDE method(s) may be used, provided that and all other requirements of this section are met.**

Where the welds were subject to volumetric NDE during construction, repairs may be made to the base material and weld joints without volumetric examination ~~under~~ **provided all** the following conditions **are met:**

- 1) The repair depth does not exceed the lesser of 1/8 inch (3 mm) or 25% of the nominal base material thickness;
- 2) The aggregate repair length is no longer than 6 inches (150 mm);
- 3) The repair cavity and each layer of deposited weld, including the final weld surface, have been examined by MT or PT.

b) NDE personnel shall be qualified and certified in accordance with the requirements of the original code of construction. When this is not possible or practicable, NDE personnel may be qualified and certified in accordance with their employer's written practice. ASNT SNT-TC-1A, Recommended Practice Nondestructive Testing Personnel Qualification and Certification (2006 edition), or ANSI/ASNT CP-189, Standard for Qualification and Certification of Nondestructive Testing Personnel (2006 edition), shall be used as a guideline for employers to establish their written practice. Provisions for training, experience, qualification, and certification of NDE personnel shall be described in the "R" Certificate Holder's written quality system.

4.4 EXAMINATION AND TEST FOR REPAIRS AND ALTERATIONS

The following requirements shall apply to all repairs and alterations to pressure-retaining items:

a) The integrity of repairs, ~~alterations,~~ and replacement parts used in repairs ~~and alterations~~ shall be verified by examination or test; **in accordance with 4.4.1**

b) The integrity of ~~repairs,~~ alterations, and replacement parts used in ~~repairs and~~ alterations shall be verified by examination or test; **in accordance with 4.4.2**

~~b.c)~~ **Examination or** testing methods used shall be suitable for providing meaningful results to verify the integrity of the repair or alteration. Any **impediment that compromises or limits a test method, such as** insulation, coatings, oxidation, or coverings ~~that may inhibit or compromise a meaningful test method~~ shall be removed, to the extent **acceptable to** the Inspector;

~~d)~~ The "R" Certificate Holder is responsible for all activities relating to examination and test of repairs and alterations;

~~e)~~ Examinations and tests to be used shall be subject to acceptance of the Inspector and, where required, acceptance of the Jurisdiction.

A23-59 proposed changes**4.2 NONDESTRUCTIVE EXAMINATION**

a) Nondestructive examination (NDE) requirements, **except for NDE personnel qualification requirements**, including technique, ~~extent of coverage, procedures, personnel qualification, and acceptance criteria~~, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Weld repairs and alterations shall be subjected to the same nondestructive examination requirements as the original welds. Where this is not possible or practicable, alternative NDE methods acceptable to the Inspector and the Jurisdiction where the pressure-retaining item is installed, where required, may be used, provided that all other requirements of this section are met.

Where the welds were subject to volumetric NDE during construction, repairs may be made to the base material and weld joints without volumetric examination under the following conditions:

- 1) The repair depth does not exceed the lesser of 1/8 inch (3 mm) or 25% of the nominal base material thickness;
- 2) The aggregate repair length is no longer than 6 inches (150 mm);
- 3) The repair cavity and each layer of deposited weld, including the final weld surface, have been examined by MT or PT.

b) NDE personnel shall be qualified and certified in accordance with the requirements of the original code of construction, **standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2)**. When this is not possible or practicable, NDE personnel may be qualified and certified in accordance with their employer's written practice. ASNT SNT-TC-1A, *Recommended Practice Nondestructive Testing Personnel Qualification and Certification* (2008 edition), or ANSI/ASNT CP-189, *Standard for Qualification and Certification of Nondestructive Testing Personnel* (2008 edition), shall be used as a guideline for employers to establish their written practice. Provisions for training, experience, qualification, and certification of NDE personnel shall be described in the "R" Certificate Holder's written quality system.

A23-77 Proposed Text**4.2 NONDESTRUCTIVE EXAMINATION**

a) Nondestructive examination (NDE) requirements, including technique, extent of coverage, procedures, personnel qualification, and acceptance criteria, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Weld repairs and alterations shall be subjected to the same ~~nondestructive examination~~ **NDE** requirements as the original welds; **all available documentation from original construction should be used to aid in determining these NDE requirements**. Where this is not possible or practicable, **or where there is not enough information available to determine the original NDE**, alternative NDE methods acceptable to the Inspector and the Jurisdiction where the pressure-retaining item is installed, **if** required, may be used; provided that all other requirements of this section are met.

PROPOSED REVISION OR ADDITION

Item No.	A24-17 Rev 3
Subject/Title	Specific Requirements For Stamping and Nameplates
NBIC Location	NBIC Part 3, 5.7.5 a) and b)
Project Manager and Task Group	S. Marks (PM), TG – B. Schafer, T. LeBeau, J. Ferreira, A. Khssassi
Source (Name/Email)	Certificate Administrator
Statement of Need	Allow alternative marking methods within the NBIC Part 3, Section 5, Paragraph 5.7.5 a) and b). Currently ASME Section VIII Div 1 (23), ASME Section I (23) - PG-106.6 and Mandatory Appendix VIII, and ASME CA-1 (22) all allow other methods of marking.
Background Information	Pressure vessel nameplates would look more professional with the use of mechanical etching or similar. There would not be any more stampings that are upside-down, cock-eyed, wrong location on the plate, or uneven striking pressure that results in the edges not showing up clearly. Item A25-51 addresses related revisions to QMS controls.
Existing Text	5.7.5 Specific Requirements For Stamping and Nameplates a) Required data shall be in characters of at least 5/32 in. (4 mm) high, except that characters for pressure relief valve repair nameplates may be smaller. Markings may be produced by casting, etching, embossing, debossing, stamping, or engraving. The selected method shall not result in any harmful contamination, or sharp discontinuities to, the pressure-retaining item. See NBIC Part 3, Figures 5.7.5-a through 5.7.5-e. b) The National Board Code Symbols ("R", "VR", and "NR") are to be stamped; do not emboss.
Proposed Text	a) Required data shall be in characters of at least 5/32 in. (4 mm) high, except that characters for pressure relief valve repair nameplates may be smaller. Markings may be produced by casting, etching, embossing, debossing, stamping, ~~or engraving,~~ <u>or laser. Any marking by laser is permitted only on stainless steel and aluminum. No coating that obscures the marking shall be allowed.</u> The selected method shall not result in any harmful contamination, or sharp discontinuities to the pressure-retaining item. See NBIC Part 3, Figures 5.7.5–a through 5.7.5-e. b) The National Board Code Symbols ("R", ~~"VR",~~ and "NR") ~~are to be stamped; do not emboss.~~ <u>shall be made by direct application of the National Board issued Stamp or as an alternative the following requirements may be applied:</u> 1) <u>The "R" and "NR" Symbol may be made by casting, embossing, engraving, etching, dot peening, laser, or any other process that will leave a legible and permanent image.</u>

	2) <u>The applied “R” or “NR” Symbol shall be the same shape, size, and configuration as the National Board issued Symbol Stamp.</u> 3) <u>Process controls for the method of marking and to prevent unauthorized application of the Symbol shall be described in the QMS. See 1.5.1 g).</u>
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VOTE:							
COMMITTEE	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date
SG R&A							
SC R&A							



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PROPOSED REVISION OR ADDITION

Item No.	
A24-96	
Subject/Title	
Add examples of repairs and alterations specific to Electrochemical Cell Stacks	
NBIC Location	
Part: 3; Supplement xx	
Project Manager and Task Group	
PM – A. Triplett, R. Collins, R. Miletta	
Source (Name/Email)	
Matthew Sweetland / msweetland@estacks.energy	
Statement of Need	
With inclusion of electrochemical cell stacks as "U" stamped pressure vessels under ASME BPVC Section VIII Division 1 and Code Case 3078, these stacks are starting to be shipped and registered with the National Board. Lists of repairs and alterations are needed to help guide an understanding of limitations for electrochemical cell stacks. Based on discussion at the July 2025 NBIC meetings with Robert Underwood and George Galanes, and due to planned changes in the NBIC that will affect the scope and contents of the new Supplement 11, the best place to include this information would be in a new Supplement xx "Electrochemical Cell Stack Repairs and Alterations".	
Background Information	
Electrochemical cell stacks are being built and registered with the National Board under ASME BPVC Section VIII Division 1 and Code Case 3078. Once deployed, if some modification is required by the end user, having repair and alteration lists in NBIC Part 3 will help guide decisions by Owners, Inspectors, and Jurisdictions. Illustrations of a typical electrochemical cell stack, related NBIC language for plate heat exchangers, and an Interpretation applicable to electrochemical cell stacks (23-07) are included in this Action Item. Note 1: Robert Underwood and Terry Hellman have confirmed with Gary Scribner, NBBI Assistant Executive Director – Technical, that the National Board has no issue with the addition of definitions within NBIC Supplements which are specific to that Supplement, and which will not appear in Section 9 of Parts 1-4. Note 2: While Interpretation 23-07 clarifies that some mechanical-only activities on electrochemical cell stacks that do not affect pressure-retaining items are not covered by current NBIC rules, the addition of this Supplement will place these activities in NBIC space when they affect the unit's mechanical or electrochemical performance. To lower the burden on this subset of activities, the requirements in this Supplement provide a path for some mechanical-only repairs to not require standard examination/testing or stamping unless mandated by the Jurisdiction.	
Existing Text	Proposed Text
None.	<u>SUPPLEMENT xx</u> <u>ELECTROCHEMICAL CELL STACK UNIT REPAIRS AND ALTERATIONS</u> <u>Sxx.1 SCOPE</u> <u>This Supplement provides requirements and guidelines for repairs and alterations to electrochemical cell stack units fabricated in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. These requirements shall be used in conjunction with the applicable rules in this Code. When the standard governing the original construction is not the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and where the Jurisdiction requires that repairs or alterations to such units be performed in accordance with this Code, the requirements of NBIC Part 3, 1.2 b) shall apply.</u>



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Sxx.2 DEFINITIONS SPECIFIC TO ELECTROCHEMICAL CELL STACK UNIT REPAIRS AND ALTERATIONS

Cell Component – Any component located completely between the end plates of an electrochemical cell stack unit. Examples include insulator plates (e.g., dielectric plates), separator plates, cell frames, current collectors, membrane electrode assemblies (MEA), fluid isolators, compressive force elements (e.g., internal springs), and gaskets.

Electrochemical Performance – The ability of an electrochemical cell stack unit to perform its intended electrochemical function, wherein electricity is applied to a fluid or gas to cause chemical reactions that produce known chemicals or elements in predictable quantities.

Mechanical Performance – The ability of an electrochemical cell stack unit to perform its intended pressure-retaining function under known mechanical conditions, including pressure, temperature, flow, and physical loadings and stresses. Changes to pressure-retaining items or known mechanical conditions shall be interpreted as potentially affecting the unit's mechanical performance.

Sxx.3 QUALITY MANAGEMENT SYSTEM

Organizations performing repairs and alterations to electrochemical cell stack units under the rules of this Supplement shall include in their written Quality Management System the following:

a) The scope of activities to be performed;

b) The process by which the competent technical advice described in Sxx.4 may be obtained prior to conducting repair or alteration activities; and

c) Reference to, or inclusion of, the examination, testing, and stamping requirements in Sxx.7 and Sxx.8.

Sxx.4 MECHANICAL AND ELECTROCHEMICAL PERFORMANCE

The operating nature of electrochemical cell stack units is technically complex, and slight variations in chemical, electrical, and mechanical characteristics (even within permissible ranges allowed by specification) can dramatically affect the operation and expected life of the item. Due to this, prior to conducting repair or alteration activities, potential effects of the work on the item's mechanical and electrochemical performance shall be determined. In addition, competent technical advice should be obtained from the Original Equipment Manufacturer (OEM) or another qualified source prior to conducting repair or alteration activities, with such advice being especially important in the following cases:

a) When activities under this Supplement may affect the mechanical or electrochemical performance of the electrochemical cell stack unit to such an extent that its expected life may be shortened; and

b) When the available documentation for an electrochemical cell stack unit, including the Manufacturer's Data Report (MDR) and OEM drawings, does not provide enough information to assess how activities under this Supplement will affect the mechanical or electrochemical performance of the item.

Commented [AT1]: The definitions here have been reviewed for technical accuracy by Matthew Sweetland with Electrochemical Stack Engineering LLC, the original submitter of this Item. According to Matt Sweetland, all cell components play some role in the unit's electrochemical or mechanical performance.

Commented [AT2]: As this is outside the scope of VIII-1 construction code considerations, but is important to the proper functioning of these units, this definition is intended to be open-ended enough that users/OEMs can determine R&A activity impact based on the technical nature of the electrochemical cell stack unit being repaired/alterd.

Commented [AT3]: This definition is intended to be broad enough to cover most R&A activities which aren't like-for-like replacements.



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Sxx.5 REPAIR OF ELECTROCHEMICAL CELL STACK UNITS

The following activities on electrochemical cell stack units are classified as repairs under this Code:

- a) Applicable repairs listed in NBIC Part 3, 3.3.2 and 3.3.3, including those listed for plate heat exchangers in 3.3.3 u); and
- b) Changes to, or replacement of, cell components that will not affect the mechanical performance of the unit.

Sxx.6 ALTERATION OF ELECTROCHEMICAL CELL STACK UNITS

The following activities on electrochemical cell stack units are classified as alterations under this Code:

- a) Applicable alterations listed in NBIC Part 3, 3.4.4, including those listed for plate heat exchangers in 3.4.4 j) 2);
- b) Changes to cell components that may affect the mechanical performance of the unit; and
- c) The following changes from what is described on the MDR or OEM drawings:
 - 1) A reduction in number of cells below any minimum, or when no minimum is specified; and
 - 2) An increase in number of cells above any maximum, or when no maximum is specified.

Sxx.7 EXAMINATION AND TEST

a) The examination and testing requirements in NBIC Part 3, 4.4.1, only apply to the following repair activities on electrochemical cell stack units:

- 1) Those listed in NBIC Part 3, Section 3;
- 2) Those that involve welding, brazing, or fusing; and
- 3) Those that involve the replacement or installation of stamped parts.

b) When repair and alteration activities on an electrochemical cell stack unit may affect the item's electrochemical performance, or where examination/testing in accordance with Sxx.7 a) is not required, the unit shall receive an operational test after the completion of work to verify successful operation of the unit and to verify the integrity of the repair or alteration. The scope and acceptance criteria of this test shall be a matter of agreement between the Owner, "R" Certificate Holder, Inspector, and where required, the Jurisdiction. A short description of this test shall be included on the applicable Form "R" Report.

Sxx.8 STAMPING

Unless required by the Jurisdiction where the electrochemical cell stack unit is installed, repair activities on electrochemical cell stack units that do not require examination and test under Sxx.7 a) do not require stamping or nameplate attachment as described in NBIC Part 3, 5.7, provided the repair procedure has been accepted by the Inspector. Routine repairs may also be exempt from stamping and nameplate attachment when allowed by NBIC Part 3, 3.3.2. When stamping or nameplate attachment is not performed, it shall be documented on the NB-66, Form R-1, Report of Repair.

Commented [AT4]: This list is intended to encompass all R&A activities other than mechanical replacement of cell components that do not affect the unit's pressure-retaining function. The inclusion of the "stamped parts" language is to cover a potential situation where the ASME boundary for these units expands to require stamping of non-pressure-retaining parts internal to the unit - there's no indication this will happen, but I've been told that ASME VIII-1 discussions about electrochemical cell stack units are ongoing, so it's a possibility. Having this language in Part 3 now will preclude a situation where these activities do not get appropriately tested and stamped.

Commented [AT5]: Because electrochemical performance is outside the scope of VIII-1 construction code considerations, this testing is left broad enough that NBIC users can determine appropriate measures for their specific equipment, while still meeting the overarching examination/testing fundamentals from NBIC Part 3, 4.4.

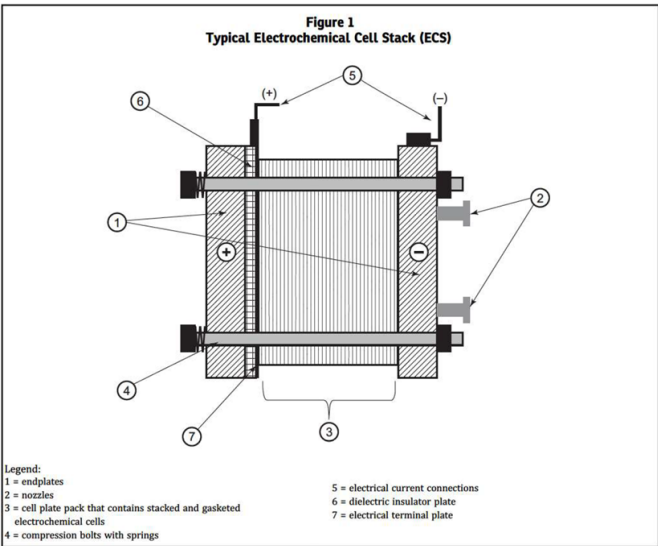
Commented [AT6]: The exemption provided here is tailored for repair activities that involve mechanical replacement of internal electrochemical cell stack components that don't affect the unit's pressure-retaining function.



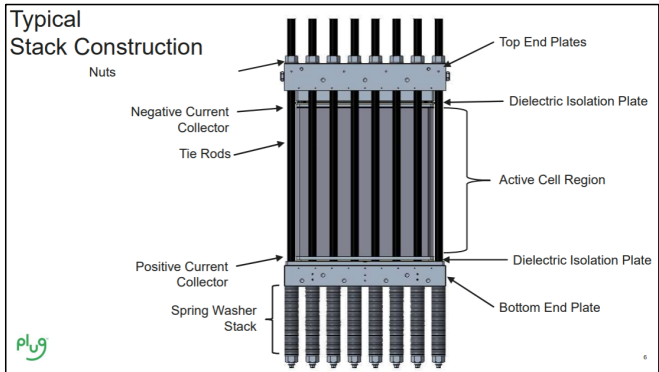
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Page 4 of 5

VOTE:							
COMMITTEE	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date
SG R&A	18	0	0	0	Passed	N/A	10/31/25



Typical Electrochemical Cell Stack configuration (from ASME Code Case 3078)



Typical Electrochemical Cell Stack configuration (from Plug Power)



Page 5 of 5

2025 NBIC Part 3, 3.3.3 u)

- u) Repairs to plate heat exchangers (PHE) are limited to the following:
- 1) Welding on any pressure part, i.e. not limited to a flange, nozzle, or endplate;
 - 2) In kind replacement of endplates, or welded nozzles;
 - 3) Replacement of any failed connection or frame bolting, representing the replacement parts described in Part 3, 3.2.2-a), with no change of material or grade as described on the Manufacturer's Data Report (MDR) or Original Equipment Manufacturer's (OEM) drawing;
 - 4) The addition or repair of load bearing attachments (e.g., welded supports or lifting lugs) to the endplates; and
 - 5) Replacement of parts bearing certification or manufacturer's stamping with no-change in material allowed as described on the MDR or verifiable OEM drawing.

2025 NBIC Part 3, 3.4.4 i) 2)

- j) For plate heat exchangers, in addition to the applicable examples of alterations above, the following changes from what is listed on the MDR or described on the Original Equipment Manufacturer's (OEM) drawing:
- 2) Any change in material whether described at 3.3.3 s) or as described at 3.4.4 g):
 - a. A change in connection bolt or frame compression bolt diameter or material grade;
 - b. A change in material grade or nominal dimensions of any end plates or nozzles.

INTERPRETATION 23-07

Subject: Replacement of nonpressure-retaining parts in Electrolyzer PEM Stack

Edition: 2023

Question 1: Is the replacement of mechanically installed nonpressure parts not listed on the MDR within a mechanically assembled ASME Section VIII pressure-retaining item that does not affect the pressure parts considered a repair or routine repair by the NBIC?

Reply 1: No, the NBIC does not address the requirements for mechanical repairs to these types of components.

Question 2: Is the mechanical assembly of an ASME Section VIII pressure-retaining item after only mechanically installed nonpressure parts have been replaced required to be documented on Form R-1, Report of Repair?

Reply 2: No, this is beyond the scope of NBIC Part 3.



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PROPOSED REVISION OR ADDITION

Item No. A24-98 Rev 07
Subject/Title Local PWHT for Spherical or Cylindrical Pressure-Retaining Items.
NBIC Location 2.5.2
Project Manager and Task Group P Gilston (PM), Matt Schaser, Walt Sperko
Source (Name/email) Jay Cameron (jay_cameron@hsb.com)
Statement of Need The referenced paragraph addresses soak, band, heat band and gradient control bands for 'bulls-eye' local PWHT. It is inconsistent in how band dimensions are defined. The dimension for the soak band is currently defined as measured from the nozzle wall. If the shell wall and weld size are similar, then there may insufficient HAZ or base metal within the soak band for a satisfactory PWHT.
Background Information Many sub-paragraphs in paragraph 2.5.2 are confusing, specifically the ones relating to measuring the Soak and Heat Bands. The purpose of this proposal is to review the current requirements and revise to bring consistency with terminology and definition of band widths. Further after researching the subject it is clear that there are many considerations in the execution of a bulls eye PWHT, which if not properly executed can lead to detrimental residual stress or extensive distortion of the pressure component. These issues are addressed in several reports: WRC Bulletin 452 Local Practices for Local Heating of Welds in Pressure Vessels ASME PCC-2 references WRC Bulletin 452 and API 510 and states that: <i>Evaluation of spot or bulls eye areas usually require the use of FEA performed by an engineer experienced in the evaluation of heat treating procedures.</i> API 510, also addresses bullseye application: <i>Local PWHT may be substituted for 360° banding provided that the application is reviewed, and a procedure is developed by an engineer experienced in the appropriate engineering specialties.</i> ASME Section VIII notes: <i>Spot or bullseye local heating is permitted provided that other measures (based upon sufficiently similar documented experience or evaluation) are taken that consider the effect of thermal gradients, all significant structural discontinuities (such as nozzles, attachments, head-to-shell junctions), and any mechanical loads which may be present during PWHT.</i> A useful report can be found at https://parstechnic.com/pdf/RECOMMENDED_PRACTICES_FOR_LOCAL_POSTWELD_HEAT_TREATMENT.pdf A presentation by Equity Engineering at the API Inspection & Mechanical Integrity Summit provided a summary of updates for local PWHT guidance in WRC 452. The presentation compared stresses compared between bullseye and full circumferential heat treatments as well as pictures illustrating distortion of vessel walls as a result of bullseye heat treatments. The presentation is based on a paper 'Establishing Recommended Guidance for Local Post Weld Heat Treatment Configurations Based on Thermal-Mechanical Finite Element Analysis' presented at the Proceedings of the ASME 2016 Pressure Vessels & Piping Division Conference, July 17 - 21, 2016, Vancouver, British Columbia, Canada, PVP2016-63581

Based on these, it is proposed to remove existing requirements for bullseye heat treatment, and include a cautionary note, so that it not prohibited, but done at the discretion of the user.

Rev 06 Change Summary

2.5.2-b Editorial changes per Mr. Triplett.

2.5.2-c Editorial changes per Mr. Triplett.

2.5.2-d Spelling correction per Mr. Triplett and Mr. Underwood.

2.5.2-d second paragraph, revised the wording for heating and cooling rates per Mr. Lane.

2.5.2-d Note, Editorial changes per Mr. Triplett.

2.5.2-e-1, Editorial changes per Mr. Triplett.

2.5.2-e-2, Editorial changes per Mr. Triplett.

2.5.2-e-3, Editorial changes per Mr. Triplett.

Rev 07 Change Summary (see clean copy to clearly identify changes)

2.5.2e)2), added the word temperature after PWHT per Mr. Shanks

2.5.2-f, Added new subparagraph f to address comments on possible detrimental effects of PWHT on riveted joints per Mr. Moedinger. This note is cautionary it was agreed that if anything more detailed was required that a new action would be opened.

Existing Text

2.5.2 POSTWELD HEAT TREATMENT (PWHT)

- a) Postweld heat treatment shall be performed as required by the original code of construction, the construction standard or code selected in accordance with a written procedure. The procedure shall contain the parameters for postweld heat treatment.
- b) Postweld heat treatment shall be performed by heating either the entire item or a circumferential band around the item. When heating a circumferential band, the heat treatment procedure shall specify the soak band (SB) width, the heated band (HB) width, the gradient control band (GCB) width, the location of thermocouples and method of attachment of thermocouples in addition to the heating rate, holding time, temperature and cooling rate. Figures 2.5.2-a and 2.5.2-b show these bands. AWS D10.10, Recommended Practices for Local Heating of Welds in Piping and Tubing may be referred to for further information.
- c) When it is impractical or detrimental to Postweld Heat Treat (PWHT) the entire item or band around the item, the following local PWHT method may be performed on spherical or cylindrical pressure-retaining items using the time and temperature parameters in the original code of construction and in accordance with a written procedure acceptable to the Inspector and, when required, by the Jurisdiction:

Proposed Text

2.5.2 POSTWELD HEAT TREATMENT (PWHT)

- a) Postweld heat treatmentPWHT shall be performed as required by the original ~~code of construction, the construction~~ standard or code ~~selected~~ in accordance with a written procedure. The procedure shall contain the parameters for ~~postweld heat treatmentPWHT~~. Efforts should be made to avoid detrimental thermal gradients during PWHT, as they may lead to the generation of additional residual stresses or distortion.
- b) Postweld heat treatmentPWHT shall should be performed by heating either the entire item or a circumferential band around the item. When heating a circumferential band, the heat treatment procedure shall specify locations and widths of the temperature bands, i.e., the soak band (SB) width, the heated band (HB) width, and the gradient control band (GCB). Figure 2.5.2-a shows these bands. width Additionally, the number, location, of thermocouples and method of attachment of thermocouples, in addition to the heating rate, PWHT temperature holding time, temperature and heating and cooling rates shall be specified. Figures 2.5.2-a and 2.5.2-b show these bands. If the original Construction standard or code does not give detailed or specific details, AWS D10.10, Recommended Practices for Local Heating of Welds in Piping and Tubing may be referred to for further information.
- c) When it is ~~impractical or detrimental~~ not practical to perform Postweld Heat Treat (PWHT) on the entire item or band around the item, a local non-circumferential PWHT (Bullseye) ~~the following local PWHT method~~ may be performed on spherical or cylindrical pressure-retaining items based on an engineering evaluation using the time and temperature parameters in the original code of construction and in accordance

- 1) Heat a local area around the nozzle, welded attachment, or repair area such that the area is brought up uniformly to the required PWHT temperature. The application of local PWHT should be performed with controlled heating methods, such as induction or electric resistance heaters, and employing thermocouples to monitor PWHT temperature. The Soak Band (SB) shall extend tangentially and radially from the edge of the nozzle wall, or attachment weld or repair area equally by a minimum distance as defined by the thickness of the shell, t or 2 in. (50 mm), whichever is less. See Figure 2.5.2-b.

Soak Band (SB) — this is the region on the spherical or cylindrical shell that will be heated uniformly to the required PWHT temperature. This band encompasses a circular region in the tangential and radial directions starting from the edge of a welded nozzle, or repair area or welded attachment that will be subjected to PWHT.

~~with~~following a written procedure acceptable to the Inspector and, when required, by the Jurisdiction.

Note: Local non-circumferential PWHT (Bullseye) should be avoided if possible, since it will result in higher residual stresses than will occur when a circumferential band is heated and it may cause distortion of the component. If local PWHT are being considered, an engineering evaluation considering the thermal distribution associated with the intended PWHT, the full constraint characteristics of the component, and all applicable loading should be performed to identify the resulting induced residual stresses and potential distortion associated with the application of the proposed local heating.

d) Heating and Cooling rates

- 1) — Heat a local area around the nozzle, welded attachment, or repair area such that the area is brought up uniformly to the required PWHT temperature. The application of local full circumferential PWHT should be performed with controlled heating methods, such as induction or electric resistance heaters, and employing thermocouples to monitor PWHT temperature.

Heating and cooling rates shall be in accordance with the original Construction standard or code. When not specified, above 600°F (315°C) the rate of heating and cooling shall not exceed 400°F/hr. (222°C/hr.) divided by the maximum base metal thickness in inches or 400°F/hr. (222°C/hr.), whichever is less. The Soak Band (SB) shall extend tangentially and radially from the edge of the nozzle wall, or attachment weld or repair area equally by a minimum distance as defined by the thickness of the shell, t or 2 in. (50 mm), whichever is less. See Figure 2.5.2-b.

Note: When heat treatment is in an area that is in close proximity to or encompassing other structural features such as nozzles, lugs, saddle supports and other attachments etc., consideration should be given to extending the bands beyond the minimum distances specified so that structural discontinuities that are within the heating bands maintain a constant temperature range through the zones which will help avoid detrimental effects of stress and distortion due to the variations of heat sink caused by such features.

e) Heat Bands (see Figure 2.5.2-a)

1) Soak Band (SB) —

†This SB is the minimum region on the spherical or cylindrical shell that will be heated uniformly to the required PWHT temperature. This band encompasses a circular region in the tangential and radial directions starting from the edge of a welded nozzle, or repair area or welded attachment that will be subjected to PWHT.

- 2) The length of the Heating Band (HB) shall consist of the SB distance plus $4\sqrt{R * t}$. In no case shall the distance of the HB that extends beyond the edge of the nozzle weld, attachment weld or repair area be less than $2.5\sqrt{R * t}$.

Heating Band (HB) – this is the region that encompasses the application of heat for PWHT and is defined in length by the equation, $SB + 4\sqrt{R * t}$ where R is the outer radius of the spherical or cylindrical shell in inches (mm), and t is equal to the nominal thickness of the spherical or cylindrical shell in inches (mm).

- 3) The Gradient Control Band (GCB) shall be kept as low as possible in all directions to avoid harmful temperature gradients adjacent to nozzles or geometric discontinuities.

~~The SB shall, or attachment weld or repair area~~
~~When not specified by the original construction~~
~~standard or code, the minimum SB shall be the~~
~~width, W, across the toes of the weld plus equally by~~
~~as defined by thickness of the shell, $t/2$ or 2-4 in. (50~~
~~100 mm), whichever is less, where T is . See Figure~~
~~2.5.2 b. one of the following:~~

- i. ~~The shell thickness for a full penetration weld.~~
- ii. ~~The groove weld depth of a partial penetration repair weld.~~
- iii. ~~For a fillet weld, the throat thickness of the weld.~~
- iv. ~~If a fillet weld is used in combination with a groove weld, the nominal thickness for PWHT shall be the depth of the groove weld.~~

~~For nozzles and attachments with a nominal diameter is less than or equal to 4 in. (100 mm), the nozzle or attachment should be included entirely in the SB.~~

~~For nozzles and attachments with a nominal diameter greater than 4 in. (100 mm), the SB should extend along the shell across the nozzle junction and along the neck a minimum of $2t$ or 2 in. (50 mm) past the toe of the weld, whichever is the less, where t is the nozzle or attachment wall thickness.~~

2) Heating Band (HB)

The HB encompasses the SB and additional base metal beyond the SB to ensure that the minimum PWHT temperature is achieved in the SB. It also allows for a uniform temperature gradient to the outer extents of the HB and GCB.

~~The length of the Heating Band (HB) shall consist of the SB distance plus $4\sqrt{R * t}$. In no case shall the distance of the HB that extends beyond the edge of the nozzle weld, attachment weld or repair area be less than $2.5\sqrt{R * t}$.~~

~~Heating Band (HB) — this is the region that encompasses the application of heat for PWHT and is defined in length by the equation, $SB + 4\sqrt{R * t}$ where R is the outer radius of the spherical or cylindrical shell in inches (mm), and t is equal to the nominal thickness of the spherical or cylindrical shell in inches (mm).~~

The temperature differential within the GCB measured at the outside edge of the SB and the temperature measured at the outside edge of the HB shall not exceed one-half ($\frac{1}{2}$) of the peak soak PWHT temperature.

3) Temperature Gradient Control Band (GCB)

The Gradient Control Band (GCB) is the region that encompasses the SB, HB, and extends beyond the edge of the HB. The size of the GCB shall be sufficient in all directions to prevent harmful

Gradient Control Band – this is the region that encompasses the SB, HB and extends beyond the edge of the HB.

- 4) For PWHT of nozzle welds, repair welds, and external attachment welds on smooth spherical shells, heads, and cylindrical shells, the temperature differential within the GCB measured at the outside edge of the SB and the temperature measured at the outside edge of the HB shall not exceed one-half (1/2) of the peak soak PWHT temperature.
- 5) The term t , as used above to determine SB, HB and GCB shall be the nominal thickness of either a full penetration weld, or the groove weld depth of a partial penetration repair weld. If a fillet weld is used in combination with a groove weld, the nominal thickness for PWHT shall be the depth of the groove weld.

temperature gradients adjacent to nozzles or geometric discontinuities.

shall be kept as low as possible in all directions to avoid harmful temperature gradients adjacent to nozzles or geometric discontinuities.

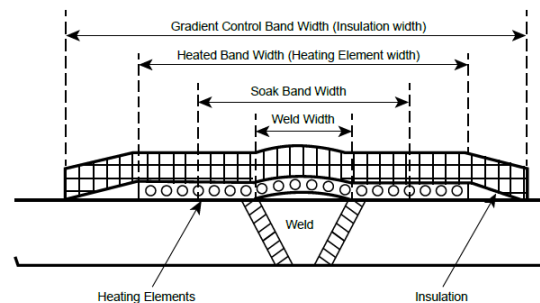
Gradient Control Band – this is the region that encompasses the SB, HB and extends beyond the edge of the HB.

4) For PWHT of nozzle welds, repair welds, and external attachment welds on smooth spherical shells, heads, and cylindrical shells, the temperature differential within the GCB measured at the outside edge of the SB and the temperature measured at the outside edge of the HB shall not exceed one-half (1/2) of the peak soak PWHT temperature.

5) The term t , as used above to determine SB, HB and GCB shall be the nominal thickness of either a full penetration weld, or the groove weld depth of a partial penetration repair weld. If a fillet weld is used in combination with a groove weld, the nominal thickness for PWHT shall be the depth of the groove weld.

f) When PWHT is performed pressure components that contain riveted joints consideration should be given to the maximum temperature the rivet joint should be exposed to, to avoid any detrimental effects to the integrity of the joint.

FIGURE 2.5.2-a
LOCAL POSTWELD HEAT TREATMENT TEMPERATURE CONTROL BANDS BUTT WELD IN CYLINDER



Delete Figure 2.5.2-b

Clean Copy, for information only.

Shows changes between Rev 06 and Rev 07

2.5.2 POSTWELD HEAT TREATMENT (PWHT)

- a) PWHT shall be performed as required by the original construction standard or code in accordance with a written procedure. The procedure shall contain the parameters for PWHT. Efforts should be made to avoid detrimental thermal gradients during PWHT, as they may lead to the generation of additional residual stresses or distortion.
- b) PWHT shall be performed by heating either the entire item or a circumferential band around the item. When heating a circumferential band, the heat treatment procedure shall specify locations and widths of the temperature bands, i.e., the soak band (SB), the heated band (HB), and the gradient control band (GCB). Figure 2.5.2-a shows these bands. Additionally, the number, location, and method of attachment of thermocouples, the PWHT temperature holding time, and heating and cooling rates shall be specified. If the original construction standard or code does not

give detailed or specific details, AWS D10.10, Recommended Practices for Local Heating of Welds in Piping and Tubing may be referred to for further information.

- c) When it is not practical to perform PWHT on the entire item or band around the item, a local non-circumferential PWHT (Bullseye) method may be performed on spherical or cylindrical pressure-retaining items based on an engineering evaluation using the time and temperature parameters in the original code of construction following a written procedure acceptable to the Inspector and, when required, by the Jurisdiction.

Note: Local non-circumferential PWHT should be avoided if possible, since it will result in higher residual stresses than will occur when a circumferential band is heated and it may cause distortion of the component. If local PWHT (bullseyes) are being considered, an engineering evaluation considering the thermal distribution associated with the intended PWHT, the full constraint characteristics of the component, and all applicable loading should be performed to identify the resulting induced residual stresses and potential distortion associated with the application of the proposed local heating.

d) Heating and Cooling Rates

The application of full circumferential PWHT should be performed with controlled heating methods, such as induction or electric resistance heaters, and employing thermocouples to monitor PWHT temperature.

Heating and cooling rates shall be in accordance with the original Construction standard or code. When not specified, above 600°F (315°C), the rate of heating and cooling shall not exceed 400°F/hr. (222°C/hr.) divided by the maximum base metal thickness in inches or 400°F/hr. (222°C/hr.), whichever is less.

Note: When heat treatment is in an area that is in close proximity to or encompassing other structural features such as nozzles, lugs, saddle supports and other attachments etc., consideration should be given to extending the bands beyond the minimum distances specified so that structural discontinuities that are within the heating bands maintain a constant temperature range through the zones, which will help avoid detrimental effects of stress and distortion due to the variations of heat sink caused by such features.

e) Heat Bands (see Figure 2.5.2-a)

(1) Soak Band (SB)

The SB is the minimum region that will be heated to the required temperature.

When not specified by the original construction standard or code, the minimum SB shall be the width, W, across the toes of the weld plus 2T or 4 in. (100 mm), whichever is less, where T is one of the following:

- i. The shell thickness for a full penetration weld.
- ii. The groove weld depth of a partial penetration repair weld.
- iii. For a fillet weld, the throat thickness of the weld.
- iv. If a fillet weld is used in combination with a groove weld, the nominal thickness for PWHT shall be the depth of the groove weld.

For nozzles and attachments with a nominal diameter is less than or equal to 4 in. (100 mm), the nozzle or attachment should be included entirely in the SB.

For nozzles and attachments with a nominal diameter greater than 4 in. (100 mm), the SB should extend along the shell across the nozzle junction and along the neck a minimum of 2t or 2 in. (50 mm) past the toe of the weld, whichever is the less, where t is the nozzle or attachment wall thickness.

2) Heating Band (HB)

The HB encompasses the SB and additional base metal beyond the SB to ensure that the minimum PWHT is achieved in the SB. It also allows for a uniform temperature gradient to the outer extents of the HB and GCB.

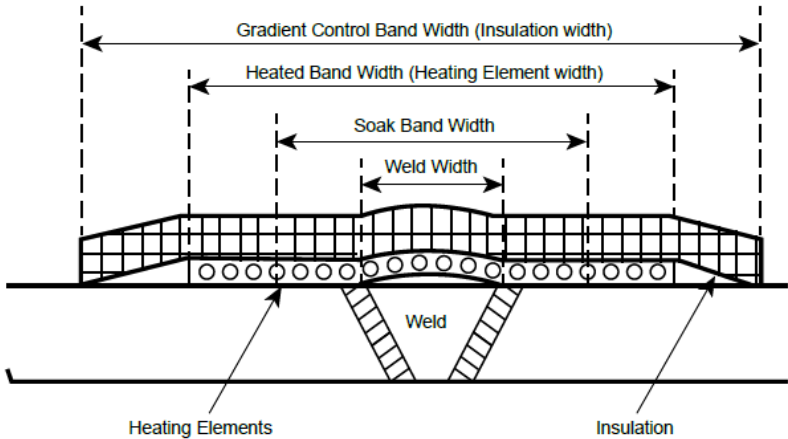
The temperature differential within the GCB measured at the outside edge of the SB and the temperature measured at the outside edge of the HB shall not exceed one-half ($\frac{1}{2}$) of the peak soak PWHT temperature.

3) Temperature Gradient Control Band (GCB)

The GCB is the region that encompasses the SB, HB, and extends beyond the edge of the HB. The size of the GCB shall be sufficient in all directions to prevent harmful temperature gradients adjacent to nozzles or geometric discontinuities.

- f) When PWHT is performed pressure components that contain riveted joints consideration should be given to the maximum temperature the rivet joint should be exposed to, to avoid any detrimental effects to the integrity of the joint.

FIGURE 2.5.2-a
LOCAL POSTWELD HEAT TREATMENT TEMPERATURE CONTROL BANDS BUTT WELD IN CYLINDER



VOTE							
Committee	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date

NBIC Action Item A25-21

Submitted by Riley Collins (rileycollins@eastman.com)

Submitted on 7-22-2025



**THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	Synchronize/Revise Repairs & Alterations of VIII-2, VIII-3 PRIs
NBIC Location:	2025 Part 3, S11.2.3 b) and S11.3.2 a)
Statement of Need:	Mr. Tim Gardner, NBBI Senior Staff Engineer/Instructor Training, plans to create an online course for repairs of ASME Sect VIII-2 and VIII-3 PRIs but the current requirements in 3.3.5 and 3.4.5 do not seem to agree.
Background Information:	In discussion with Mr. Tim Gardner, NBBI Senior Staff Engineer/Instructor Training, he asked why 3.4.5.1 a) does not have the same opening sentence for alterations as exists for repairs in 3.3.5.2. Furthermore, it is recommended for the current 3.3.5.2 sentence to read, "The user shall prepare, or cause to have prepared, detailed specifications covering the scope of the repair/alteration". The reason is to be consistent with the VIII-2/VIII-3 terms and phrases. The user provides the specifications, and the certificate holder then provides the plan.

Proposed Text (2027 Edition since A24-60 was passed at January 2025 Meeting):

S11.2.3 REPAIR OF ASME SECTION VIII, DIVISION 2 OR DIVISION 3 PRESSURE VESSELS

a) Scope

The following requirements shall apply for the repair of pressure vessels constructed to the requirements of Section VIII, Division 2 or Division 3 of the ASME Code.

b) Repair Plan

Prior to the commencement of work, the user shall prepare, or cause to have prepared, a detailed ~~plan covering the scope of the repair.~~ The "R" Certificate Holder shall prepare a detailed repair plan that fulfills this scope.

1) Review and Certification

- a. Prior to the commencement of work, ~~the~~ repair plan shall be reviewed and certified by a person or persons meeting the requirements of the original code of construction for a designer, engineer, or Certifying Engineer signing and certifying a Manufacturer's Design Report. The review and certification shall ensure the work involved in the repair is compatible with the User's Design Specification (UDS) and the Manufacturer's Design Report.
[...]

S11.3.2 ALTERATION OF ASME SECTION VIII, DIVISION 2 OR DIVISION 3, PRESSURE VESSELS

a) Scope

The following requirements shall apply for the alteration of pressure vessels constructed to the requirements of Section VIII, Division 2 or Division 3 of the ASME Code.

a)b) Alteration Plan

Prior to the commencement of work, the user shall prepare, or cause to have prepared, a detailed scope of the alteration. The "R" Certificate Holder shall prepare a detailed alteration plan that fulfills this scope.

1) Review and Certification

- a. Prior to the commencement of work, the alteration plan shall be reviewed and certified by a person or persons meeting the requirements of the original code of construction for a designer, engineer, or Certifying Engineer signing and certifying a Manufacturer's Design Report. The review and certification shall ensure the work involved in the alteration is compatible with the User's Design Specification (UDS) and the Manufacturer's Design Report.
[...]



**THE NATIONAL BOARD
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Subject:	Revise Part 3, Table 2.5.1
NBIC Location:	2025 Part 3, Table 2.5.1
Statement of Need:	There have been changes to materials in the ASME Code that have made a review/revision of Table 2.5.1 necessary. If anything, the obsolete group numbers should be deleted. It will be up to the committee to decide whether to add the missing P/group numbers and the associated temperatures.
Background Information:	An NBBI student challenged a question on an exam which referenced Table 2.5.1. The research of the table revealed there are some material group numbers that no longer exist and some new ones (P No & Gr No) that are not addressed.

2.5.1 PREHEATING

a) Preheating may be employed during use of a process to assist in completion of the joint. The need for and the temperature of preheat are dependent on a number of factors such as chemical analysis, degree of restraint of the items being joined, material thickness, and mechanical properties. The procedure specification for the material being joined shall specify the preheat temperature requirements.

~~b) See minimum temperatures for preheating given in NBIC Part 3, Table 2.5.1 as a general guide. It is cautioned that the preheating temperatures listed may not be the same as those of the original code of construction and do not necessarily ensure satisfactory completion of the joint. Requirements for individual materials within the P-Number listing may have preheating requirements more or less restrictive than this general guide. When reference is made in this section to materials by the ASME designation, P-Number and Group Number, the suggestions of this section apply to the applicable materials of the original code of construction, either ASME or other, which conform by chemical composition and mechanical properties to ASME materials having the ASME P-Number and Group Number designations.~~

b. Minimum temperatures for preheating and maximum temperatures for interpass shall be in accordance with the original code of construction or as provided in alternative welding methods in 2.5.3.

Proposed Text:± 7x E₁₁ □ □ □**MINIMUM TEMPERATURES FOR PREHEATING**

Thicknesses referenced are nominal at the weld for the parts to be joined.	
a) P-No. 1 Group Nos. 1, 2, ~~and 3, and 4~~	1) 175°F (79°C) for material that has both a specified maximum carbon content in excess of 0.30% and a thickness at the joint in excess of 1 in. (25 mm). 2) 50°F (10°C) for all other materials in this P-Number.
b) P-No. 3 Group Nos. 1, 2, and 3	1) 175°F (79°C) for material that has either a specified minimum tensile strength in excess of 70,000 psi (480 MPa) or a thickness at the joint in excess of 5/8 in. (16 mm). 2) 50°F (10°C) for all other materials in this P-Number.
c) P-No. 4 Group Nos. 1 and 2	1) 250°F (120°C) for material that has either a specified minimum tensile strength in excess of 60,000 psi (410 MPa) or a thickness at the joint in excess of 1/2 in. (13 mm). 2) 50°F (10°C) for all other materials in this P-Number.
d) P-No. 5A Group 1 and 5B, Group 1, ~~5C Group 1, 3, 4, and 5,~~ and P-No. 15E Group 1	1) 400°F (205°C) for material that has either a specified minimum tensile strength in excess of 60,000 psi (410 MPa) or has both a specified minimum chromium content above 6.0% and thickness at the joint in excess of 1/2 in. (13 mm). 2) 300°F (150°C) for all other materials in this P-Number.
e) P-No. 6 Group Nos. 1, 2, and ~~3, and 4~~	400°F (205°C)
f) P-No. 7 Group Nos. 1 and 2	None
g) P-No. 8 Group Nos. 1, ~~and 2, 3, and 4~~	None
h) P-No. 9 Group	1) 250°F (120°C) for P-9A Gr. 1 materials 2) 300°F (150°C) for P-9B Gr. 1 materials 3) ~~XXX° F (XXX°C) for P-9C Gr. 1 materials (insert applicable values) delete~~

i) P-No. 10 Group These 2 are the same	1) 175°F (70°C) for P-10A Gr. 1 materials 2) 250°F (120°C) for P-10B Gr. ~~2~~<u>1</u> materials 3) ~~175°F (70°C) for P-10C Gr. 3 materials~~ 4) ~~250°F (120°C) for P-10F Gr. 6 materials~~ 5) ~~P-10H, 10I, 10J and 10K None~~ 6) ~~200 F (95 C) for P-10H NONE~~ 7) ~~200 F (95 C) for P-10I NONE~~ 8) ~~200 F (95 C) for P-10J Gr. 1 materials delete~~ 9) ~~200 F (95 C) for P-10K Gr. 1 materials~~ 5) For P-10C Gr. 3 materials, preheat is neither required nor prohibited, and consideration shall be given to the limitation of interpass temperature for various thicknesses to avoid detrimental effects on the mechanical properties of heat treated material. 6) For P-10D Gr. 4 and P-10E Gr. 5 materials, 300°F (150°C) with interpass temperature maintained between 350°F and 450°F (175°C and 230°C).
j) P-No. 11 Group	1) P-11A Group Group 1 — None (Note 1) Group 2 — Same as for P-No. 5 (Note 1) Group 3 — Same as for P-No. 5 (Note 1) Same as for P-No. 5 (Note 1) Group 4 — 250°F (120°C) ~~Group 5 — XXXXX delete~~ 2) P-11B Group Group 1 — Same as for P-No. 3 (Note 1) Group 2 — Same as for P-No. 3 (Note 1) Group 3 — Same as for P-No. 3 (Note 1) Group 4 — Same as for P-No. 3 (Note 1) Group 5 ~~8~~ — Same as for P-No. 3 (Note 1) Group 6 ~~9~~ — Same as for P-No. 5 (Note 1) Group 7 ~~10~~ — Same as for P-No. 5 (Note 1) ~~3) P-11C Group Group 1 — XXXXXX delete~~

Note 1:

~~c. Consideration shall be given to the limitation of interpass temperature for various thicknesses to avoid detrimental effects on the mechanical properties of heat treated materials.~~



A25-22

From Gilston Philip - Hartford-HSB <Philip_Gilston@hsb.com>

Date Wed 1/14/2026 2:37 PM

To Terrence Hellman <THellman@nationalboard.org>

My objection is that the proposal as voted means that users can take some codes of construction as not requiring preheat, as their rules are not mandatory. It is my experience that when preheating is not adequately applied then significant issues with regard to pressure part welds and repairs can be experienced. The existing words in 2.5.1 b says that while they are a guide, it states

‘...preheating temperatures listed may not be the same as those of the original code of construction and do not necessarily ensure satisfactory completion of the joint. Requirements for individual materials within the P-Number listing may have preheating requirements more or less restrictive than this general guide...’.

Therefore, in my opinion to set preheat temperatures as a mandatory minimum essentially follows the philosophy of the words already in the code.

I would also note, Mr. Sekely stated that interpass temperature only applies when notch toughness is required. This is not true, ASME Section I specifies rules for interpass temperature, and that code section does not require toughness testing.

Regards,

Philip Gilston
Principal Engineer

**The Hartford Steam Boiler
Inspection and Insurance Company**

One State Street
P.O. Box 5024
Hartford, CT 06102-5024
Telephone: +1 (860) 722-1851
Facsimile:

Philip_Gilston@hsb.com

hsb.com

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NBIC Action Item A25-25

Submitted by Bob Underwood (robert_underwood@hsb.com)

June 12, 2025



**THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	Repair of PRIs Without Complete Removal of Defect
NBIC Location:	2025 Part 3, S11.2.2
Statement of Need:	To clarify this repair activity can be used for welded or non-welded repairs. This proposal will remove reference to welded repairs in S11.2.2 and only refer to "repair."
Background Information:	The intent of S11.2.2 (formerly 3.3.4.8) is that this activity be permitted in conjunction with a welded or non-welded repair activity. However, the current wording appears to permit it only when performing a welded repair activity.

Proposed Text:

- a) There may be cases where removal of a defect in a pressure-retaining item is not practical at the time the defect is found. In such cases, with approval of the Inspector and, when required, the Jurisdiction, an engineering evaluation shall be performed to determine the scope of the repair and impact to safety prior to returning the pressure-retaining item to service for a specified period of time. The engineering evaluation shall be performed by an organization with demonstrated competency in defect (and flaw) characterization of pressure-retaining items. The method of defect evaluation and time interval for returning the pressure-retaining item back to service shall be as agreed upon by the Inspector, and when required, the Jurisdiction. The specified period of time the defect can remain in service after ~~weld~~ repair shall be based on no measureable defect growth during subsequent inspections, or a period of time as specified by the Jurisdiction, if applicable. This repair method is not permitted for vessels used in lethal service, vessels designed for high-cycle operation or fatigue service, compressed air storage, and in cases where high stress concentration cannot be reduced by ~~weld~~ repair. This repair method is not permitted for DOT vessels.
- b) One or more fitness-for-service engineering evaluation methods as described in NBIC Part 2, 4.4 shall be used to determine whether the defect may remain, either in part or in whole, in the pressure-retaining item. If it is determined that the defect can remain in the item, a risk-based inspection program shall be developed as described in NBIC Part 2, 4.5 to assure inspection of the defect and monitoring of defect growth over time. This program shall be a controlled and documented inspection program that specifies inspection intervals as agreed

NBIC Action Item A25-25

Submitted by Bob Underwood (robert_underwood@hsb.com)

June 12, 2025

upon with the Inspector and, when required, the Jurisdiction, and shall be maintained until the defect can be completely removed and the item repaired.

- c) The following requirements shall apply to the **weld** repair of pressure-retaining items without complete removal of defects:
- 1) Engineering evaluation of the defect in the pressure-retaining item shall be conducted using one or more fitness-for-service condition assessment method(s) as described in NBIC Part 2, 4.4. Engineering evaluation of the condition assessment results shall be performed by an organization that has demonstrated industry experience in evaluating pressure-retaining items, if the fitness-for-service engineering evaluation requires finite element analysis (FEA), the requirements in NBIC Part 2, 4.6 and NBIC Part 2, Supplement 11 shall be met.
 - 2) If engineering evaluation indicates a defect can remain in the pressure-retaining item, a risk-based inspection program shall be developed and implemented based on review and acceptance by the Inspector and, when required, the Jurisdiction. The risk-based inspection program shall be in accordance with the requirements in NBIC, Part 2, 4.4.
 - 3) The fitness-for-service condition assessment and risk-based inspection programs shall remain in effect for the pressure-retaining item until such time that the defect can be completely removed and the item repaired. The fitness-for-service condition assessment method, results of assessment, and method of **weld** repair, if applicable, shall be documented on a Report of Fitness for Service Assessment (FFSA) Form as described in NBIC Part 2, 4.4.1 and shall be filed with the Jurisdiction, when required.
 - 4) When **weld** repairs are performed without complete removal of the defect(s), this shall be noted on the Form R-1 in the description of the work. The "R" Stamp Holder performing the **weld** repairs shall provide detailed information on the Form R-1, describing the method, extent, and include the specific location of the **weld** repair on the item.
 - 5) The interval to re-inspect or remove the item from service or perform **weld** repair shall be determined based on a risk-based inspection program developed and implemented as required by NBIC Part 2, 4.5. The inspection interval shall not exceed the remaining life of the item, and shall be documented on the Form NB-403 and in the Remarks section of the Form R-1. The Form NB-403 shall be affixed to the Form R-1. A National Board Commissioned Inspector holding an "R" endorsement as described in NB-263, RCI-1 shall sign both the Form R-1 and the attached Form NB-403.
 - 6) A copy of the completed Form R-1 with the completed Form NB-403 attached may be registered with the National Board, and when required, filed with the Jurisdiction where the item was installed.



THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

PROPOSED REVISION OR ADDITION

Item No. A 25-29 Rev 01
Subject/Title Referencing for Weld Metal, Filler Metal etc.
NBIC Location
Project Manager and Task Group P Gilston (PM), J. Siefert, W. Sperko, M. Vance, T Melfi
Source (Name/email) January 2023, Sub-Committee Discussion
Statement of Need Within Part 3, welding consumables are referred to in several different ways e.g., filler metal, weld metal etc. This item is to review these references and identify if a single reference description is beneficial for users of the Code.
Background Information When discussing weld metal, references can be made to the weld consumable itself, or the deposited weld metal. Often we describe the 'nominal composition' for the weld, this is normally based on the actual weld metal deposited in a weld joint. Various factors can influence the chemistry of a deposited weld metal, including, but not limited to dilution with the base metal, protective fluxes, shielding gas etc. Definitions of Weld Metal, Filler Metal and Weld Filler Material have been approved under item A23-13 and will be published in 2025.
Rev 01 1.5.1(i), revised materials to consumable per Mr. Riley 1.6.6.2(i)(2), revised materials to consumable per Mr. Riley 2.5.3.5 c), deleted the word deposit and revised the fourth sentence per Mr. Triplett. 2.5.3.6 c) 5) b, revised the word 'is' to 'are' per Mr. Triplett. 2.5.3.7 i) 4), corrected 'of' to 'or' in sixth line per Mr. Underwood and Mr. Triplett. 2.5.3.7 i) 2), revised the word 'is' to 'are' per Mr. Triplett. S8.3 e), revised 'an' to 'a' in the third line per Mr. Triplett. 9.1, revised the word 'the' to 'a' in the third line per Mr. Triplett.

Paragraph	Current Text	Proposed Text
1.5.1(i)	The QMS shall describe the method used to ensure that only acceptable materials (including welding material) are used for repairs and/or alterations. The QMS shall include a description of how existing material is identified and new material is	The QMS shall describe the method used to ensure that only acceptable materials (including welding ~~material~~ <u>consumables</u>) are used for repairs and/or alterations. The QMS shall include a description of how existing material is identified and new material is

	ordered, verified, and identified. The QMS shall identify the title of the individual(s) responsible for each function and a brief description of how the function is to be performed.	ordered, verified, and identified. The QMS shall identify the title of the individual(s) responsible for each function and a brief description of how the function is to be performed.
1.6.6.2(i)(2)	Welding, brazing and fusing materials shall be identified and controlled.	Welding, brazing and fusing ~~materials~~ <u>consumables</u> shall be identified and controlled.
2.5.3.1 e) 1)	Provided the carbon equivalent of the base material to be welded is determined to be 0.40 or less.	Provided the carbon equivalent of the base ~~material-metal~~ to be welded is determined to be 0.40 or less.
2.5.3.1 e) 2)	The electrodes and filler metals are classified by the filler metal specification with a diffusible hydrogen designator of H4 or lower.	The ~~electrodes and filler metals~~ <u>weld consumables</u> are classified ~~by the filler metal specification~~ with a diffusible hydrogen designator of H4 or lower
2.5.3.2 i)	For the welding process in NBIC Part 3, 2.5.3.2 c), use of austenitic or ferritic filler metals is permitted. For ferritic filler metals, use only electrodes and filler metals that are classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes. When shielding gases are used with a process, the gas shall exhibit a dew point that is below -60°F (-50°C). Surfaces on which welding will be done shall be maintained in a dry condition during welding and be free of rust, mill scale, and hydrogen producing contaminants such as oil, grease, and other organic materials;	For the welding process in NBIC Part 3, 2.5.3.2 c), use of austenitic or ferritic filler metals is permitted. For ferritic filler metals, use only ~~electrodes and filler metals~~ <u>those</u> that are classified by the ~~filler metal~~ <u>weld consumable</u> specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes. When shielding gases are used with a process, the gas shall exhibit a dew point that is below -60°F (-50°C). Surfaces on which welding will be done shall be maintained in a dry condition during welding and be free of rust, mill scale, and hydrogen producing contaminants such as oil, grease, and other organic materials;
2.5.3.2 k)	For welds made by SMAW and FCAW, after completion of welding and without allowing the weldment to cool below the minimum preheat temperature, the temperature of the weldment shall be raised to a temperature of 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted provided the electrode used is classified by the filler metal manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018-H4); and	For welds made by SMAW and FCAW, after completion of welding and without allowing the ~~weldment~~ to cool below the minimum preheat temperature, the temperature of the ~~weldment~~ shall be raised to a temperature of 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted provided the electrode used is classified by the ~~filler metal~~ <u>weld consumable</u> manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018-H4); and
2.5.3.2 l)	After the finished repair weld has cooled to ambient temperature, the surface temper reinforcing layer shall be removed substantially flush with the surface of the base material.	After the finished repair weld has cooled to ambient temperature, the surface temper reinforcing layer shall be removed substantially flush with the surface of the base ~~material~~ <u>metal</u> .
2.5.3.3 d)	The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base material specification of the repair. In the event that the original material specification is obsolete, the test material used should conform to the nominal composition and carbon equivalent (IIW Formula CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15; elements are expressed in Weight Percent Amounts), as the material being repaired, but in no case shall the material be lower in strength;	The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base ~~material-metal~~ specification of the repair. In the event that the original ~~material-base metal~~ specification is obsolete, the test material used should conform to the nominal composition and carbon equivalent (IIW Formula CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15; elements are expressed in Weight Percent Amounts), as the ~~material-base metal~~ being repaired, but in no case shall the material be lower in strength;
2.5.3.3 g) 2)	For the welding processes in NBIC Part 3, 2.5.3.3 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only	For the welding processes in NBIC Part 3, 2.5.3.3 c), use of austenitic or ferritic filler metal is permitted. For ferritic ~~filler-weld~~ metals, use only

	electrodes or filler metals that are classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes;	electrodes or filler metals that are classified by the ~~filler-metal~~ <u>weld consumable</u> specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes;
2.5.3.3 g) 3)	After completion of welding using SMAW and without allowing the weldment to cool below the minimum preheat temperature, the temperature of the weldment shall be raised to a temperature of 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the filler metal manufacturer with a diffusible- hydrogen designator of H4 (e.g., E7018-H4); and	After completion of welding using SMAW and without allowing the weld ~~ment~~ to cool below the minimum preheat temperature, the temperature of the weld ~~ment~~ shall be raised to a temperature of 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the ~~filler-metal~~ <u>weld consumable</u> manufacturer with a diffusible- hydrogen designator of H4 (e.g., E7018-H4); and
2.5.3.3 g) 4)	After the finished repair weld has cooled to ambient temperature, the final temper bead reinforcement layer shall be removed substantially flush with the surface of the base material.	After the finished repair weld has cooled to ambient temperature, the final temper bead reinforcement layer shall be removed substantially flush with the surface of the base ~~material~~ <u>metal</u> .
2.5.3.4 c)	The welding shall be limited to the SMAW, FCAW, GMAW or GTAW processes using low-hydrogen electrodes and filler metals classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower, and suitably controlled by maintenance procedures to avoid contamination by hydrogen producing sources. The surface of the metal prepared for welding shall be free of contaminants;	The welding shall be limited to the SMAW, FCAW, GMAW or GTAW processes using low-hydrogen ~~electrodes and filler metals~~ <u>weld consumables</u> classified by the ~~filler-metal~~ specification with a diffusible-hydrogen designator of H8 or lower, and suitably controlled by maintenance procedures to avoid contamination by hydrogen producing sources. The surface of the metal prepared for welding shall be free of contaminants;
2.5.3.4 d)	The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base material specification of the repair. In the event that the original material specification is obsolete, the test material used should conform to the nominal composition and carbon equivalent (IIW Formula $CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$; elements are expressed in Weight Percent Amounts), as the material being repaired, but in no case shall the material be lower in strength;	The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base ~~material-metal~~ specification of the repair. In the event that the original ~~material-base metal~~ specification is obsolete, the test material used should conform to the nominal composition and carbon equivalent (IIW Formula $CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$; elements are expressed in Weight Percent Amounts), as the ~~material-base metal~~ being repaired, but in no case shall the material be lower in strength;
2.5.3.4 g) 2)	For the welding processes in NBIC Part 3, 2.5.3.4 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only electrodes or filler metals that are classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes;	For the welding processes in NBIC Part 3, 2.5.3.4 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only ~~electrodes or filler metals~~ <u>those</u> that are classified by the ~~filler-metal~~ <u>weld consumable</u> specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes;
2.5.3.4 g) 4)	For welds made by the SMAW and FCAW processes, after completion of welding and without allowing the weldment to cool below the minimum preheat temperature, the temperature of the weldment shall be raised to 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the filler metal manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018 H4); and	For welds made by the SMAW and FCAW processes, after completion of welding and without allowing the weld ~~ment~~ to cool below the minimum preheat temperature, the temperature of the weld ~~ment~~ shall be raised to 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the ~~filler-metal~~ <u>weld consumable</u> manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018 H4); and

2.5.3.5 c)	The welding shall be limited to the SMAW, FCAW, GMAW and machine or automatic GTAW processes. The filler metal used for joining the dissimilar materials shall be either A-No 8 or Nickel-Chrome alloy classification (F-No 43). When selecting a filler metal for dissimilar metal weld joints, determine if the weld joint will be exposed to elevated temperature service. A-No 8 filler metals exposed to service temperatures greater than 800°F (427°C) will exhibit reduced creep life along the fusion zone of the ferritic material due to carbon diffusion. Instead, a low hydrogen, Nickel-Chromium alloy classification filler metal shall be used for dissimilar weld joints exposed to service temperatures at or above 800°F (427°C);	The welding shall be limited to the SMAW, FCAW, GMAW and machine or automatic GTAW processes. The <u>filler-metalweld consumable</u> used for joining the dissimilar materials shall be either <u>an A-No 8 weld metal in Section IX Table QW-442</u> or Nickel- ~~Chrome~~ -Chromium alloy classification ~~{of F-No 43} in Section IX, QW-432~~ . When selecting a <u>filler-metalweld consumable</u> for dissimilar metal weld joints, determine if the weld joint will be exposed to elevated temperature service. <u>Weld metals with chemistry matching A-No 8 (per Section IX Table QW-442) filler metals</u> exposed to service temperatures greater than 800°F (427°C) will exhibit reduced creep life along the fusion zone of the ferritic material due to carbon diffusion. Instead, a low hydrogen, Nickel-Chromium alloy classification <u>filler-metalweld consumable</u> shall be used for dissimilar weld joints exposed to service temperatures at or above 800°F (427°C);
2.5.3.6 c) 5) b.	When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW-process is specified any limits in filler size is to be shown on the WPS;	When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW-process is specified any limits in <u>filler-weld consumable diametersize is-are</u> to be shown on the WPS;
2.5.3.6 c) 5) d.	The filler metal shall be limited to an austenitic, nickel-base filler metal to those assigned to F-number 43 in Section IX, QW-432 and limited to the following consumables: ERNiCr-3 (e.g., Filler Metal 82), ENiCrFe-3 (e.g., INCONEL Welding Electrode 182), ENiCrFe-2 (e.g., INCOWELD A), UNS N08087;	The <u>filler-metalweld consumable</u> shall be limited to ~~an austenitic, nickel-base type filler metal to those~~ assigned to ~~F-number-Number~~ 43 in Section IX, QW-432 and limited to the following <u>consumablesclassifications: A or SFA-5.14</u> ERNiCr-3 ~~(e.g., Filler Metal 82)~~ , <u>A or SFA-5.11</u> ENiCrFe-3 ~~(e.g., INCONEL Welding Electrode 182)~~ , ENiCrFe-2 ~~(e.g., INCOWELD A)~~ , <u>UNS N08087or ENiCrFe-4;</u>
2.5.3.6 c) 5) e.	A martensitic, iron-base filler metal to those assigned to F-number 4 or F-number 6 in ASME Section IX, QW-432 and limited to the following consumables: E8015-B8, E8018-B8 or ER80S-B8; and	A martensitic, iron-base <u>filler-metalweld consumable to those</u> assigned to ~~F-number-Number~~ 4 or ~~F-number-Number~~ 6 in ASME Section IX, QW-432 and limited to the following <u>consumablesclassifications: A or SFA-5.5</u> E8015-B8, E8018-B8 or <u>A or SFA-5.28</u> ER80S-B8; and
2.5.3.6 c) 5) f.	For weld build-up repairs due to wastage, the filler metal shall be limited to those assigned to F-number 43 in ASME Section IX, QW-432.	For weld build-up repairs due to wastage, the <u>filler metalweld consumable</u> shall be limited to those assigned to ~~F-number-Number~~ 43 in ASME Section IX, QW-432.
2.5.3.7 i) 2)	When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW-process is specified any limits in filler size is to be shown on the WPS.	When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW-process is specified any limits in <u>filler sizeweld consumable diameter is-are</u> to be shown on the WPS.
2.5.3.7 i) 4)	For the joining of ASME P-No. 15E, Group 1 to P-No. 5A, the filler metal shall be limited to a martensitic, iron-base filler metal to those assigned to F-No. 4 or F-No. 6 in ASME Section IX, QW-432 and limited to the following	For the joining of ASME P-No. 15E, Group 1 to P-No. 5A, the <u>filler-metalweld consumable</u> shall be limited to a martensitic, iron-base filler metal to those assigned to F-No. 4 or F-No. 6 in ASME Section IX, QW-432 and limited to the following

	consumables: E8015-B8, E8018-B8 or ER80S-B8.	~~consumables classifications: A or SFA-5.5 E8015-B8, E8018-B8 or A or SFA-5.28 ER80S-B8.~~
2.5.3.7 i) 5)	For the joining of ASME P-No. 15E, Group 1 to P-No. 8, P-No. 42, P-No. 43 or P-No. 45, the filler metal shall be limited to an austenitic, nickel-base filler metal to those assigned to F-No. 43 in ASME Section IX, QW-432 and limited to the following consumables: ERNiCr-3, ENiCrFe-3, ENi-CrFe-2, UNS N08087.	For the joining of ASME P-No. 15E, Group 1 to P-No. 8, P-No. 42, P-No. 43 or P-No. 45, the filler metal shall be limited to ~~an austenitic, nickel-base filler metal to those~~ <u>weld consumable</u> assigned to F-No. 43 in ASME Section IX, QW-432 and limited to the following <u>consumables classifications: A or SFA-5.14 ERNiCr-3, A or SFA-5.11 ENiCrFe-3, ENi-CrFe-2, or UNS N08087 ENiCrFe-47.</u>
3.3.3 a)	Weld repairs or replacement of pressure parts or attachments that have failed in a weld or in the base material;	Weld repairs or replacement of pressure parts or attachments that have failed in a weld or in the base <u>material</u> ~~metal~~ ;
3.3.4.1	Except as provided in NBIC Part 3, 3.3.4.8, a repair of a defect in a welded joint or base material shall not be made until the defect has been removed. A suitable nondestructive examination (NDE) method, such as magnetic particle (MT) or liquid penetrant (PT), may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, by the Jurisdiction.	Except as provided in NBIC Part 3, 3.3.4.8, a repair of a defect in a welded joint or base <u>material</u> ~~metal~~ shall not be made until the defect has been removed. A suitable nondestructive examination (NDE) method, such as magnetic particle (MT) or liquid penetrant (PT), may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, by the Jurisdiction.
3.3.4.2 a)	Cracks Except as provided in NBIC Part 3, 3.3.4.8, a repair of a crack in a welded joint or base material shall not be made until the defect has been removed. A suitable nondestructive examination method such as MT or PT may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or single butt weld with or without backing, as allowed by the original code of construction.	Cracks Except as provided in NBIC Part 3, 3.3.4.8, a repair of a crack in a welded joint or base <u>material</u> ~~metal~~ shall not be made until the defect has been removed. A suitable nondestructive examination method such as MT or PT may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or single butt weld with or without backing, as allowed by the original code of construction.
3.3.4.3 e) 2) d.	The WPS followed shall be qualified for weld metal buildup in accordance with ASME Section IX. The nominal chemical analysis of the deposited weld metal shall be equivalent to the base material that is to be repaired. In addition, the nominal tensile strength of the deposited weld metal shall be equal to or exceed the specified minimum tensile strength and shall be based on the requirements of the welding consumable. If butt welds in the component being overlaid required postweld heat treatment by the code of construction, the WPS followed for the weld buildup shall be qualified with PWHT;	The WPS followed shall be qualified for weld metal buildup in accordance with ASME Section IX. The nominal chemical analysis of the deposited weld metal shall be equivalent to the base <u>material</u> ~~metal~~ that is to be repaired. In addition, the nominal tensile strength of the deposited weld metal shall be equal to or exceed the specified minimum tensile strength and shall be based on the requirements of the <u>welding consumable classification or specification</u> . If butt welds in the component being overlaid required postweld heat treatment by the code of construction, the WPS followed for the weld buildup shall be qualified with PWHT;
4.2 a)	All nondestructive examination (NDE) requirements, except for NDE personnel	All nondestructive examination (NDE) requirements, except for NDE personnel

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	qualification requirements, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Weld repairs and alterations shall be subjected to the same NDE requirements as the original welds. Where this is not possible or practicable, or where there is insufficient information available to determine the original NDE requirements, alternative NDE methods that provide meaningful results to verify the integrity of the repair or alteration, if acceptable to the Inspector, and where required, the jurisdiction where the pressure-retaining item is installed, may be used, provided all other requirements of this section are met. For welds that were subject to volumetric NDE during construction, repairs may be made to the base material and welded joints without volumetric examination, under the following conditions: 1) The repair depth does not exceed the lesser of 1/8 in. (3 mm) or 25% of the nominal base material thickness; 2) The aggregate repair length is no longer than 6 in. (150 mm); and 3) The repair cavity and each layer of deposited weld, including the final weld surface, have been examined by magnetic particle (MT) or liquid penetrant (PT).	qualification requirements, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Weld repairs and alterations shall be subjected to the same NDE requirements as the original welds. Where this is not possible or practicable, or where there is insufficient information available to determine the original NDE requirements, alternative NDE methods that provide meaningful results to verify the integrity of the repair or alteration, if acceptable to the Inspector, and where required, the jurisdiction where the pressure-retaining item is installed, may be used, provided all other requirements of this section are met. For welds that were subject to volumetric NDE during construction, repairs may be made to the base ~~material-metal~~ and welded joints without volumetric examination, under the following conditions: 1) The repair depth does not exceed the lesser of 1/8 in. (3 mm) or 25% of the nominal base ~~material-metal~~ thickness; 2) The aggregate repair length is no longer than 6 in. (150 mm); and 3) The repair cavity and each layer of deposited weld ~~metal~~, including the final weld surface, have been examined by magnetic particle (MT) or liquid penetrant (PT).
S1.2.10 a)	Except as provided in NBIC Part 3, 3.4.4.8, a repair of a defect in a welded joint or base material shall not be made until the defect is removed. A suitable nondestructive examination (NDE) method such as magnetic particle (MT) or liquid penetrant (PT) may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or a single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required by the Jurisdiction.	Except as provided in NBIC Part 3, 3.4.4.8, a repair of a defect in a welded joint or base ~~material-metal~~ shall not be made until the defect is removed. A suitable nondestructive examination (NDE) method such as magnetic particle (MT) or liquid penetrant (PT) may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or a single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required by the Jurisdiction.
S2.13 c)	Except as provided in NBIC Part 3, 3.3.4.8, a repair of a defect, such as a crack in a welded joint or base material, shall not be made until the defect has been removed. A suitable nondestructive examination method such as magnetic particle (MT) or liquid penetrant (PT) may be necessary to assure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a complete penetration weld such as	Except as provided in NBIC Part 3, 3.3.4.8, a repair of a defect, such as a crack in a welded joint or base ~~material-metal~~, shall not be made until the defect has been removed. A suitable nondestructive examination method such as magnetic particle (MT) or liquid penetrant (PT) may be necessary to assure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a complete penetration weld such as a

	a double butt weld or a single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, the Jurisdiction.	double butt weld or a single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, the Jurisdiction.
S5.6.3 e)	The plug material shall conform in all respects to the material specification of the base material;	The plug material shall conform in all respects to the material specification of the base material;
S6.11 b)	For hydrogen control when low alloy steel filler metals are used, the filler metal classification shall include an H4 supplemental diffusible hydrogen designator (maximum 4 ml [H ₂]/100 g deposited metal) for each of the following welding processes: 1) electrodes for shielded- metal arc welding (SMAW) conforming to SFA-5.5; 2) electrodes and fluxes for submerged arc welding (SAW) conforming to SFA-5.26; 3) electrodes and rods for gas- shielded metal arc welding (GMAW) conforming to SFA-5.28; 4) electrodes for flux-cored arc welding (FCAW) conforming to SFA 5.29.	For hydrogen control when low alloy steel ~~filler metals~~ <u>weld consumables</u> are used, the ~~filler metal~~ classification shall include an H4 supplemental diffusible hydrogen designator (maximum 4 ml [H ₂]/100 g deposited metal) for each of the following welding processes: 1) ~~electrodes for~~ shielded- metal arc welding (SMAW) conforming to SFA-5.5; 2) ~~electrodes and fluxes for~~ submerged arc welding (SAW) conforming to SFA-5.26; 3) ~~electrodes and rods for~~ gas- shielded metal arc welding (GMAW) conforming to SFA-5.28; 4) ~~electrodes for~~ flux-cored arc welding (FCAW) conforming to SFA 5.29.
S6.11 c)	Practices used for controlling storage and exposure of filler metals shall be those developed by the "R" Certificate Holder or those recommended by the filler metal manufacturer.	Practices used for controlling storage and exposure of ~~filler metals~~ <u>weld consumables</u> shall be those developed by the "R" Certificate Holder or those recommended by the ~~filler metal~~ <u>weld consumable</u> manufacturer.
S8.2.1 a)	9Cr-1Mo-VNbN Filler Metal (i.e. matching to Grade 91) + Controlled Fill + Low PWHT (Minimum temperature is 1250°F, 675°C). Acceptable filler materials are referenced in Table S8.2.1. The minimum time and maximum heat treatment temperature shall be in accordance with the original code of construction. For reference, where the Ni+Mn content of the filler metal is not known, the maximum PWHT temperature shall be 1425°F (775°C). This maximum shall be enforced to avoid over-tempering or exceeding the absolute maximum PWHT temperature. PWHT hold times at temperature shall be as follows:	9Cr-1Mo-VNbN Filler Metal (~~i.e. designed to matching to~~ Grade 91 <u>base metals</u>) + Controlled Fill + Low PWHT (Minimum temperature is 1250°F, 675°C). Acceptable ~~filler materials~~ <u>weld consumables</u> are referenced in Table S8.2.1. The minimum time and maximum heat treatment temperature shall be in accordance with the original code of construction. For reference, where the ~~Nickel + Manganese~~ content of the ~~filler metal~~ <u>weld consumable</u> is not known, the maximum PWHT temperature shall be 1425°F (775°C). This maximum shall be enforced to avoid over-tempering or exceeding the absolute maximum PWHT temperature. PWHT hold times at temperature shall be as follows:
S8.2.1 b)	9Cr-1Mo Filler Metal + Controlled Fill and No PWHT. Acceptable filler materials are detailed in Table S8.2.1.	9Cr-1Mo Filler Metal + Controlled Fill and No PWHT. Acceptable ~~filler materials~~ <u>weld consumables</u> are detailed in Table S8.2.1.
S8.2.1 c)	Ni-base Filler Metal + Controlled Fill and No PWHT. Acceptable nickel base consumables include selected ASME F No. 43 filler metals as detailed in Table S8.2.1.	Ni- ~~ckel~~ base Filler Metal + Controlled Fill and No PWHT. Acceptable nickel base <u>weld</u> consumables include selected ~~ASME F-F-No. 43 types per ASME Section IX, QW-432~~ <u>filler metals</u> as detailed in Table S8.2.1.
Table S8.2.1	See Attachment A	
S8.2.2 a)	For repairs in P-No. 15E, Group 1, Grade 91, CSEF steel joined to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45, as permitted for welded construction by the applicable rules of the	For repairs in P-No. 15E, Group 1, Grade 91, CSEF steel <u>joined welded</u> to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45, as permitted for welded construction by the applicable rules of the original

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	original code of construction, the filler metal shall be limited to an austenitic, nickel-base filler metal having a designation F-No. 43 and limited to the following consumables: ERNiCr-3, ENiCrFe-3, ENiCrFe-2, ERNiCrFe-4, ENiCrFe-4, ENiCr3Tx-y, ENiCrFe2Tx-y, or ENiCrFe3Tx-y. UNS N08087. This weld repair option does not require PWHT.	code of construction, the filler metal shall be limited to an austenitic, nickel-base ~~filler metal~~ weld consumable having a designation F-No. 43 ~~per ASME Section IX, QW-432~~ and limited to the following ~~weld consumable classifications: A or SFA-5.14~~ ERNiCr-3, ~~or ERNiCrFe-4, A or SFA-5.11~~ ENiCrFe-3, ENiCrFe-2, ~~or ERNiCrFe-4,~~ ENiCrFe-4, ~~A or SFA 5.34~~ ENiCr3Tx-y, ENiCrFe2Tx-y, or ENiCrFe3Tx-y. This weld repair option does not require PWHT.
S8.2.2 b)	b) For repairs in P-No. 15E, Group 1, Grade 91, CSEF steel joined to P-No. 4, Group 1, or P-No. 5A, Group 1, the filler metal shall be limited to: 1) A martensitic, iron-base filler metal having a designation F-No. 4 or F-No. 6 and limited to the following consumables: E8015-B8, E8018-B8, or ER80S-B8. This weld repair option does not require PWHT; or 2) A martensitic, iron-base filler metal having a designation F-No. 4 or F-No. 6 and limited to the following consumables: E9015-B91, E9016-B91, E9018-B91, E91T1-B91, or ER90S-B91. This weld repair option requires PWHT at a minimum temperature of 1250°F (675°C).	b) For repairs in P-No. 15E, Group 1, Grade 91, CSEF steel joined to P-No. 4, Group 1, or P-No. 5A, Group 1, the filler metal shall be limited to: 1) A martensitic, iron-base ~~filler metal~~weld consumable having a designation F-No. 4 or F-No. 6 ~~per ASME Section IX, QW-432~~ and limited to the following ~~consumables~~weld consumable classifications: A or SFA-5.4 E8015-B8, E8018-B8, or ~~A or SFA-5.28~~ ER80S-B8. This weld repair option does not require PWHT; or 2) A martensitic, iron-base ~~filler metal~~weld consumable having a designation F-No. 4 or F-No. 6 ~~per ASME Section IX, QW-432~~ and limited to the following ~~weld consumable classifications: A or SFA-5.5~~ E9015-B91, E9016-B91, E9018-B91, ~~A or SFA-5.29~~ E91T1-B91, or ~~A or SFA-5.28~~ ER90S-B91. This weld repair option requires PWHT at a minimum temperature of 1250°F (675°C).
S8.3 e)	When the SMAW process is specified, the weld beads deposited onto the base material shall not exceed an electrode diameter of 1/8 in. (3.2 mm). The remaining fill passes shall not exceed an electrode diameter of 5/32 in. (4.0 mm). When the GTAW process is specified, any limits for filler metal size shall be reflected in the qualified PQR and WPS.	When the SMAW process is specified, the weld beads deposited onto the base ~~material-metal~~ weld consumable shall not exceed an ~~electrode~~ weld consumable diameter of 1/8 in. (3.2 mm). The remaining fill passes shall not exceed an electrode diameter of 5/32 in. (4.0 mm). When the GTAW process is specified, any limits for ~~filler metal~~ weld consumable size shall be reflected in the qualified PQR and WPS.
9.1	Brazing — A group of metal joining processes which produce coalescence of materials by heating them to a suitable temperature, and by using a filler metal having a liquidus above 840°F (450°C) and below the solidus of the base materials. The filler metal is distributed between the closely fitted surfaces of the joint by capillary action.	Brazing — A group of metal joining processes which produce coalescence of materials by heating them to a suitable temperature, and by using a ~~filler metal~~ brazing consumable having a liquidus above 840°F (450°C) and below the solidus of the base materials. The filler metal is distributed between the closely fitted surfaces of the joint by capillary action.
9.1	Welding — A group of processes which produce a localized coalescence of metallic or nonmetallic materials by heating the materials to the suitable temperature, with or without the application of pressure, and with or without the use of filler material.	Welding — A group of processes which produce a localized coalescence of metallic or nonmetallic materials by heating the materials to ~~the a~~ suitable temperature, with or without the application of pressure, and with or without the use of ~~filler material~~ a weld consumable .

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TABLE S8.2.1

ALTERNATIVE WELD REPAIR METHODS, FILLER METALS WELD CONSUMABLES AND WELDING PROCESSES FOR GRADE 91 STEEL.

Acceptable Weld Repair Method		Welding Process and ~~Filler Metal~~ <u>Weld Consumable</u> AWS <u>or ASME SFA</u> Classification
Filler Metal	Welding Procedure	
Matching (9Cr-1Mo-VNbN)	Controlled Fill + Low PWHT	• SMAW – E9015-B91, E9016-B91 or E9018-B91 • FCAW – E91T1-B91 • GTAW – ER90S-B91
9Cr-1Mo	Controlled Fill	• SMAW – E8015-B8, E8016-B8 or E8018-B8 • FCAW – E81T1-B8 • GTAW – ER80S-B8
Ni- ~~ckel~~ base	Controlled Fill	• SMAW – ENiCrFe-2, ENiCrFe-3, ENiCrFe-4 • FCAW – ENiCr3Tx-y¹, ENiCrFe2Tx-y¹, or ENiCrFe3Tx-y¹ • GTAW – ERNiCr-3, ERNiCrFe-4

¹Clarification on the 'x-y' Designators may be found in ASME BPVC Section IIC, SFA-5.34/SFA-5.34M Specification for Nickel-Alloy Flux Cored and Metal Cored Welding Electrodes.

4.4.1 TEST OR EXAMINATION METHODS APPLICABLE TO REPAIRS

a) Liquid Pressure Test

b) Pneumatic Test

A pneumatic test may be conducted. Concurrence of the owner shall be obtained in addition to that of the Inspector and Jurisdiction where required. The test pressure shall be the minimum required to verify leak tightness integrity of the repair, but shall not exceed the maximum pneumatic test pressure of the original code of construction. Precautionary requirements of the original code of construction shall be followed;

~~e) Initial Service Leak Test~~

~~When an initial service leak test is permitted by the original code of construction, such testing may also be used to verify the leak tightness integrity of repairs;~~

~~d) c) Vacuum Test~~

A vacuum test may be conducted. Vacuum test methods used shall be suitable to verify the leak tightness integrity of the repair;

~~e) d) Nondestructive Examination (NDE)~~

NDE may be conducted. NDE methods used shall be suitable for providing meaningful results to verify the integrity of the repair. Exclusive use of visual examination (VT) is only permitted with the following considerations:

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Submitted by Stacey Marks
1/13/2026 Rev. 4



**THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	NBIC Part 3, 1.4.2 and 1.5.1 q) R-Stamp Controls
NBIC Location:	2025 NBIC Part 3, 1.4.2 and 1.5.1 q)
Statement of Need:	With the newly allowed marking methods which give alternatives to hard stamping there is a requirement to describe the marking controls in the QMS. This revision will guide industry on expectations.
Background Information:	ASME CA-1 allows the code symbol stamp to be made by casting, embossing, engraving, etching, dot peening, or any other process that will leave a legible and permanent image. NBIC users have asked to be allowed to use these alternative methods as well, see item A24-17. NBIC committee expressed concern about the robustness of the required QMS controls.

Proposed Text:

1.4.2 NATIONAL BOARD “R” SYMBOL STAMP

- a) The “R” Symbol Stamp is furnished on loan by the National Board for a nominal fee.
- b) Provisions may be made for the issuance of the “R” Symbol Stamp for use at various field locations.
- c) Additional requirements shall be met in accordance with NB-415, Accreditation of Repair (“R”) Organizations.

d) Alternatives to stamping are permitted in accordance with 5.7.5 b).

1.5.1 OUTLINE OF REQUIREMENTS FOR A QMS FOR QUALIFICATION FOR THE NATIONAL BOARD “R” CERTIFICATE OF AUTHORIZATION

- q) Control of the “R” Symbol Stamp
 - 1) The QMS shall contain provide adequate controls for the custody of the “R” Symbol stamp and any prestamped nameplates. In addition:
 - 2) The QMS shall make provisions for Inspector acceptance of the application of the “R” Symbol stamp to the pressure-retaining item or nameplate. See also 5.7.5 b) 3).
 - 3) The accepted abbreviation of the “R” Certificate Holder’s name shall be included in the QMS;

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- 34) If an organization's request to maintain more than one "R" Symbol stamp is authorized, the use and control of multiple "R" Symbol stamps shall be included in the QMS; and
- 45) The QMS shall contain provisions and a timeframe for the "R" Symbol stamp(s) to be returned to the National Board if the organization discontinues its use of the "R" Certificate of Authorization, if it no longer holds an Inspection Agreement with an Authorized Inspection Agency (if applicable), or if the "R" Certificate of Authorization has expired and the organization has not submitted an application to renew their certificate.
- Additionally, the QMS shall contain provisions for the ~~return or~~ destruction of nameplates containing the "R" Symbol that have not been attached to a pressure retaining item.

VOTE:							
COMMITTEE	Approved	Disapproved	Abstained	Not Voting	Passed	Failed	Date
SG R&A							
SC R&A							

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2025 NATIONAL BOARD INSPECTION CODE(25) **TABLE 1.5.1**

Form "R" Reports, Records, or Documents	Instructions	Minimum Retention Period
a) Form "R" Reports and supporting records and documentation	The organization performing repairs and alterations shall retain a copy of the completed Form "R" Report on file, and all records substantiating the summary of work described in Item 19 of NBIC Part 3, Table S9.2 and S9.3 for a minimum of 5 years. When the method of repair described in NBIC Part 3, ~~3.3.4.8~~ <u>11.2.2</u> is used, the record retention period shall as be described in Table 1.5.1 b), below.	5 years
b) Form "R" Report with NB-403, <i>Report of Fitness for Service Assessment</i> attached	When the method of repair described in NBIC Part 3,~~3.3.4.8~~<u>11.2.2</u> is used, the record retention period shall be for the duration described on the Fitness- for-Service Assessment (FFSA) form required by the repair method and as described in NBIC Part 2, 4.4. Notes: 1. The "R" Certificate Holders should be aware that some referenced codes and standards identified in NBIC Part 2, 1.3 describe requirements for permanent record retention throughout the service life of each equipment item. 2. When the "R" Certificate Holder is not the owner or user of the equipment, the record retention period is limited to the FFSA results described on line 8 of the Form NB-403.	5 years or as described on line 8 as reported on Form NB-403, whichever period is longer.
c) Continuity records for a welder, welding operator, bonder, or cementing technician	Minimally, continuity records for a welder, welding operator, bonder, or cementing technician within the Certificate Holder's QMS shall be described and established at the time of the applicant's initial certificate review and demonstrated at each triennial review required thereafter.	As applicable to the scope of work identified on the "R" <i>Certificate of Authorization</i> , the continuity records are subject to review during each National Board triennial certificate review. Continuity records shall be maintained for a minimum of 5 years.

- 1) Provided the carbon equivalent of the base material to be welded is determined to be 0.40 or less.
 - 2) The electrodes and filler metals are classified by the filler metal specification with a diffusible hydrogen designator of H4 or lower.
 - 3) When shielding gas is used, it shall have a dew point that is -60°F (-50°C) or lower.
- b) The preheat temperature shall be checked to assure that 4 in. (102 mm) of the material or four times the material thickness (whichever is greater) on each side of the groove (or full thickness of joint for a groove weld) is maintained at the preheat temperature during welding. When the weld does not penetrate through the full thickness of the material, the preheat need only be maintained at a distance of 4 in. (102 mm) or four times the depth of the repair weld, whichever is greater, on each side of the joint.

2.5.3.2 WELDING METHOD 2

When using this method, the following is required:

- a) This method shall be used when the applicable rules of the original code of construction required notch toughness testing or shall be used when the applicable rules of the original code of construction did not require notch toughness testing provided the adequacy of the notch toughness of the weld, including the heat-affected zone, in the as-welded condition at operating and pressure test conditions is verified;
- b) The materials shall be limited to carbon and low alloy steels permitted for welded construction by the applicable rules of the original code of construction, including those materials conforming to any of the following ASME P-No. designations: P-No. 1, Groups 1, 2, and 3; P-No. 3, Groups 1, 2, and 3; P-No. 4; P-No. 5A; P-No. 9A; P-No. 10A; P-No. 10B; P-No. 10C; P-No. 11A; or P-No. 11B;
- c) The welding shall be limited to the Shielded Metal-Arc Welding (SMAW), Gas Metal-Arc Welding (GMAW), Flux Cored-Arc Welding (FCAW), and Gas Tungsten-Arc Welding (GTAW) processes;
- d) The Welding Procedures Specifications shall be qualified in accordance with the temper bead procedure qualification requirements in QW-290 of ASME Section IX, and shall include the following additional requirements:
 - 1) For P-No. 1 Groups 1, 2, and 3 and P-No. 3 Groups 1, 2, and 3, the minimum preheat temperature shall be 350°F (177°C), and the maximum interpass shall be 450°F (232°C).
 - 2) For P-No. 9A, P-No. 10A, P-No. 10B, P-No. 10C, P-No. 11A, or P-No. 11B, the minimum preheat and interpass temperature requirements shall be in accordance with the guidelines in NBIC Part 3, 2.5.1.
 - 3) For P-No. 4 and P-No. 5A materials, the minimum preheat, interpass temperature, and technique shall be in accordance with NBIC Part 3, 2.5.3.4. The repair depth for temper bead repairs to pressure retaining items of P-No. 4 and P-No. 5A materials is limited to welds not penetrating through full thickness.
 - 4) Full thickness temper bead weld repairs are permitted to pressure retaining items of P-No 4 and P-No 5A materials under the following conditions:
 - a. ASME Section VIII, Division 2 pressure vessels, where application of PWHT on in-service vessels has been demonstrated to cause harm to vessel material.
 - b. For tube-to-header welds in steam service.

Full thickness weld repairs above shall be completed per NBIC Part 3, ~~3.3.5~~[11.2.3](#) with the following requirements:

- a. The full thickness repair weld shall be verified as being the full penetration.

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- a) The welding shall be limited to the SMAW, FCAW, and GTAW processes;
- b) The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base material specification of the repair. In the event that the original material specification is obsolete, the test material used should conform to the nominal composition and carbon equivalent (IIW Formula $CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$; elements are expressed in Weight Percent Amounts), as the material being repaired, but in no case shall the material be lower in strength;
- c) If for reasons of corrosion resistance, special hardness limits are necessary, such limits shall be included when qualifying the WPS. For pressure retaining items repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME Section IX temper bead procedure qualification provided the pressure retaining item operates in steam service above 900°F (482°C);
- d) The qualification thickness for the test plates and repair groove depths shall be in accordance with ASME Section IX; and
- e) The WPS shall be qualified in accordance with the temper bead procedure qualification requirements in QW-290 of ASME Section IX, and shall include the following additional requirements:
 - 1) The minimum preheat temperature for welding shall be 350°F (177°C) and the maximum interpass temperature shall be 450°F (232°C);
 - 2) For the welding processes in NBIC Part 3, 2.5.3.3 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only electrodes or filler metals that are classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes;
 - 3) After completion of welding using SMAW and without allowing the weldment to cool below the minimum preheat temperature, the temperature of the weldment shall be raised to a temperature of 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the filler metal manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018-H4); and
 - 4) After the finished repair weld has cooled to ambient temperature, the final temper bead reinforcement layer shall be removed substantially flush with the surface of the base material.

(25) 2.5.3.4 WELDING METHOD 4

When using this method, the following is required:

- a) This method is limited to repair welds in pressure-retaining items for which the applicable rules of the original code of construction did not require notch toughness testing. The repair depth for temper bead repairs to pressure-retaining items shall not penetrate the full thickness except as permitted below.
 - 1) ASME Section VIII, Division 2 pressure vessels, where application of PWHT on inservice vessels has been demonstrated to be detrimental to the vessel's material; or
 - 2) Tube-to-header welds in steam service.
- b) Full thickness weld repairs, as permitted in 2.5.3.4 a) 1) and 2), above, shall be completed in accordance with NBIC Part 3, ~~3.3.5~~[S11.2.3](#), and the following additional requirements:
 - 1) The full thickness repair shall be verified as being full penetration.
 - 2) Volumetric examination of the full thickness weld shall be performed.
- c) The materials shall be limited to P-No. 4, Groups 1 and 2, and P-No. 5A steels as permitted for welded construction by the applicable rules of the original code of construction;

- a) Subject to the administrative procedures of the Jurisdiction and approval of the Inspector, the replacement of a riveted section or part by welding;
- b) The repair or replacement of a pressure part with a code-accepted material that has a nominal composition and strength that is equivalent to the original material, and is suitable for the intended service;
- c) Replacement of a pressure-retaining part with a material of different nominal composition and, equal to or greater in allowable stress from that used in the original design, provided the replacement material satisfies the material and design requirements of the original code of construction under which the pressure-retaining part was built. The minimum required thickness shall be at least equal to the thickness stated on the original *Manufacturer's Data Report*;
- d) The replacement of a pressure relieving device (PRD) attached by welding, provided the replacement device's relieving capacity is equal to or greater than the PRD capacity required by the original code of construction; or
- e) Repairs to plate heat exchangers (PHE) are limited to the following:
 - 1) Welding on any pressure part, i.e. not limited to a flange, nozzle, or endplate;
 - 2) In kind replacement of endplates, or welded nozzles;
 - 3) Replacement of any failed connection or frame bolting, representing the replacement parts described in Part 3, 3.2.2-a), with no change of material or grade as described on the Manufacturer's Data Report (MDR) or Original Equipment Manufacturer's (OEM) drawing;
 - 4) The addition or repair of load bearing attachments (e.g., welded supports or lifting lugs) to the endplates; and
 - 5) Replacement of parts bearing certification or manufacturer's stamping with no-change in material allowed as described on the MDR or verifiable OEM drawing.

3.3.4 REPAIR METHODS

3.3.4.1 SCOPE

Except as provided in NBIC Part 3, [3.3.4.8S11.2.2](#), a repair of a defect in a welded joint or base material shall not be made until the defect has been removed. A suitable nondestructive examination (NDE) method, such as magnetic particle (MT) or liquid penetrant (PT), may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, by the Jurisdiction.

3.3.4.2 DEFECT REPAIRS

a) Cracks

Except as provided in NBIC Part 3, [3.3.4.8S11.2.2](#), a repair of a crack in a welded joint or base material shall not be made until the defect has been removed. A suitable nondestructive examination method such as MT or PT may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld such as a double butt weld or single butt weld with or without backing, as allowed by the original code of construction.

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b) Unstayed Boiler Furnace Cracks

Cracks at the knuckle or at the turn of the flange of the furnace opening require immediate replacement of the affected area or specific approval of repairs by the Jurisdiction (See NBIC Part 3, Figure 3.3.4.2-a).

c) Rivet or Staybolt Hole Cracks

Cracks radiating from rivet or staybolt holes may be repaired if the plate is not seriously damaged. If the plate is seriously damaged, it shall be replaced. For suggested methods of repair, see NBIC Part 3, Figure 3.3.4.2-b.

d) Minor Defects

Minor cracks, isolated pits, and small plate imperfections should be examined to determine the extent of the defect and whether repair by welding is required. Except as provided in NBIC Part 3, [3.3.4.8S11.2.2](#) prior to repair by welding, the defects shall be removed to sound metal. Liquid penetrant or magnetic particle examination may be used before or after welding.

e) Defective Bolting

Defective bolting material shall not be repaired but shall be replaced with suitable material that meets the specifications of the original code of construction.

f) Bulges

- 1) A bulge on a watertube shall be investigated to determine the cause and extent of damage to the tube prior to repair. If the bulge has resulted in metallurgical changes to the original tube material, as determined by field metallography, installation of a new length of tubing or tube patch (see NBIC Part 3, 3.3.4.6 b) is required. If the bulge has cracks as determined by NDE, installation of a new length of tubing or a tube patch is required. If the bulge does not exhibit cracks and has not resulted in metallurgical changes to the original tube material, a mechanical repair may be considered subject to the concurrence of the Inspector or Jurisdiction.
- 2) A bulge on a plate shall be investigated to determine the cause and extent of damage to the plate prior to repair. If the bulge has resulted in metallurgical changes to the original plate material, as determined by field metallography, installation of a flush patch (see NBIC Part 3, 3.3.4.6 a)) is required. If the plate has cracks as determined by NDE, installation of a flush patch is required. If the bulge does not exhibit cracks and has not resulted in metallurgical changes to the original plate material, a mechanical repair may be considered, subject to the concurrence of the Inspector or Jurisdiction.

g) Blisters

A blister may be caused by a defect in the metal such as lamination where one side exposed to the fire overheats but the other side retains its strength due to the cooling effect of the water. After the blistered material has been removed, the remaining wall thickness shall be determined by ultrasonic thickness testing. A surface examination using liquid penetrant testing or magnetic particle testing shall be made to ensure the remaining material contains no defects. If the remaining wall thickness is adequate, in the judgment of the Inspector, the area may be repaired by welding as covered in NBIC Part 3, 3.3.4.3. If the remaining wall thickness is not adequate, a plate will require a flush patch (See NBIC Part 3, 3.3.4.6 a) and a tube will require a new length of tube or tube patch [see NBIC Part 3, 3.3.4.6 b)].

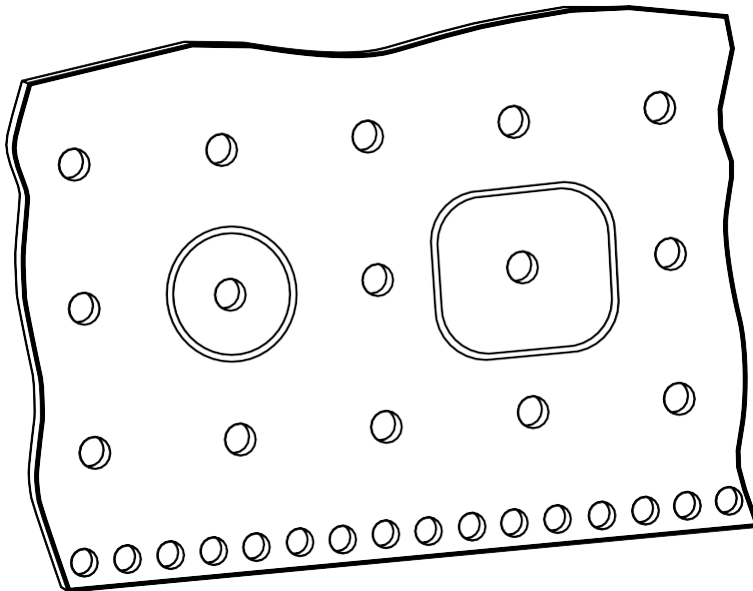
S2.13 REPAIR METHODS

- a) Before performing any welding activity, consideration shall be given to ensure the weldability of historical boiler materials. Materials used for patches shall be made from material that is at least equal in quality and strength to the original material.
- b) Before a repair is made to a defect in a welded joint or base metal, care should be taken to investigate its cause and to determine its extent and likelihood of recurrence.
- c) Except as provided in NBIC Part 3, [3-3.4.8S11.2.2](#), a repair of a defect, such as a crack in a welded joint or base material, shall not be made until the defect has been removed. A suitable nondestructive examination method such as magnetic particle (MT) or liquid penetrant (PT) may be necessary to assure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a complete penetration weld such as a double butt weld or a single butt weld with or without backing. Where circumstances indicate that the defect is likely to recur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, the Jurisdiction.
- d) Welded repairs at or near riveted seams requiring preheating or postweld heat treatment shall be carefully made to prevent loosening in the riveted seams, especially when localized heating is used. Where necessary to control expansion or to gain access for welding, rivets at the defective section and to each side of it may be removed. Reuse of rivets is prohibited.

S2.13.1 REPAIR OF THREADED STAYBOLT HOLES

Staybolt holes may be repaired by welding, reaming, re-tapping to a larger size, or by installing a flush patch. (See NBIC Part 3, Figure S2.13.1). If the staybolt hole was threaded and is to be repaired by welding, the threads shall be removed prior to welding.

FIGURE S2.13.1
SINGLE STAYBOLT FLUSH PATCH



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SUPPLEMENT 7

REPAIR AND ALTERATIONS OF PRESSURE VESSELS IN LIQUEFIED PETROLEUM GAS SERVICE**S7.1 SCOPE**

This supplement provides requirements and guidelines that apply to the repairs or alterations to pressure vessels designed for storing Liquid Petroleum Gas (LPG) and which are fabricated in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquid and Gases. When the standard governing the original construction is not the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquid and Gases, the requirements of NBIC Part 3, 1.2 b), shall apply. In addition to this supplement, the applicable paragraphs of NBIC Part 3 shall be met. Vessels used for anhydrous ammonia service shall not be considered for repair or alteration activities in accordance with this supplement.

S7.2 GENERAL AND ADMINISTRATIVE REQUIREMENTS

- a) Refer to NBIC Part 3, Section 1 for all applicable post construction activities pertaining to general and administrative requirements.
- b) Repairs or alterations shall conform to the edition of the ASME Code or standard most applicable to the work.

S7.3 WELDING

Refer to NBIC Part 3, Section 2 for all applicable post construction activities pertaining to welding requirements.

S7.4 REQUIREMENTS FOR REPAIRS AND ALTERATIONS

- a) Refer to NBIC Part 3, Section 3 for all applicable post construction activities pertaining to requirements for repairs and alterations.

Excluded is NBIC Part 3, ~~3.3.4.8~~[S11.2.2](#) *Repair of Pressure-Retaining Items Without Complete Removal of Defects*.

- b) Radiographic or ultrasonic examinations are considered to be suitable alternative nondestructive examination methods to ensure complete removal of the defect, as described in NBIC Part 3, 3.3.4.1.

S7.5 REQUIREMENTS FOR CHANGE OF SERVICE FROM ABOVE GROUND TO UNDERGROUND SERVICE

(25)

ASME LPG storage vessels may be changed from above-ground service to underground (UG) service under the conditions of NBIC Part 2, S7.10.

S7.6 EXAMINATION AND TESTING

Refer to NBIC Part 3, Section 4 for all applicable post construction activities pertaining to examination and testing.

TABLE S9.2

GUIDE FOR COMPLETING THE NB-66, FORM R-1, *REPORT OF REPAIR*

Reference to Circled Numbers in the Form	Description
(1)	Initials of the authorized representative of the "R" Certificate Holder.
(2)	Initials of the Inspector reviewing the "R" Certificate Holders work.
(3)	When registering a Form R-1 Report with the National Board, this line is solely designated for a unique sequential number assigned by the "R" Certificate Holder. When the "R" Form is not to be registered, indicate so by "N/A". As described in NBIC Part 3, 5.6, a log shall be maintained identifying sequentially, any Form "R" registered with the National Board.
(4)	If applicable, document the unique purchase order, job, or tracking number assigned by the organization performing the work.
(5)	The name and address of the National Board "R" Certificate Holder performing the work as it appears on the " <i>Certificate of Authorization</i> ".
(6)	Name and address of the owner of the pressure-retaining item.
(7)	Name and address of plant or facility where the pressure-retaining item is installed.
(8)	Description of the pressure-retaining item, such as boiler or pressure vessel, or piping. Include the applicable unit identification.
(9)	Name of the original manufacturer of the pressure-retaining item. If the original manufacturer is unknown, indicate by, "unknown."
(10)	Document the serial number of the pressure-retaining item if assigned by the original manufacturer. If there is no serial number assigned or is unknown, indicate "unknown."
(11)	When the pressure-retaining item is registered with the National Board, document the applicable registration number. If the pressure-retaining item is installed in Canada, indicate the Canadian design registration number (CRN), and list the drawing number under "other." If the item is not registered, indicate, "none."
(12)	Indicate the jurisdiction number assigned to the pressure retaining item, if available.
(13)	Indicate any other unique identifying nomenclature assigned to the pressure retaining item by the owner or user.
(14)	Identify the year in which fabrication/construction of the pressure retaining item was completed.
(15)	Indicate edition and addenda of the NBIC under which this work is being performed.
(16)	Indicate the name, section, division, edition, and addenda (if applicable) of the original code of construction for the pressure-retaining item.

TABLE S9.2 CONT'D

Reference to Circled Numbers in the Form	Description
(17)	Indicate the name, section, division, edition, and addenda (if applicable) of the construction code used for the work being performed. If code cases are used, they shall be identified in the "Remarks" section.
(18)	Check the repair type performed on the pressure retaining item.
(19)	Provide a detailed summary describing the scope of work that was completed to a pressure retaining item (PRI). The information to be considered when describing the scope of work should include such items as, the nature of the repair (i.e. welding, bonding, cementing), the specific location of the work performed to the PRI, the steps taken to remove a defect or as allowed by 3.3.4.8S11.2.2 to remain in place, the method of repair described as listed in the examples of Part 3, Section 3 or supplemental section if applicable, and the acceptance testing and or examination method used in accordance with the NBIC. When additional space is required to describe the scope of work, a Form R-4 shall be used and attached (check box). If a FITNESS FOR SERVICE Form (NB-403) is part of the Form R-1 repair package, check box and attach the form. Information determined to be of a proprietary nature need not be included, but shall be stated on the form.
(20)	Indicate type of pressure test applied (Liquid, Pneumatic, Vacuum, Leak). If no pressure test applied, indicate "none."
(21)	Indicate test pressure applied.
(22)	Indicate maximum allowable working pressure (MAWP) for the pressure retaining item, if known.
(23)	As applicable, identify what Replacement Parts manufactured by welding or bonding were introduced as needed to complete the scope of work. Indicate part, item number, manufacturer's name, stamped identification, and data report type or Certificate of Compliance.
(24)	Indicate any additional information pertaining to the work involved (e.g., routine repairs, code cases).
(25)	When registering a Form R-1 Report with the National Board, this line is solely designated for a unique sequential number assigned by the "R" Certificate Holder. When the "R" Form is not to be registered, indicate so by "N/A". As described in NBIC Part 3, 5.6, a log shall be maintained identifying sequentially, any Form "R" registered with the National Board.
(26)	If applicable, document the unique purchase order, job, or tracking number assigned by organization performing work.
(27)	Type or print name of authorized representative of the "R" Certificate Holder attesting to accuracy of the work described.
(28)	Indicate National Board "R" <i>Certificate of Authorization</i> number.
(29)	Indicate month, day, and year that the "R" <i>Certificate of Authorization</i> expires.

TABLE S9.3**GUIDE FOR COMPLETING THE NB-229, FORM R-2, *REPORT OF ALTERATION***

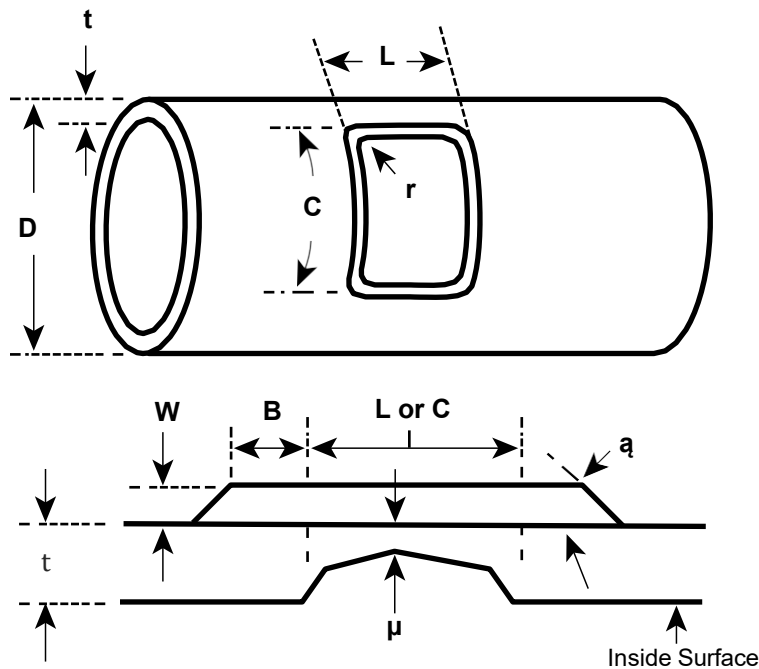
Reference to Circled Numbers in the Form	Description
(1)	Initials of the National Board “R” <i>Certificate of Authorization</i> authorized representative who registers the Form R-2.
(2)	Initials of the Inspector who certified the completed Form R-2 for registration.
(3)	When registering a Form R-2 with the National Board, this line is solely designated for a unique sequential number assigned by the “R” Certificate Holder. As described in NBIC Part 3, Paragraph 5.6, a log shall be maintained identifying unique and sequentially numbered Form “R” reports that are registered with the National Board. For rerating only, the Design Organization registers the Form R-2.
(4)	If applicable, document the unique purchase order, job, or tracking number assigned by the organization performing the work.
(5)	The name and address of the National Board “R” <i>Certificate of Authorization</i> holder performing the design as it appears on the “ <i>Certificate of Authorization</i> ”.
(6)	The name and address of the National Board “R” <i>Certificate of Authorization</i> holder performing the construction activity as it appears on the “ <i>Certificate of Authorization</i> .”
(7)	Name and address of the owner of the pressure-retaining item.
(8)	Name and address of the plant or facility where the pressure-retaining item is installed.
(9)	Description of the pressure-retaining item, such as boiler or pressure vessel, or piping. Include the applicable unit identification.
(10)	Name of the original manufacturer of the pressure-retaining item. If the original manufacturer is unknown, indicate by, “unknown.”
(11)	Document the serial number of the pressure-retaining item if assigned by the original manufacturer. If there is no serial number assigned or it is unknown, indicate “unknown.”
(12)	When the pressure-retaining item is registered with the National Board, document the applicable registration number. If the pressure-retaining item is installed in Canada, indicate the Canadian design, registration number (CRN), and list the drawing number under “other.” If the item is not registered, indicate, “none.”
(13)	Indicate the jurisdiction number assigned to the pressure retaining item, if available.
(14)	Indicate any other unique identifying nomenclature assigned to the pressure retaining item by the owner or user.
(15)	Identify the year in which fabrication/construction of the pressure retaining item was completed.

TABLE S9.3 CONT'D

Reference to Circled Numbers in the Form	Description
(16)	Indicate edition and addenda of the NBIC under which this work is being performed, as applicable.
(17)	Indicate the name, section, division, edition, and addenda (if applicable) of the original code of construction for the pressure-retaining item.
(18)	Indicate the name, section, division, edition, and addenda (if applicable) of the construction code used for the work being performed. If code cases are used, they shall be identified in the "Remarks" section.
(19)	Provide a detailed summary of the scope of design that was performed. When additional space is required to describe the design scope, a Form R-4 shall be used and attached (check box if needed).
(20)	The information to be considered when describing the construction scope of work should include such items as, the nature of the alteration (i.e. welding, bonding, cementing), the specific location of the work performed to the pressure retaining item, the steps taken to remove a defect or as allowed by NBIC Part 3, Paragraph 3.3.4.8S11.2.2 to remain in place, and the method of alteration described as listed in the examples of NBIC Part 3, Paragraph 3.4.4 or applicable supplement. When additional space is required to describe the construction scope, a Form R-4 shall be used and attached (check box if needed).
(21)	Indicate type of pressure test applied (liquid, pneumatic, vacuum, leak). If no pressure test applied, indicate "none."
(22)	Indicate test pressure applied.
(23)	Indicate maximum allowable working pressure (MAWP) for the pressure retaining item. (As altered)
(24)	When registering a Form R-2 with the National Board, this line is solely designated for a unique sequential number assigned by the "R" Certificate Holder. As described in NBIC Part 3, Paragraph 5.6, a log shall be maintained identifying unique and sequentially numbered Form "R" reports that are registered with the National Board. For rerating only, the Design Organization registers the Form R-2.
(25)	If applicable, document the unique purchase order, job, or tracking number assigned by organization performing work.
(26)	As applicable, identify what parts manufactured by welding or bonding were introduced as needed to complete the scope of work. Indicate part, item number, manufacturer's name, stamped identification, and data report type or Certificate of Compliance.
(27)	Indicate any additional information pertaining to the work involved (e.g. code cases, interpretations used).
(28)	Type or print name of the National Board "R" <i>Certificate of Authorization</i> authorized representative responsible for design certification.

FIGURE S11.2.1-a
EXTERNAL OVERLAY TERMS AND DEFINITIONS

(25)



L = length of area to be repaired along the axis of the component

C = length of area to be repaired along outside circumference of the component

W = the completed thickness of the overlay

α = the angle between the component and the overlay (maximum 45°)

$B = 3/4 (Rt)^{0.5}$ minimum

R = nominal outside radius of the component

D = the nominal outside diameter of the component

t = nominal wall thickness of the component

μ = remaining wall thickness of the component shall be 1/16 in. (1.6 mm) or greater

r = minimum radius, not less than the overlay thickness

S11.2.2 REPAIR OF PRESSURE-RETAINING ITEMS WITHOUT THE COMPLETE REMOVAL OF DEFECTS

- a) There may be cases where removal of a defect in a pressure-retaining item is not practical at the time the defect is found. In such cases, with approval of the Inspector and, when required, the Jurisdiction, an engineering evaluation shall be performed to determine the scope of the repair and impact to safety prior to returning the pressure-retaining item to service for a specified period of time. The engineering evaluation shall be performed by an organization with demonstrated competency in defect (and flaw) characterization of pressure-retaining items. The method of defect evaluation and time interval for returning the pressure-retaining item back to service shall be as agreed upon by the Inspector, and when required, the Jurisdiction. The specified period of time the defect can remain in service after weld repair shall be based on no measureable defect growth during subsequent inspections, or a period of time as specified by the Jurisdiction, if applicable. This repair method is not permitted for vessels used in lethal service, vessels designed for high-cycle operation or fatigue service, compressed air storage, and in cases where high stress concentration cannot be reduced by weld repair. This repair method is not permitted for United States Department of Transportation (DOT) vessels.
- b) One or more fitness-for-service engineering evaluation methods as described in NBIC Part 2, 4.4 shall be used to determine whether any part of the defect may remain, in the pressure-retaining item. If it is determined that the defect can remain in the item, a risk-based inspection program shall be developed as described in NBIC Part 2, 4.5 to ensure inspection of the defect and monitoring of defect growth over time. This program shall be a controlled and documented inspection program that specifies inspection intervals as agreed upon with the Inspector and, when required, jurisdiction, and shall be maintained until the defect can be completely removed and the item repaired.

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- a. If the UDS is lost or destroyed, the ASME nameplate and the applicable ASME Section VIII, Division 2 or Division 3 Manufacturer's Data Report, Partial Data Reports, and/or Manufacturer's Design Report shall be used to reconstruct the UDS. The reconstructed UDS shall meet the requirements of and be certified in accordance with the latest edition of ASME Section VIII, Division 2 or Division 3. (25)
- 2) Authorized Inspection Agency Acceptance (25)
 - a. After the repair plan is reviewed and certified, it shall be submitted for acceptance to the Authorized Inspection Agency/Owner-User Inspection Organization employing the Inspector performing the acceptance inspection and signing the Form R-1.

S11.3 ENGINEERED ALTERATION METHODS**S11.3.1 ENCAPSULATION**

Encapsulation is a method used to maintain the pressure retaining capability of piping and valves (with the exception of firetube boilers) by fabricating a new pressure containing boundary over the item in the form of a "welded leak box" as described by ASME PCC-2, Article 204.

- a) Except as required in ~~3.4.3~~**S11.3.1** c) 1), ASME PCC-2 should be used as a guideline for the design of the welded leak box and fabrication shall be in accordance with the original code of construction, when practicable. Design of the encapsulation shall consider original design conditions, taking into account current service conditions and damage mechanisms. Use of this method shall be acceptable to the inspector and when required, the jurisdiction.
- b) The "R" Certificate Holder responsible for the design of the encapsulation shall ensure a Fitness for Service Assessment (FFSA) has been performed on the portion of the item being encapsulated in accordance with NBIC Part 2, 4.4.1, supporting the continued service of the item. The leak box shall not remain in place beyond the calculated remaining life of the encapsulated portion of the pressure retaining item.
 - 1) The remaining life of the encapsulated pressure retaining item shall be documented on the Report of FFSA in the Remarks section. The Report of FFSA Form shall be affixed to the NB-229, Form R-2, *Report of Alteration* and identified in the Remarks section.
 - 2) The leak box shall fully encapsulate the thinned or leaking area, as specified in the FFSA, to the distance where the minimum required metal thickness is verified. Wall thickness shall be verified in the area to be welded.
 - 3) A welded leak box shall not be used to encapsulate a crack unless it has been removed and repaired in accordance with Part 3, Paragraph 3.3.4.2 a).
- c) Hazards associated with welding on degraded components should be addressed with the Owner-User by the use of engineering controls, administrative controls, and personal protective equipment.
 - 1) When the pressure retaining item will remain in service while implementing this method, the requirements and limitations described within ASME PCC-2, Part-1 shall be used in conjunction with the Welded Leak Box Repair article in ASME PCC-2, Part-2, Article 210.
 - 2) API RP-2201, "Safe Hot Tapping Practices in the Petroleum and Petrochemical Industries" may be used as a guideline for identifying hazards associated with welding to a component that is under pressure, including service restrictions.
- d) Visual examination shall be in accordance with the NBIC Part 3, 4.4.1 e).

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Federal Inspection Agency

(1.3)

Federal Railroad Administration (FRA)

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(S1.2.9.7)

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(3.3.3), (3.3.4.1), (3.3.4.2), (3.3.4.3), (3.3.4.6), (S1.2.10), (S1.2.11.1), (S1.2.11.3), (S1.2.11.4), (S1.2.11.6), (S2.13.1), (S2.13.9.1), (S2.13.9.2), (S2.13.9.3), (S2.13.10.3), (S2.13.10.4), (S2.13.11.1), (S2.13.11.2), (S2.13.11.3), (S2.13.12.3), (S2.13.14.1), (S2.13.14.3)

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R-1

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R-2

(5.2.2), (S9.3)

R-3

(5.2.3), (S9.4))

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G**Gage Glass**

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Gel Coat Repairs

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Gradient Control Band (GCB)

(2.5.2)

Graphite Pressure Equipment

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Grooving

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H**Handhole**

(3.3.4.3), (S2.13.14.2), (S2.13.14.4)

Hardness

(2.5.3.2), (2.5.3.3), (2.5.3.4), (2.5.3.5), (3.2.1), (S4.12), (S4.18.2.1), (S4.18.2.2), (S4.18.2.4)

Heated Band (HB)

(2.5.2)

Heat Treatment

(1.5.1), (1.6.7.2), (2.1), (2.5.2), (2.5.3), (2.5.3.1), (2.5.3.2), (2.5.3.6), (3.2.1), (3.2.2), (3.3.2), (3.3.4.3), (S1.2.10), (S1.2.11.2), (S2.10), (S2.13), (S2.13.9.2), (S2.13.9.3), (S6.8.1), (S6.10.2), (S6.10.3)

Hold Time

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Hydrogen

(2.5.3), (2.5.3.1), (2.5.3.2), (2.5.3.4), (2.5.3.5), (2.5.3.6), (S1.1.3), (S2.7), (S6.9), (S6.10.3)

Hydrophilic Solvent

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Hydrostatic Test

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(1.6.6.2), (1.6.7.2), (1.6.8.2), (2.2.5), (3.2.2), (S4.10.4), (S6.6), (S6.9.5), (S9.6)

Impervious

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Impregnated

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Inspection(Foreword), (Introduction), (1.3), (1.3.2), (1.4.2), (1.5.1), (1.6.1), (1.6.3), (1.6.6.2), (1.6.7.2), (1.6.8.2), (3.2.2), (3.3.4.3), ([3-3.4.8S11.2.2](#)), (3.4.1), (3.4.2), (5.3), (5.4), (S1.2.11.4), (S1.2.12.2), (S2.1), (S2.3), (S2.8), (S2.13.3), (S2.13.10.4), (S2.13.14.1), (S3.2), (S3.4), (S4.2), (S4.9), (S4.12), (S4.14), (S4.17.5), (S4.17.6), (S5.1), (S5.6.1), (S6.6), (S6.8.1), (S6.8), (S6.8.1), (S6.12), (S6.14), (S7.7), (S8.5), (S9)**Inquiries**

(Foreword)

Install/Installation(1.2), (1.6.2), (1.6.6.2), (1.6.7.2), (2.5.3), (3.2.1), (3.3.3), (3.3.4.1), (3.3.4.2), (3.3.4.6), ([3-3.4.8S11.2.2](#)), (3.4.1), (S1.2.1), (S1.2.2), (S1.2.3), (S1.2.5), (S1.2.6), (S1.2.6.1), (S1.2.6.2), (S1.2.6.3), (S1.2.9.2), (S1.2.9.4), (S1.2.10), (S1.2.11.1), (S1.2.11.4), (S1.2.11.6), (S1.2.12.1), (S1.2.12.2), (S2.13.1), (S2.13.2), (S2.13.4), (S2.13.5), (S2.13.8), (S2.13.9.1), (S2.13.9.2), (S2.13.9.4), (S2.13.10.3), (S2.13.10.4), (S2.13.11.1), (S2.13.11.2), (S2.13.14.2), (S3.2), (S3.3), (S3.5.1), (S3.5.3.1), (S4.7), (S4.17.5), (S4.17.6), (S4.18.2.5), (S5.6.3), (S6.5)**Insulation**

(2.5.2), (3.4.1), (4.4), (S8.3)

Internal

(3.2.2), (3.3.4.3), (3.4.4), (S3.2), (S3.5.4), (S4.9), (S4.17.5), (S4.18.2.3), (S4.18.2.5), (S5.5), (S6.6), (S6.8.1)

Interpretations

(Introduction), (10.1)

J**Jaeger Type No. 1**

(4.4.1), (S4.2)

Jurisdiction

(Foreword), (Introduction), (1.2), (1.3), (1.3.1), (1.4.1), (1.6.4), (1.6.7.2), (1.6.8.1), (1.6.9), (2.5.3), (3.2.4), (3.2.7), (3.3.2), (3.3.3), (3.3.4.2), (3.3.4.3), (3.3.4.8S11.2.2), (3.3.4.9), (3.3.5.2), (3.4.1), (3.4.5.1S11.3.2), (4.2), (4.4.1), (5.2), (5.5), (5.7.2), (5.8.1), (5.11), (S1.1.1), (S2.8), (S4.6), (S4.16.3), (S4.17.2), (S4.17.3), (S4.17.4), (S9), (9.1)

Jurisdictional Authority

(Foreword), (1.6.7.2), (S4.15), (S4.17.6)

Jurisdictional Requirements

(1.4), (1.5.1), (1.6.5), (1.6.6.2), (2.5.2), (3.3.4.1), (3.3.4.2), (3.3.4.4), (3.3.4.8S11.2.2), (3.4.1), (3.4.2), (4.2), (4.4), (4.4.1), (4.4.2), (5.3), (5.4), (5.5), (5.7.2), (5.8.1), (5.11), (S1.1.2), (S1.1.3), (S1.2.10), (S2.2), (S2.3), (S2.5), (S2.6), (S2.7), (S2.7.2), (S3.2), (S4.7), (S4.16.3), (S4.16.4), (S4.17.5), (S9.2), (S9.7)

K**Knuckles**

(3.3.4.2), (S1.2.9.4), (S1.2.11.2), (S1.2.11.5), (S2.13.10.3), (S2.13.10.4), (S2.13.11.1), (S2.13.11.2), (S2.13.11.3), (3.2.6), (3.3.2)

L**Laminate**

(3.3.4.2), (S4.10.1), (S4.10.2), (S4.10.5), (S4.18.1), (4.18.2.1), (S4.18.2.2), (S4.18.2.3), (S4.18.2.4), (S4.18.2.7), (S4.18.2.8)

Lap Joints

(3.3.4.2), (3.3.4.4), (S2.13.9.2)

Leakage

(S1.2.5.1), (S2.13), (S3.5.4), (S4.15), (S4.17.6), (S4.18.2.7), (S9.6)

Leak Testing

(4.4.1), (S3.5.4)

Ligaments

(S1.2.11.6), (S2.13.12.2), (S3.5.4)

Linings

(3.3.3), (S6.12)

Liquefied Petroleum Gas

(S7.1), (S7.5)

Liquid Penetrant Examination

(2.5.3), (3.3.4.1), (3.3.4.2), (3.3.4.3), (S1.2.10), (S2.13), (S5.6.2)

Liquid Pressure Test

(4.4.1), (4.4.2), (S6.18.1)

Liquid Temperature

(4.4.1), (4.4.2)

Loading

(1.2), (S1.2.3), (S1.2.5), (S4.17.6), (S5.6.1), (S5.6.4)

Local Post Weld Heat Treatment (PWHT)

(2.5.2), (2.5.3.6), (S6.10.2)

Local Thinning

(S5.6.1), (S5.6.4)

Location

(1.4.1), (1.4.2), (1.6.2), (1.6.4), (1.6.6.2), (1.6.7.2), (2.5.3), (2.5.3.6), (3.3.4.9), (3.4.1), (5.8.2), (5.9), (5.11), (S4.17.5), (S5.6.1), (S5.6.2), (S9.2), (S9.6), (S9.7)

Locomotive Boilers**Arch Tube**

(S1.1.3.1), (S1.2.9), (S1.2.9.2), (S1.2.9.3), (S1.2.9.5), (S1.2.9.7)

Ferrules

(S1.2.9.7)

Flue

(S1.1.3.1), (S1.2.9), (S1.2.9.1), (S1.2.9.6), (S1.2.9.7), (S1.2.9.8), (S1.2.11.6), (S1.2.13.1)

Inspection

(S1.2.11.4), (S1.2.12.2)

Installation

(S1.2.1), (S1.2.2), (S1.2.3), (S1.2.5), (S1.2.6), (S1.2.6.1), (S1.2.6.2), (S1.2.6.3), (S1.2.9.2), (S1.2.9.4), (S1.2.9.6), (S1.2.9.7), (S1.2.10), (S1.2.11.1), (S1.2.11.2), (S1.2.11.4), (S1.2.11.6), (S1.2.12.1), (S1.2.12.2)

Minimum Wall Thickness

(S1.2.9), (S1.2.9.2), (S1.2.9.3), (S2.13.7)

Riveted Patches

(S1.2.10)

Riveted Seam

(S1.2.10), (S1.2.11.1), (S1.2.11.2), (S1.2.12.1)

M**Magnetic Particle Examination**

(2.5.3), (3.3.4.1), (3.3.4.2), (3.3.4.3), (S1.2.10), (S2.13), (S5.6.2)

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(Introduction), (5.4), (S1.1.1), (S5.5), (S6.20)

Owner-User Inspection Organization(Introduction), (1.3), (~~3.3.5.2~~[S11.2.3](#)), (3.4.4.1)**P****Partial Penetration Weld**

(2.5.2), (S1.2.9.2)

Patch Bolts

(S1.2.6.1), (S1.2.8), (S2.13.6)

Patches

(3.3.3), (3.3.4.1), (3.3.4.2), (3.3.4.3), (3.3.4.6), (S1.2.1), (S1.2.6.1), (S1.2.8), (S1.2.10), (S1.2.11.1), (S1.2.11.2), (S1.2.11.3), (S1.2.11.4), (S1.2.11.5), (S1.2.11.6), (S2.13), (S2.13.1), (S2.13.6), (S2.13.9.1), (S2.13.9.2), (S2.13.9.3), (S2.13.9.4), (S2.13.10.3), (S2.13.10.4), (S2.13.11.1), (S2.13.11.2), (S2.13.11.3), (S2.13.12.2), (S2.13.12.3), (S2.13.14.1), (S2.13.14.2), (S2.13.14.3), (S4.18.2.1), (S4.18.2.2), (S4.18.2.4)

Performance Qualification

(2.2.3), (2.2.4), (2.2.6), (2.4), (2.5.3), (S4.10.2), (S4.10.5), (S6.9.3), (S6.9.4), (S6.9.6)

Personnel Safety

(Foreword), (Introduction), (S2.3), (7.2)

Piecing

(3.3.4.5)

Pipe/Piping

(1.2), (1.6.7.2), (2.3), (2.5.2), (2.5.3), (3.2.2), (3.2.6), (3.3.2), (3.3.4.5), (S1.1.3.1), (S1.2.13.1), (S2.7.1), (S2.13.14.1), (S6.6), (S9), (7.4)

Pit

(3.3.4.2), (S1.2.11.4), (S2.13.10.4), (S4.12)

Plug

(S1.1.3.1), (S1.2.12.2), (S2.7.1), (S2.13.14.3), (S3.3), (S3.3.4.9), (S3.5.2.3), (S3.5.2.4), (S3.5.3), (S3.5.3.1), (S3.5.3.2), (S3.5.4), (S5.5), (S5.6.3), (S5.6.4)

Plug Stitching

(S3.5.2.3), (S3.5.3), (S3.5.3.1), (S3.5.3.2)

Pneumatic Testing

(4.4.1), (4.4.2), (S4.15), (S4.17.6), (S6.8.1), (S6.18.1), (S9.6), (S9.7), (9.1)

Portable Tank (DOT)

(S6.20)

Postweld Heat Treatment

(1.5.1), (2.5.2), (2.5.3), (2.5.3.1), (2.5.3.6), (3.2.1), (3.3.2), (3.3.4.3), (S1.2.10), (S1.2.11.2), (S2.10), (S2.13), (S2.13.9.2), (2.13.9.3), (S6.10.2), (S6.10.3), (S8.2)

Precision Bores

(S4.18.2), (S4.18.2.2)

Preheating

(2.5.1), (2.5.3), (2.5.3.1), (2.5.3.2), (2.5.3.3), (2.5.3.4), (2.5.3.6), (3.2.1), (S1.2.10), (S2.10), (S2.13), (S2.13.9.2), (S6.10.1)

Preparation of Forms

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Pressure Control

(S8.3)

Pressure Gages

(4.3), (S4.13.1), (S6.13)

Pressure Relief Devices

(Organization), (Foreword), (1.1), (1.6.2), (1.6.9), (4.4.1), (4.4.2), (S4.15), (S4.17.6), (S6.18.1), (S9.7)

Pressure-Retaining(Foreword), (Introduction), (1.1), (1.2), (1.3), (1.3.1), (1.4), (1.4.1), (1.5.1), (2.1), (2.2), (2.5.2), (2.5.3), (2.5.3.2), (2.5.3.4), (2.5.3.5), (3.1), (3.2.1), (3.2.6), (3.2.7), (3.3.1), (3.3.2), (3.3.3), (3.3.4.3), (~~3.3.4.8~~[S11.2.2](#)), (3.4.1), (3.4.2), (3.4.4), (4.1), (4.2), (4.4), (4.4.1), (4.4.2), (5.1), (5.2.1), (5.2.2), (5.4), (5.5.2), (5.7.1), (5.7.2), (5.7.3), (5.7.5), (5.8.1), (5.9), (S1.1.3), (S1.1.3.1), (S2.7), (S2.7.1), (S2.13), (S3.2), (S3.3), (S4.1), (S4.7), (S4.10), (S4.12), (S4.15), (S4.16.1), (S4.16.3), (S4.16.4), (S4.17.1), (S4.17.3), (S4.17.5), (S4.18.2.6), (S5.3), (S5.3.1), (S5.4), (S5.5), (S5.6.1), (S5.6.2), (S5.7.1), (S5.7.2), (S6.15), (S6.17.1), (S6.17.3), (S6.17.5), (S6.18), (S6.18.1), (S7.4), (S9.2), (S11.2.1), (S11.2.2)**Pressure Testing****Alterations**

(1.3.2), (3.4.1), (3.4.2), (4.4.2), (S3.4), (S4.17.6), (S5.7.3), (S6.8.1)

FRP Vessels

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Parts

(4.5.4)

Repairs

(1.3.2), (3.2.2), (4.4.1), (S2.8), (S3.2),
(S3.5.4), (S4.13), (S4.15), (S4.18.2.4),
(S4.18.2.5), (S6.8.1), (S6.18.1)

Pressure Vessels

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Welders Identification

(2.2.5), (S6.9.5), (S7.12.5)

Welding(1.4.1), (1.5.1), (1.6.6.2), (1.6.7.2), (1.6.8.2), (2.1),
(2.2), (2.2.1), (2.2.1.1), (2.2.2), (2.2.3), (2.2.4),
(2.2.5), (2.2.6), (2.2.6.1), (2.3), (2.4), (2.5.1), (2.5.3),
(2.5.3.1), (2.5.3.2), (2.5.3.3), (2.5.3.4), (2.5.3.5),
(2.5.3.6), (3.2.1), (3.2.2), (3.3.2), (3.3.3), (3.3.4.2),
(3.3.4.3), (3.3.4.4), (3.3.4.6), (3.3.4.9),
(~~3.4.3~~[S11.3.1](#)), (5.7.5), (S1.1.2), (S1.1.3), (S1.2.1),
(S1.2.3), (S1.2.4), (S1.2.6), (S1.2.6.1), (S1.2.6.2),
(S1.2.6.3), (S1.2.8), (S1.2.9.1), (S1.2.9.2),
(S1.2.9.6), (S1.2.9.7), (S1.2.10), (S1.2.11.1),
(S1.2.11.2), (S1.2.11.3), (S1.2.11.4), (S1.2.11.5),
(S1.2.11.6), (S1.2.12.1), (S1.2.12.2), (S2.7), (S8.1),
(S8.2), (S8.3), (S8.4), (S8.5), (S9.4), (S9.5), (S9.6)**Welding Methods**(2.5.3.1), (2.5.3.2), (2.5.3.3), (2.5.3.4), (2.5.3.5),
(2.5.3.6)**Welding Operator**(1.5.1), (2.2.3), (2.2.5), (2.2.6), (S6.8.1), (S6.9.3),
(S6.9.5), (S6.9.6)**Welding Procedures**

(2.2.1), (2.2.2), (S8.4)

Welding Records

(2.2.4), (S6.9.4)

Weld Repair(3.3.3), (3.3.4.3), (~~3.3.4.8~~[S11.2.2](#)), (4.2),
(S1.2.9.4), (S8.1), (S8.2), (S8.3), (S8.4), (S8.5)**Wrapper Sheet**

(S1.2.3), (S1.2.11.5)

X**Y****Yankee Dryers**(5.9), (S5.1), (S5.2), (S5.3), (S5.4), (S5.5), (S5.6),
(S5.7)**Z**

2025	NATIONAL BOARD INSPECTION CODE
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NBIC Action Item A25-75

Submitted by Paul Shanks

12/10/2025



**THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS**

Subject:	Yankee Dryer alteration plan approval
NBIC Location:	NBIC Part 3, S5.7.2 b)
Statement of Need:	Yankee dryer alteration plans have a different approval path than an alteration on other PRI's, there is no obvious technical need for the path to be different and this different path has the potential to cause confusion and errors.
Background Information:	The repair Inspector generally does not accept repair or alteration plan, they would authorize the activity 1.3.2 a).a Accepting the repair / alteration plan is normally reserved for Div.2 or Div.3 vessels 3.3.5.2 b) / 3.4.5.1 d) but in those cases the acceptance is by the AIA not the repair Inspector.

Proposed Text:

S5.7.2 ALTERATION TYPES

b) Alteration plans to yankee dryers shall be accepted by the ~~Inspector~~Authorized Inspection Agency/Owner-User Inspection Organization whose inspector will make the acceptance inspection and sign the Form R-2, and when required, by the Jurisdiction, prior to the start of work.



PROPOSED REVISION OR ADDITION

Item No.
A25-83
Subject/Title
Edits to NBIC Part 3, 2.5.3.4 Welding Method 4
NBIC Location
Part 3, 2.5.3.4 Welding Method 4
Project Manager and Task Group
John Siefert
Source (Name/email)
jsiefert@epri.com
Statement of Need
Minor changes, as supported by EPRI research, are requested for Welding Method 4 to allow for full penetration repairs in all configurations provided the weld or feature is operating in steam service.
Background Information
Regarding 2.5.3.4 a), a recent EPRI testing program of full penetration welds in ex-service Grade 22 material did not show a marked deviation in creep performance whether these welds are subjected to PWHT or evaluated in the as-welded (repaired) condition. Background pptx file provides data comparisons.
Regarding 2.5.3.4 h) 2), a recent EPRI testing program shows that AWS type -B3L consumables have sufficient strength for repairs to Grade 22 steel, particularly for repairs to service-exposed materials. Currently, ASME BPVC Section I prohibits the use of such filler metals in PW-5.6 (see excerpt from Section I after this table). It is the project manager's understanding that this rule was put in place in the immediate aftermath of long-seam weld failures and widespread cracking/leaks starting with Mohave in 1985 and through the late

1980s and early 1990s where it was initially suspected that the filler metal carbon content was a contributing factor to the failures. While this was later determined not to be the case, this language has never been removed. Background pptx file shows that L-grade consumables have sufficient strength for the intended application (partial or full penetration welds in steam service).

2.5.3.4 g) and h) Proposed edits are for clarity.

Rev 01 – proposed at the January 2026 meetings.

Paragraph	Current Text	Proposed Text
2.5.3.4 a)	a) This method is limited to repair welds in pressure-retaining items for which the applicable rules of the original code of construction did not require notch toughness testing. The repair depth for temper bead repairs to pressure-retaining items shall not penetrate the full thickness except as permitted below. 1) ASME Section VIII, Division 2 pressure vessels, where application of PWHT on inservice vessels has been demonstrated to be detrimental to the vessel's material; or 2) Tube-to-header welds in steam service.	a) This method is limited to repair welds in pressure-retaining items for which the applicable rules of the original code of construction did not require notch toughness testing. The repair depth for temper bead repairs to pressure-retaining items shall not penetrate the full thickness except as permitted below. 1) ASME Section VIII, Division 2 pressure vessels, where application of PWHT on inservice vessels has been demonstrated to be detrimental to the vessel's material; or 2) ~~Tube-to-header welds~~ <u>Pressure retaining items</u> in steam service.
2.5.3.4 g) and h)	g) The qualification thickness for the test plates and repair groove depths shall be in accordance with ASME Section IX. For pressure-retaining items repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME Section IX temper bead procedure qualification provided the pressure-retaining item operates in steam service above 900°F (482°C);	g) The qualification thickness for the test plates and repair groove depths shall be in accordance with ASME Section IX. ~~For pressure-retaining items repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME Section IX temper bead procedure qualification provided the pressure-retaining item operates in steam service above 900°F (482°C);~~

	h) The welding procedures (WPS) shall be qualified in accordance with the temper bead procedure qualification requirements in QW-290 of ASME Section IX, and shall include the following additional requirements:	h) The welding procedures (WPS) shall be qualified in accordance with the temper bead procedure qualification requirements in QW-290 of ASME Section IX, and shall include the following additional requirements. <u>For pressure-retaining items repaired using this temper bead method, the hardness testing and carbon equivalency requirements in QW-290 may be waived provided the pressure-retaining item operates in steam service above 900°F (482°C);</u> +
2.5.3.4 h) 2)	2) For the welding processes in NBIC Part 3, 2.5.3.4 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only electrodes or filler metals that are classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes;	2) For the welding processes in NBIC Part 3, 2.5.3.4 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only <u>electrodes or filler metals</u> <u>those</u> that are classified by the <u>filler metal weld consumable</u> specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes. <u>B2L or B3L grade consumables with a carbon content ≤0.05 wt. % are permitted;</u>

Commented [JS1]: Item 25-29

Commented [JS2]: Item 25-29

Commented [JS3]: May need to modify to be consistent with Item 25-29

ASME BPVC.I-2025

permitted in [Parts PG, PWT, and PFT](#) and for which allowable stress values are given in Section II, Part D, Subpart 1, Tables 1A and 1B, for Section I construction and for which weld Group P-Numbers are assigned in Section IX.

PW-5.2 Carbon or alloy steel having a carbon content of more than 0.35% shall not be used in welded construction or be shaped by oxygen cutting or other thermal cutting processes.

PW-5.3 Austenitic stainless steel materials joined by electroslag welding shall be limited to SA-240 Grades 304 and 316, SA-182 Grades F304 and F316, and SA-351 Grade CF 8.

PW-5.4 Welding electrodes and filler metal shall be selected to provide deposited weld metal of chemical composition and mechanical properties compatible with the materials to be joined and the service conditions anticipated.

When Grade 91 filler metal (e.g., AWS B91, ISO CrMo91, etc.) is used to make pressure-retaining welds in P-No. 15E Gr. 1 materials, the nickel plus manganese (Ni + Mn) content of the filler metal shall not exceed 1.2%.

PW-5.5 Rimmed and semi-killed steels shall not be joined by the inertia and continuous drive friction welding processes.

PW-5.6 For pressure-retaining welds in $2\frac{1}{4}\text{Cr}-1\text{Mo}$ materials, other than circumferential butt welds less than or equal to $3\frac{1}{2}$ in. (89 mm) in outside diameter, when design metal temperatures exceed 850°F (455°C), the weld metal shall have a carbon content greater than 0.05%.

PW-9.2 Welding Grooves. The dimensions and shape of the edges to be joined by butt welds shall be such as to permit complete fusion and complete joint penetration.

PW-9.3 Transitions at Butt Joints Between Materials of Unequal Thickness. This paragraph is not intended to apply to joint designs specifically provided for elsewhere in this Code.

The requirements of [PW-9.3.1](#) through [PW-9.3.3](#), as applicable to the specific type of pressure part, shall be met.

PW-9.3.1 Shells, Drums, and Vessels (Including Those Fabricated From Materials Complying With Piping or Tubing Material Specifications). When materials of unequal thickness are joined via a butt joint, a tapered transition shall be provided if the difference in thickness is greater than one-fourth the thickness of the thinner material or $\frac{1}{8}$ in. (3 mm), whichever is less. Any process that will provide a uniform taper may be used to form the transition section. The weld may be partly or entirely in the tapered section or adjacent to it as indicated in [Figure PW-9.3.1](#). The tapered transition shall have a length not less than 3 times the offset between the adjoining surfaces, as shown in [Figure PW-9.3.1](#). Provisions for tapers at circumferential butt-welded joints connecting formed heads to main shells are contained in [PW-9.3.3](#).

For longitudinal joints, the middle lines of the adjoining materials shall be in alignment with the fabricating tolerances specified in [PW-33](#). Alternatively, the middle lines of the adjoining materials may be offset so that the inside or outside diameters form a continuous surface, provided the following conditions are met:

- (a) The ratio of plate thicknesses shall not exceed 2:1.

NBIC Part 3, 2025 Edition

2.5.3.4 Welding Method 4

When using this method, the following is required:

a) This method is limited to repair welds in pressure-retaining items for which the applicable rules of the original code of construction did not require notch toughness testing. The repair depth for temper bead repairs to pressure-retaining items shall not penetrate the full thickness except as permitted below.

1) ASME Section VIII, Division 2 pressure vessels, where application of PWHT on inservice vessels has been demonstrated to be detrimental to the vessel's material; or

2) Tube-to-header welds in steam service.

b) Full thickness weld repairs, as permitted in 2.5.3.4 a) 1) and 2), above, shall be completed in accordance with NBIC Part 3, 3.3.5, and the following additional requirements:

1) The full thickness repair shall be verified as being full penetration.

2) Volumetric examination of the full thickness weld shall be performed.

c) The materials shall be limited to P-No. 4, Groups 1 and 2, and P-No. 5A steels as permitted for welded construction by the applicable rules of the original code of construction;

d) The welding shall be limited to the SMAW, FCAW, GMAW or GTAW processes using low hydrogen electrodes and filler metals classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower, and suitably controlled by maintenance procedures to avoid contamination by hydrogen producing sources. The surface of the metal prepared for welding shall be free of contaminants;

e) The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base material specification of the repair. In the event that the original material specification is obsolete, the test material used should conform to the nominal composition and carbon equivalent (IIW Formula $CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$; elements are expressed in Weight Percent Amounts), as the material being repaired, but in no case shall the material be lower in strength;

f) If for reasons of corrosion resistance, special hardness limits are necessary, such limits shall be included when qualifying the WPS;

g) The qualification thickness for the test plates and repair groove depths shall be in accordance with ASME Section IX. For pressure-retaining items repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME Section IX temper bead procedure qualification provided the pressure-retaining item operates in steam service above 900°F (482°C);

h) The welding procedures (WPS) shall be qualified in accordance with the temper bead procedure qualification requirements in QW-290 of ASME Section IX, and shall include the following additional requirements:

1) The minimum preheat temperature for welding shall be 300°F (150°C) for P-No. 4 material and 400°F (200 °C) for P-No. 5A material. The preheat temperature shall be checked to ensure that 4 in. (102 mm) of the material or four times the material thickness (whichever is greater) on each side of the groove (or full thickness of joint for a groove weld) is maintained at the minimum temperature during welding. The interpass temperature shall not exceed 800°F (430°C). When the weld does not penetrate through the full thickness of the material, the minimum preheat and maximum interpass temperature need only be maintained for 4 in. (102 mm) or four times the depth of the repair weld (whichever is greater) on each side of the joint;

2) For the welding processes in NBIC Part 3, 2.5.3.4 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only electrodes or filler metals that are classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes;

3) After the weld has been deposited flush with the base metal, a surface temper reinforcing weld layer shall be applied;

4) For welds made by the SMAW and FCAW processes, after completion of welding and without allowing the weldment to cool below the minimum preheat temperature, the temperature of the weldment shall be raised to 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the filler metal manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018 H4); and

5) After the finished repair weld has cooled to ambient temperature, the surface temper reinforcing weld layer shall be removed substantially flush with the surface of the base metal (and for a fillet weld to the required size and suitable contour of the toes).



PROPOSED REVISION OR ADDITION

Item No.	A25-85
Subject/Title	Inclusion of Grade 92 and P-No. 5B into 2.5.3.6 and Supplement 8
NBIC Location	2.5.3.6 and Supplement 8
Project Manager and Task Group	John Siefert
Source (Name/email)	John Siefert, jsiefert@epri.com
Statement of Need	Current verbiage restricts the use of Welding Method 6 and Supplement 8 to only P15E, Group 1, Grade 91 steel. Data has recently been supported to extend these alternative weld repair approaches to Grade 92 steel. One of the proposed filler metals for repair, AWS type -B8, is matching to 9Cr-1Mo steel. ASME BPVC Section IX classifies 9Cr-1Mo steel as P-No. 5B material. Extensive data has been developed on this weld metal in the as-welded condition and its use to make repairs without PWHT to 9Cr-1Mo steel. This class of steel, given that it does not contain deliberate additions of V, Nb or N, is less hardenable and weaker in strength compared to the CSEF steel grades 91 and 92.
Background Information	Summary pptx file available in the sharepoint folder with supporting data. Screen shot of ASME BPVC Section IX, 2025 P-number listings provided on page 3 of the proposal file for reference.

Rev 01 – proposed at January 2026 meetings. Simple changes in multiple places to remove explicit reference to ‘Grade 91’

Paragraph	Current Text	Proposed Text
2.5.3.6	This welding method provides requirements for welding only Grade 91 tube material within the steam boiler setting. When using this welding method, the following applies:	This welding method provides requirements for welding ~~only Grade 91~~ creep strength enhanced ferritic steel (CSEF) tube material P-No. 15E, Group 1 or P-No. 5B, Group 1 within the steam boiler setting. When using this welding method, the following applies:
2.5.3.6 c) 1)	The material shall be limited to P-No 15E, Group 1, Grade 91, creep strength enhanced ferritic steel (CSEF).	The material shall be limited to P-No 15E, Group 1 ~~or P-No. 5B, Group 1;~~ ~~Grade 91, creep strength enhanced ferritic steel (CSEF).~~
2.5.3.6 c) 3)	The welding procedure qualification test coupon shall be P-No 15 E, Group 1, Grade 91.	The welding procedure qualification test coupon shall be P-No. 15 E, Group 1 ~~or P-No. 5B, Group 1, Grade 91.~~
S8.1 a)	The technical information provided in this supplement pertains to weld repair and post repair inspection of creep strength enhanced ferritic steel (CSEF) pressure retaining items. The present guidance covers P-No. 15E, Group 1, Grade 91 and dissimilar welds made to this material (e.g. P-No. 4, P-No. 5A or P-No. 8, P-No. 42, P-No. 43 or P-No. 45). This Supplement provides guidance for full penetration and partial penetration weld repairs not covered under Welding Method 6 (NBIC Part 3, 2.5.3.6) or Welding Method 7 (NBIC Part 3, 2.5.3.7).	The technical information provided in this supplement pertains to weld repair and post repair inspection of creep strength enhanced ferritic steel (CSEF) pressure retaining items. The present guidance covers P-No. 15E, Group 1 ~~or P-No. 5B, Group 1, Grade 91~~ and dissimilar welds made to ~~either this~~ material (e.g. P-No. 4, P-No. 5A or P-No. 8, P-No. 42, P-No. 43 or P-No. 45). This Supplement provides guidance for full penetration and partial penetration weld repairs not covered under Welding Method 6 (NBIC Part 3, 2.5.3.6) or Welding Method 7 (NBIC Part 3, 2.5.3.7).
S8.4 a)	The welding procedure qualification test coupon shall be ASME P-No. 15 E, Group 1, Grade 91 joined	The welding procedure qualification test coupon shall be ASME P-No. 15 E, Group 1 ~~or P-No. 5B, Group 1;~~

	to itself, P-No. 4, P-No. 5A, P-No. 8, P-No. 42, P-No. 43, or P-No. 45.	~~Grade 91~~ joined to itself, P-No. 4, P-No. 5A, P-No. 8, P-No. 42, P-No. 43, or P-No. 45.
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Table QW/QB-422
Base Metal P-Numbers (Cont'd)

Spec No.	Designation, Alloy, Type, or Grade	UNS No.	Minimum Specified Tensile, ksi (MPa)	Welding			Brazing P-No.	Nominal Composition	Typical Product Form	Nominal Thickness Limits, in. (mm)
				P- No.	Group No.	ISO 15608 Group				
A or SA-334	9	K22035	63 (435)	9A	1	9.1	100	2Ni-1Cu	Welded tube	...
A or SA-334	3	K31918	65 (450)	9B	1	9.2	100	3.5Ni	Welded tube	...
A or SA-334	8	K81340	100 (690)	11A	1	9.3	100	9Ni	Welded tube	...
A or SA-335	P1	K11522	55 (380)	3	1	1.1	100	C-0.5Mo	Smls. pipe	...
A or SA-335	P2	K11547	55 (380)	3	1	4.2	100	0.5Cr-0.5Mo	Smls. pipe	...
A or SA-335	P12	K11562	60 (415)	4	1	5.1	110	1Cr-0.5Mo	Smls. pipe	...
A or SA-335	P15	K11578	60 (415)	3	1	...	100	1.5Si-0.5Mo	Smls. pipe	...
A or SA-335	P11	K11597	60 (415)	4	1	5.1	110	1.25Cr-0.5Mo-Si	Smls. pipe	...
A or SA-335	P22	K21590	60 (415)	5A	1	5.2	110	2.25Cr-1Mo	Smls. pipe	...
A or SA-335	P21	K31545	60 (415)	5A	1	5.2	110	3Cr-1Mo	Smls. pipe	...
A or SA-335	P5c	K41245	60 (415)	5B	1	5.3	120	5Cr-0.5Mo-Ti	Smls. pipe	...
A or SA-335	P5	K41545	60 (415)	5B	1	5.3	110	5Cr-0.5Mo	Smls. pipe	...
A or SA-335	P5b	K51545	60 (415)	5B	1	5.3	110	5Cr-0.5Mo-Si	Smls. pipe	...
A or SA-335	P91	K90901	85 (585)	15E	1	6.4	110	9Cr-1Mo-V	Smls. pipe	...
A or SA-335	P9	K90941	60 (415)	5B	1	5.4	110	9Cr-1Mo	Smls. pipe	...
A or SA-335	P92	K92460	90 (620)	15E	1	6.4	110	9Cr-2W	Smls. pipe	...
A or SA-336	F12	K11564	70 (485)	4	1	5.1	110	1Cr-0.5Mo	Forgings	...
A or SA-336	F11, Cl. 2	K11572	70 (485)	4	1	5.1	110	1.25Cr-0.5Mo-Si	Forgings	...
A or SA-336	F11, Cl. 3	K11572	75 (515)	4	1	5.1	110	1.25Cr-0.5Mo-Si	Forgings	...
A or SA-336	F11, Cl. 1	K11597	60 (415)	4	1	5.1	110	1.25Cr-0.5Mo-Si	Forgings	...
A or SA-336	F1	K12520	70 (485)	3	2	1.1	100	C-0.5Mo	Forgings	...
A or SA-336	F22, Cl. 1	K21590	60 (415)	5A	1	5.2	110	2.25Cr-1Mo	Forgings	...
A or SA-336	F22, Cl. 3	K21590	75 (515)	5A	1	5.2	110	2.25Cr-1Mo	Forgings	...
A or SA-336	F3VCb	K31390	85 (585)	5C	1	6.2	110	3Cr-1Mo-0.25V- 0.05Nb	Forgings	...

ASME BPVC IX-2025

Do we need to do anything with this?

INTERPRETATION 19-04

Subject: Welding Method 6 on Grade 92 steel (Part 3, 2.5.3.6)

Edition: 2019

Question: May Welding Method 6 also be used on CSEF steel which has been manufactured to the requirements in Code Case 2179, and otherwise classified as P No 15E Group 1?

Reply: No.

Vessel and feature cross-weld creep tests in Grade 92 to support inclusion into Welding Method 6 and Supplement 8



John A. Siefert, Ph.D.

January 12, 2026

Rev 0

INTERPRETATION 19-04

- **Subject:** Welding Method 6 on Grade 92 steel (Part 3, 2.5.3.6)
- **Edition:** 2019
- **Question:** May Welding Method 6 also be used on CSEF steel which has been manufactured to the requirements in Code Case 2179, and otherwise classified as P No 15E Group 1?
- **Reply:** No.

Outcome – need to generate relevant data to support eventual inclusion of Grade 92 into Welding Method 6 and Supplement 8

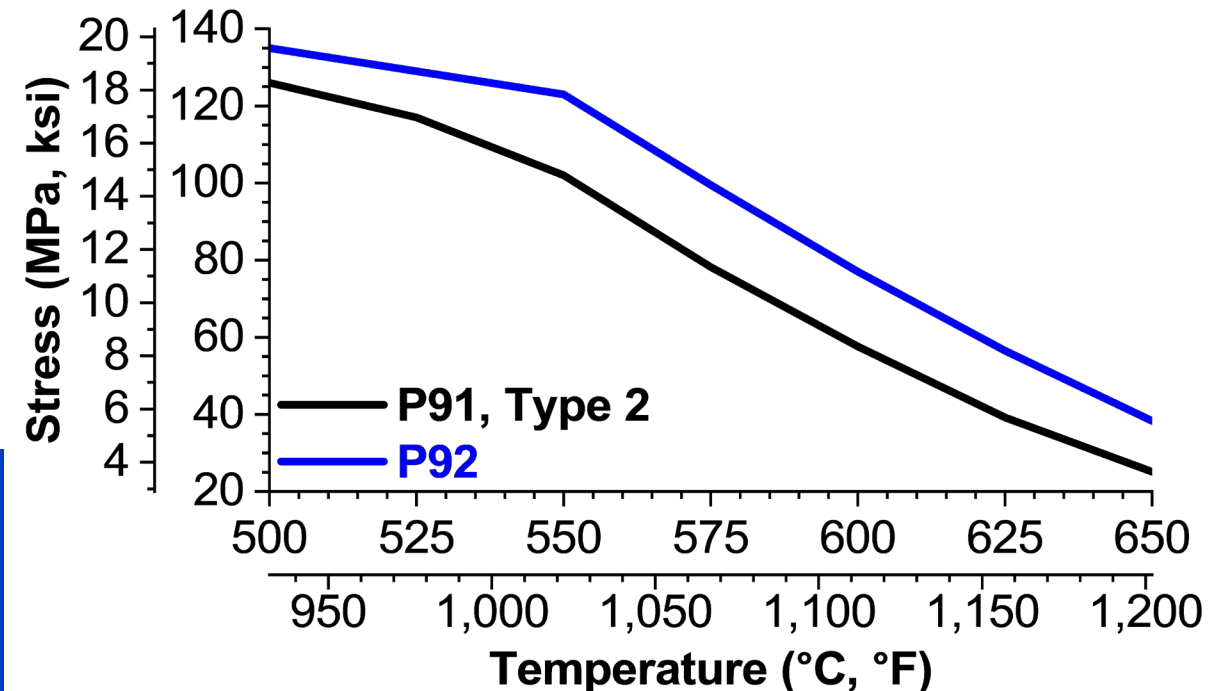
Reality – increasing use of Grade 92 over Grade 91 in modern HRSGs and piping systems due to higher stress allowable values in ASME BPVC Sec. IID

Materials – main alloying elements

Material		C	Mn	Si	Cr	Mo	V	N	Ni	Nb	W	B
SA-335 P91	Min	0.08	0.30	0.20	8.00	0.85	0.18	0.030		0.06		
	Max	0.12	0.60	0.50	9.50	1.05	0.25	0.070	0.40	0.10		
SA-335 P92	Min	0.07	0.30		8.50	0.30	0.15	0.03		0.04	1.50	0.001
	Max	0.13	0.60	0.50	9.50	0.60	0.25	0.07	0.40	0.09	2.00	0.006

- W is a more potent strengthening element compared to Mo
- B added for strength... introduces other concerns (BN)
- Grade 92 is stronger than Grade 91

ASME BPVC Section IX classifies both Grade 91 and 92 steels as P-No. 15E, Group 1



Data supporting repairs to Welding Method 6

The background of the slide is a solid blue color. In the center, there is a faint, semi-transparent image of a globe being held by two hands, one from the left and one from the right. The globe shows some grid lines and a bright spot on its surface. The hands are also semi-transparent and appear to be supporting the globe from below. The overall image has a soft, ethereal quality.

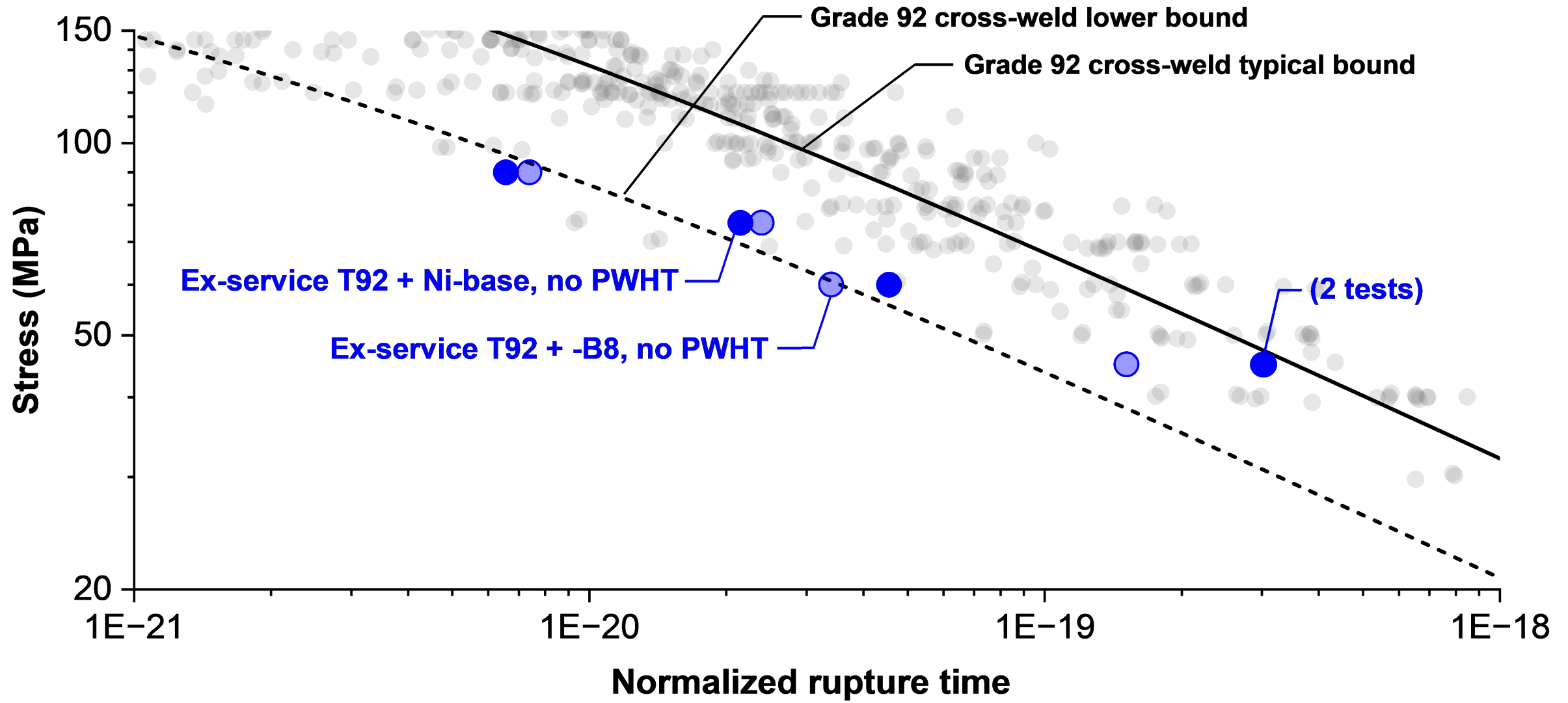
Background to vessel test program

- 45,000 hours of vessel testing (9 total tests, all completed) in ex-service T92 obtained from a supercritical plant in USA after superheater was retired from service after ~40,000 hours due to excessive oxidation and failures
 - Simulated repairs: AWS type –B8 + no PWHT or Ni-base + no PWHT
- 20,000 hours of vessel testing (6 total tests, 2 on-going) in ‘new’ T92 obtained from reputable manufacturer
 - AWS type –B8 + no PWHT (repair) or AWS type –B91 + PWHT (new construction)



**One-of-a-kind
study assessing
simulated repairs
in T92 to inform
additions to WM6
and S8**

Vessel tests in **ex-service T92** material



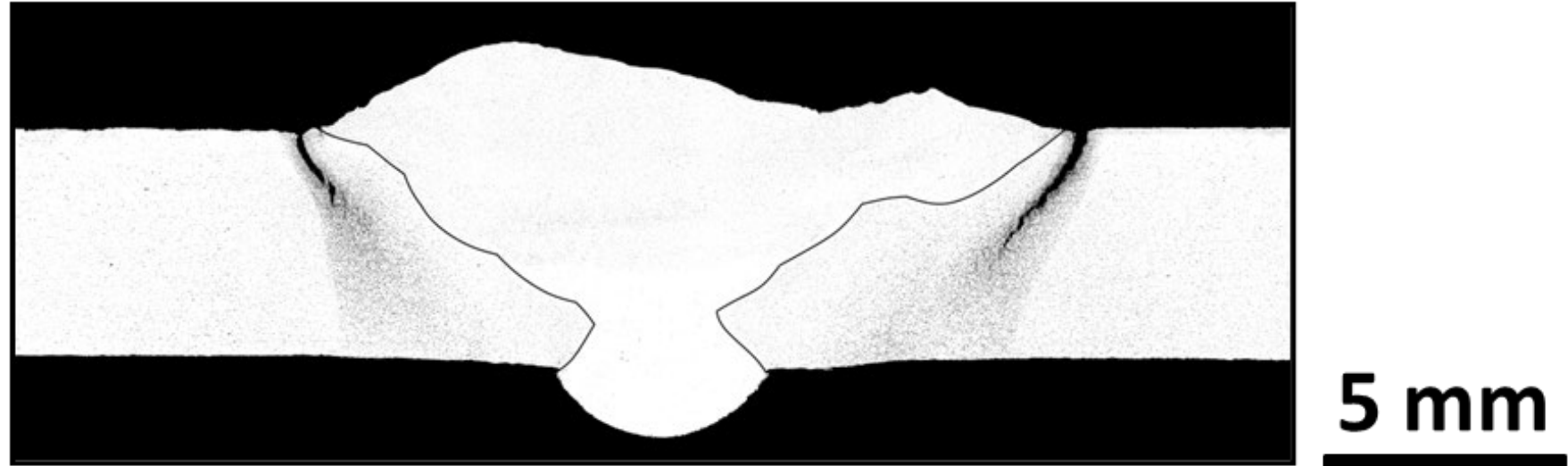
Repairs meet lower bound for 'new' cross-weld tests in Grade 92

Vessel tests in **ex-service** T92 material – failure mode

Ex-service T92

Ni-base (ERNiCr-3 +
ENiCrFe-3) + no PWHT

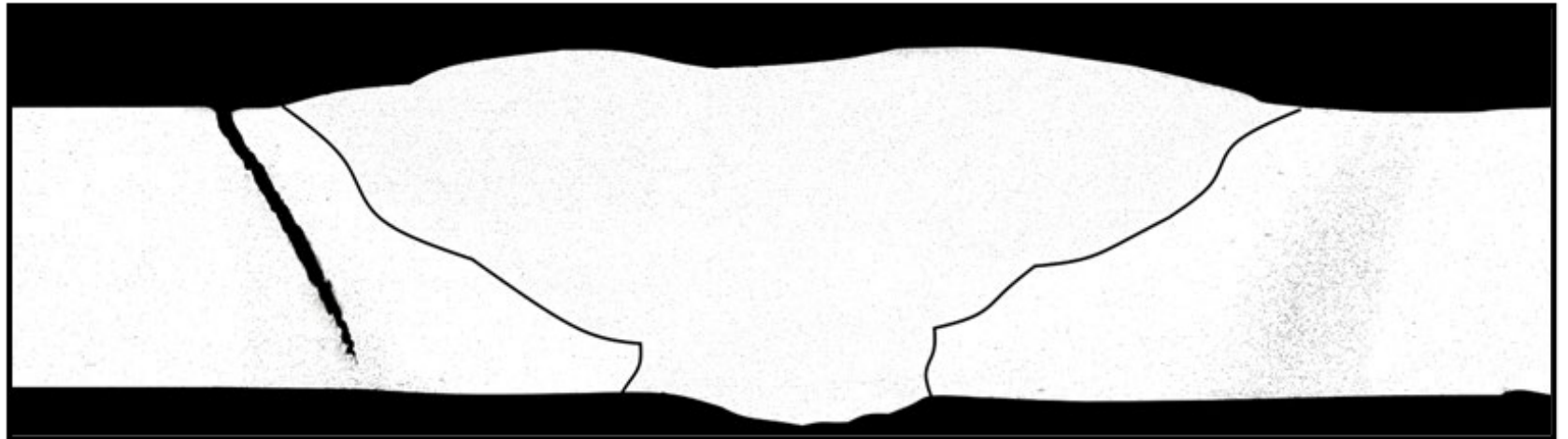
HAZ failure



Ex-service T92

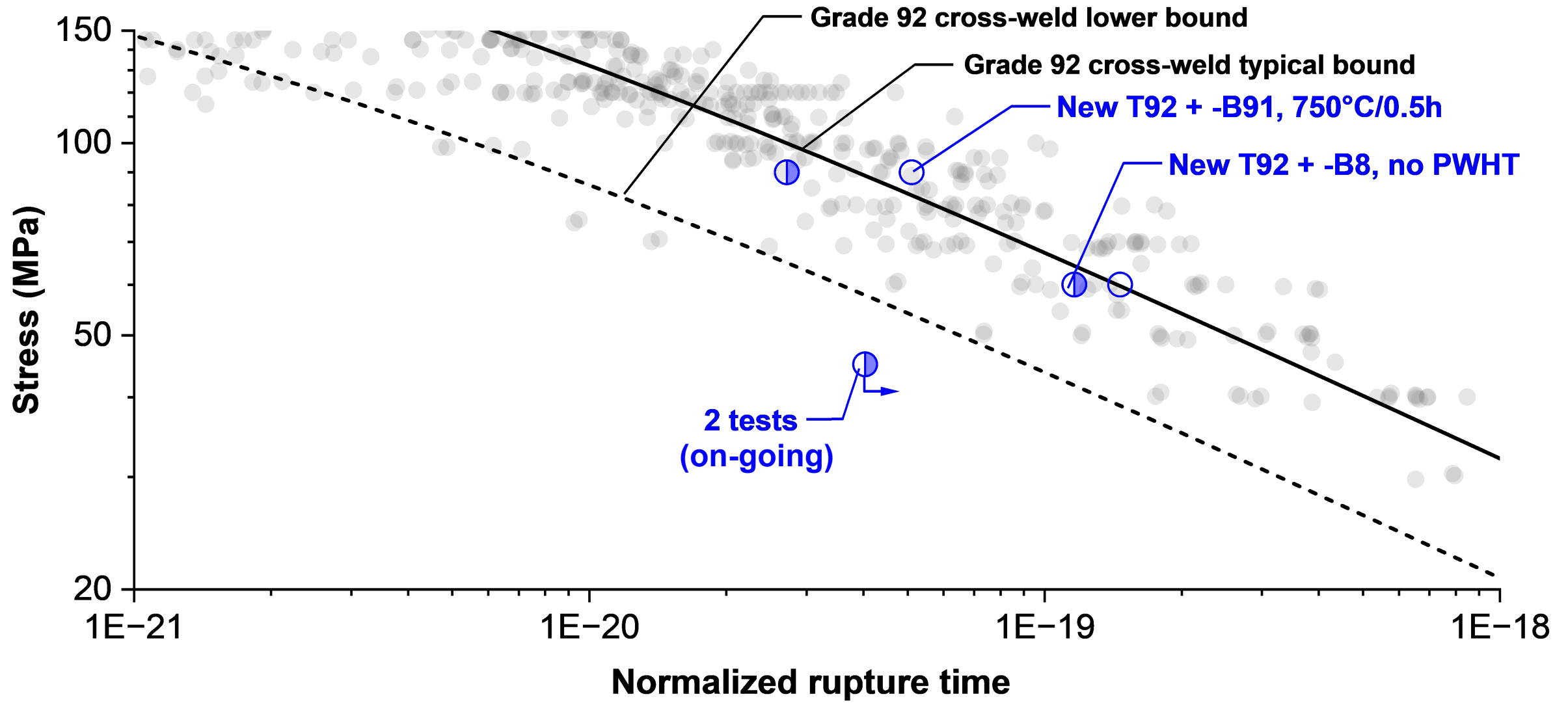
AWS type –B8 +
no PWHT

HAZ failure



Failure typically in the T92 HAZ. Some weld metal damage may be observed in AWS type –B8 weld metal (comparable to Grade 91 investigations)

Vessel tests in **new** T92 material



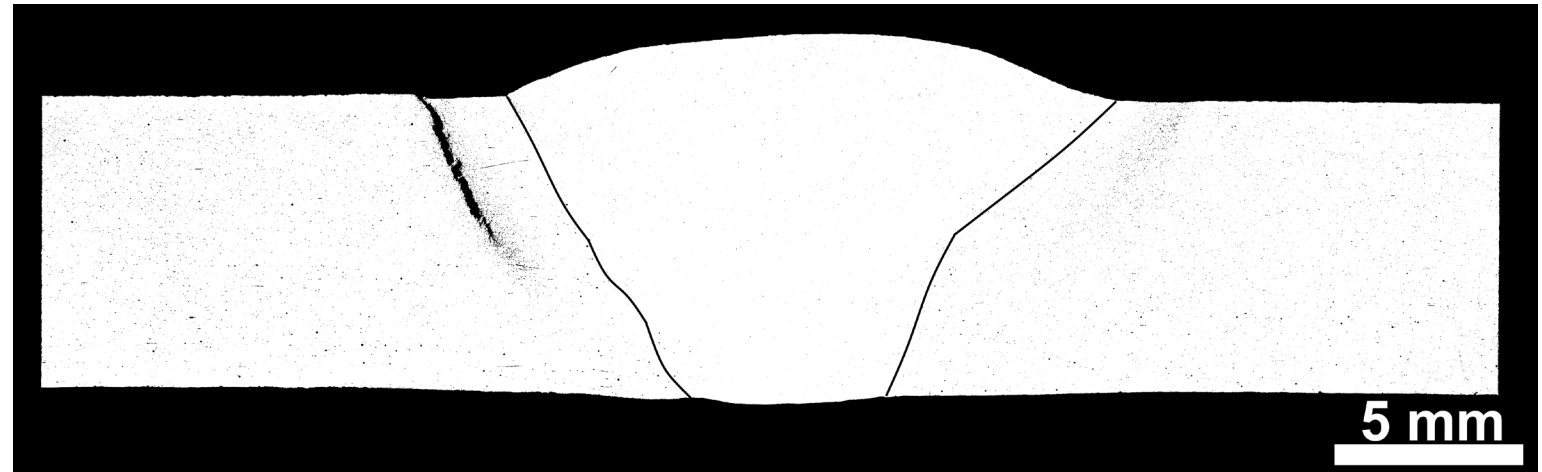
Repairs meet typical bound for 'new' cross-weld tests in Grade 92

Vessel tests in **new** T92 material – failure mode

Ex-service T92

AWS type –B8 + no PWHT

HAZ failure



Ex-service T92

AWS type –B91 + PWHT

HAZ failure



Failure typically in the T92 HAZ. Some weld metal damage may be observed in AWS type –B8 weld metal (comparable to Grade 91 investigations)

Summary

- AWS type –B91 + PWHT does not result in a marked decrease in performance and is equally acceptable for new construction welds or post-construction repairs
 - This is an important finding given the lack of availability in post-construction supply chain for matching filler metal to Grade 92 base metal
- In new material there is not a marked increase in performance for the AWS type –B91 + PWHT compared to AWS type –B8 + no PWHT repairs
 - At lower stress values, there is effectively no difference in performance
 - All failures were in the HAZ with some damage observed in AWS type –B8 weld metal for long-term tests
- Repairs in ex-service T92 generally met or exceeded the lower bound and were influenced by the degraded condition of the ex-service T92 parent material used to fabricate the vessel tests.

There are no red flags to inclusion of Grade 92 into Welding Method 6

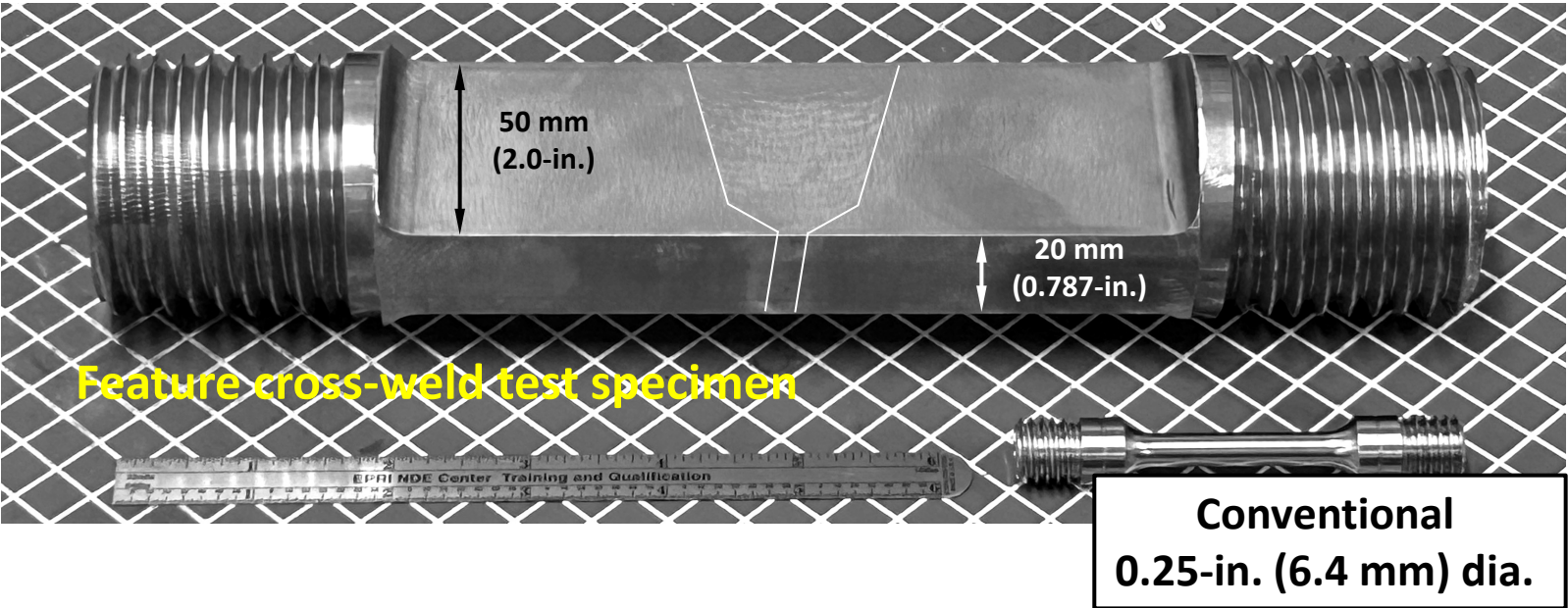
Data supporting repairs to Supplement 8



Test matrix for Grade 92 repairs

Temp.		Pressure		Est. life
°C	°F	MPa	ksi	hours
650	1,202	30	4.4	15,000
650	1,202	40	5.8	4,500
650	1,202	50	7.3	2,000
650	1,202	60	8.7	1,000
625	1,157	40	5.8	20,000
625	1,157	60	8.7	5,000
625	1,157	80	11.6	1,500
625	1,157	100	14.5	1,000
650	1,202	80	11.6	500
600	1,202	100	14.5	1,500

Testing program initiated in 2024



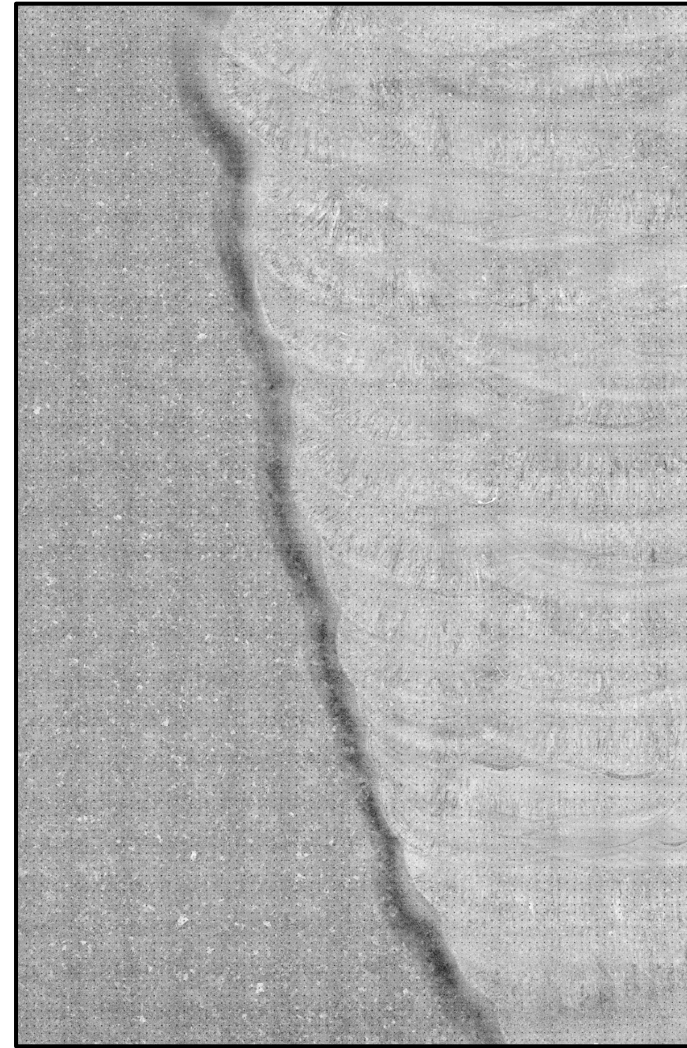
- Feature test specimen geometry includes entire through-thickness weld or repair geometry (2-in. [50.8 mm])
- 45,000 hours of testing in AWS type –B91 + PWHT
 - Includes multiple PWHT temperatures across allowable range
- 25,000 hours of testing in AWS type –B8 + no PWHT
- >100,000 hours expected at completion of test program in 2026

Repairs evaluated prior to and after testing

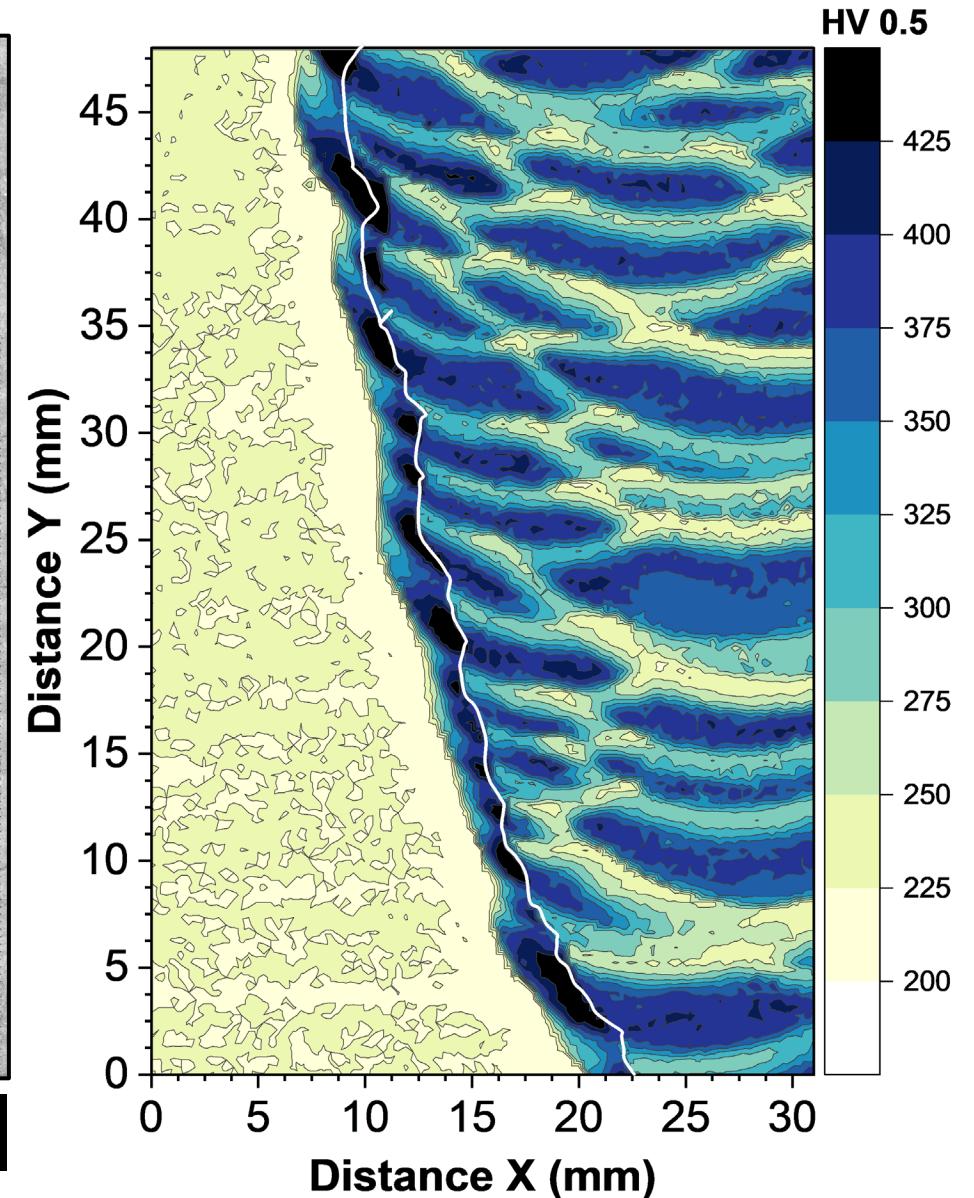
Characterization of simulated weld repair

- 0.25 mm spacing
- ~Full thickness (~50 mm) and sufficient width to capture deposited weld, HAZ, and base metal
- ~12,500 total indents

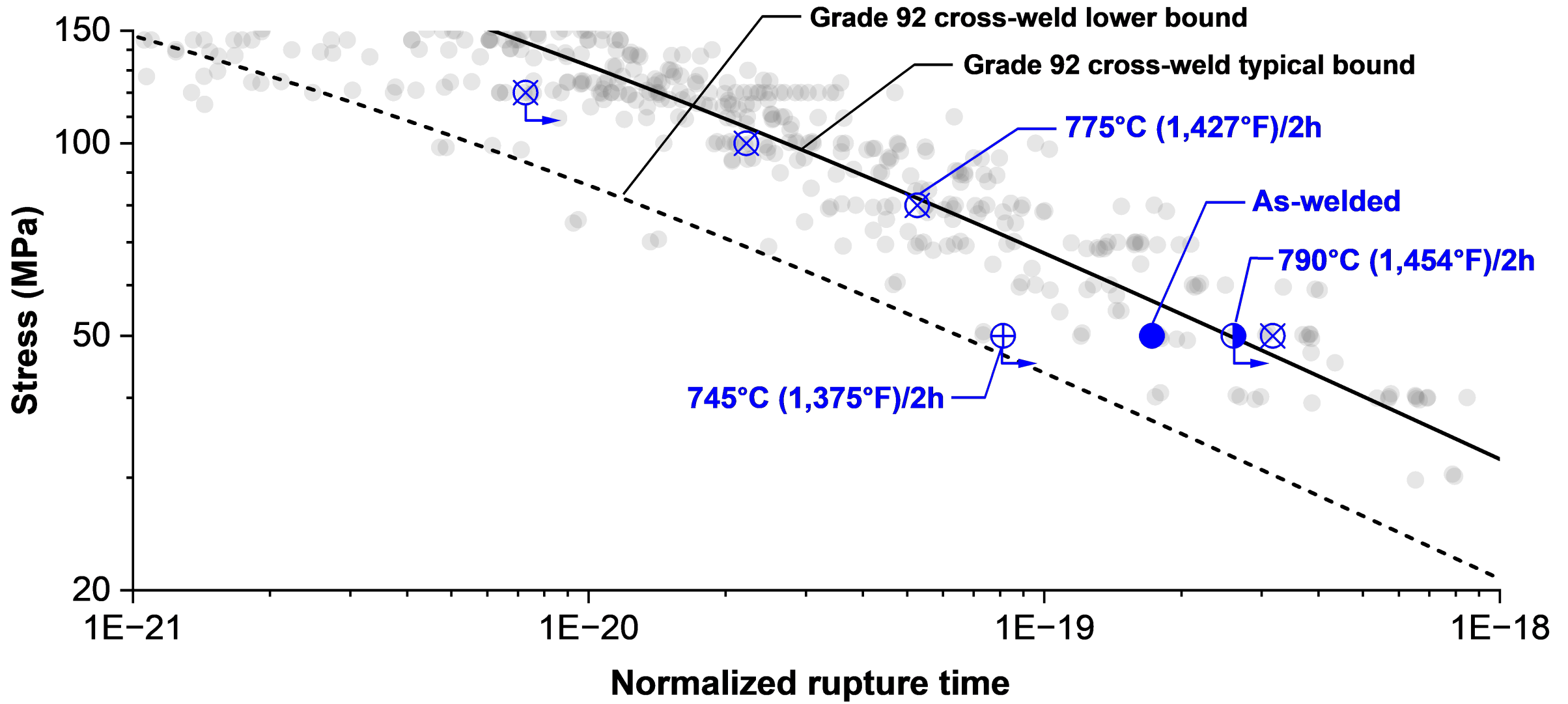
No gross defects or other anomalies that might otherwise influence creep performance



Etched hardness map

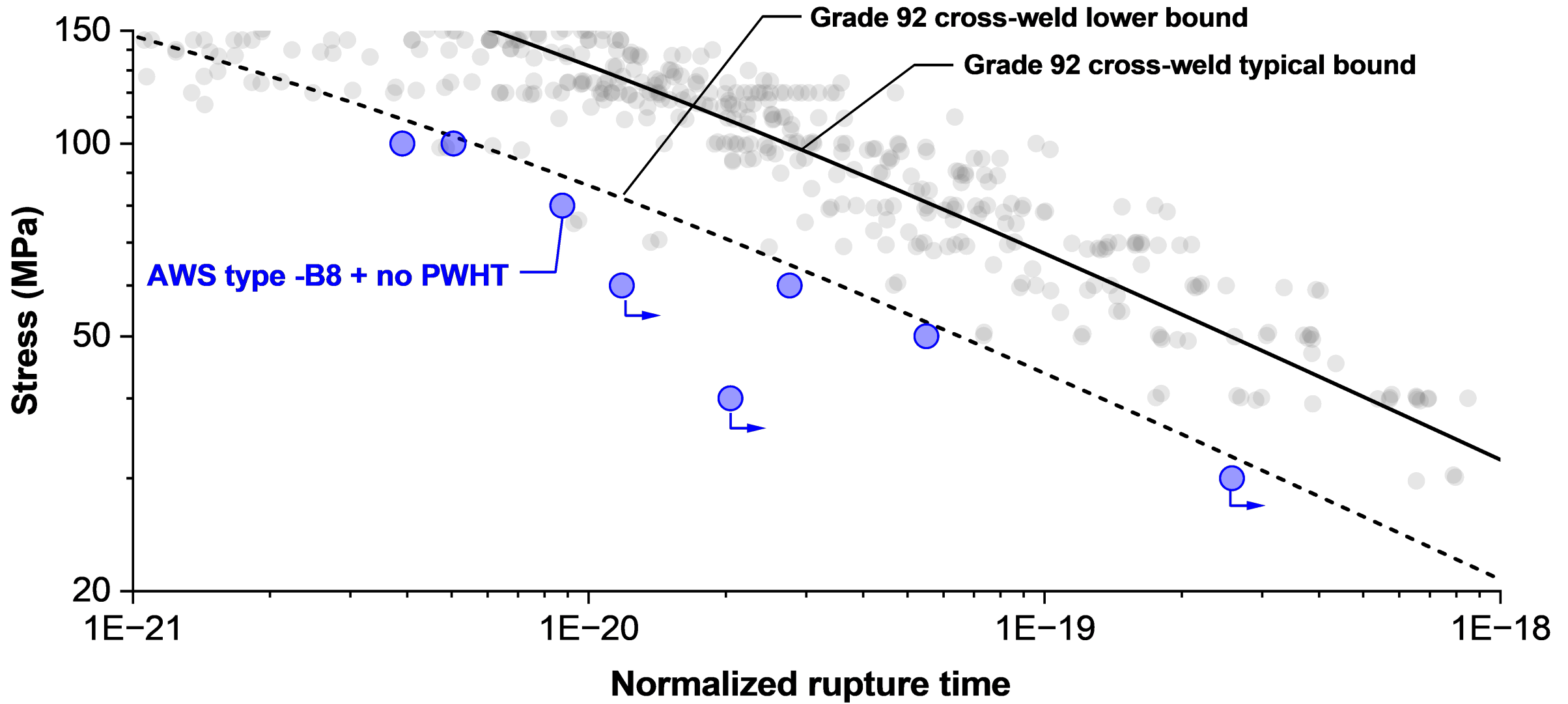


P92 + AWS type -B91 + PWHT



Trend unlikely to change with on-going tests (arrows)

P92 + AWS type -B8 + no PWHT



Trend unlikely to change with on-going tests (arrows)

Summary

- AWS type –B91 + PWHT does not result in a marked decrease in weld performance and is acceptable for new construction welds or post-construction repairs
 - PWHT did not have a marked effect on performance reinforcing the fact that PWHT is not a primary influence on the cross-weld creep behavior
 - The as-welded condition **with no deliberate PWHT** was comparable to the samples given a PWHT at 1,375, 1,425, or 1,455°F
- AWS type –B8 + no PWHT repair met the lower bound expectation for weld performance
 - Although test data shows reduced performance compared to the AWS type –B91 + PWHT, *the vessel tests subjected to multiaxial loading as would be encountered in-service* showed far less variability as presented previously
- Similar trends to those detailed here were noted in the development of Welding Method 6 and Supplement 8 for Grade 91 steel
 - Vessel testing to assess multiaxial performance is critical and cannot base recommendations solely on uniaxial test data

There are no red flags to inclusion of Grade 92 into Supplement 8



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