NATIONAL BOARD INSPECTION CODE (NBIC) REQUIREMENTS FOR REPAIRS AND ALTERATIONS OF ASME CODE VESSELS

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BACKGROUND

New Construction

ASME – The American Society of Mechanical Engineers is a group that has formulated rules for the construction, testing, stamping and certification of boilers, piping, pressure vessels, valves and nuclear components.
The scope of the non-nuclear ASME Code has been exclusively for new construction.

If one were to compare two identical vessels (one stamped with the ASME Code symbol stamp and one without), built by two different manufacturers using the same design program, of identical materials found in ASME Section II, identical welding procedures qualified to ASME Section IX and equally qualified welders there would be no physical difference other than the ASME Code symbol stamp. There are, however, differences in the way these vessels were processed : the vessel with the ASME Code symbol stamp was manufactured by a Certificate of Authorization Holder issued by ASME, in accordance with a Quality Control System Manual and was inspected during fabrication and final testing by an Authorized Inspector employed by an ASME accredited Authorized Inspection Agency and the vessel is certified on a Manufacturer's Data Report by the Manufacturer and signed by the Authorized Inspector. These actions and activities constitute the building of a Code vessel.

Post-Construction

The National Board of Boiler and Pressure Vessel Inspectors (National Board) formulated rules for repairs by welding on items in 1972 and issued the first "R" stamp in 1975. Rules for alterations were developed at a later date.

To obtain an "R" stamp, holders of ASME stamps other than V, UV and UM could submit their applications for the issuance of the "R" stamp. If the applicant was not a Certificate of Authorization Holder issued by ASME, the applicant was required to implement and demonstrate their quality control system on an actual repair or a simulated repair to a Joint Review Team. The Joint Review Team is comprised of a National Board assigned Team Leader, a Supervisor from the Authorized Inspection Agency, and the Inspector.

The National Board Inspection Code 1992 edition and earlier editions authorized repair firms to apply the "R" stamp on repaired items but only if the item was ASME Code stamped, repair plan or work description was accepted by the Inspector prior to performing the work and the work was inspected by a National Board Commissioned Inspector (the Inspector could be the assigned Inspector, the jurisdictional Inspector or the Inspector responsible for the In-service Inspection of the item). Repair work could proceed without a copy of original Manufacturer's Data Report and a pressure test was performed if required by the Inspector.

The National Board Inspection Code authorized repairs of a routine nature but the determination as to whether or not a repair was a routine repair, was left up to the Inspector. The significance was that the Inspector's concurrence that the repair was a routine repair was required and in process inspection by the Inspector and "R" stamping was waived.

The alteration of ASME Stamped items was addressed and controlled by the National Board Inspection Code. However, "R" stamping alterations item was not permitted. The work planned required Inspector acceptance prior to performing the work, a copy of the original Manufacturer's Data Report was mandatory, and a pressure test was required. However, subject to the acceptance of the jurisdiction an alternate test or examination was permitted.

Many times fabricators were caught in tight spots, for once the ASME stamp had been applied to a component, any subsequent work performed on the component was considered outside the scope of ASME. If an ASME stamped

item required any repair or alteration after application of the ASME Code stamp, what were the rules? In some cases such as, an item was ASME Code stamped and damaged during loading or perhaps a nozzle was left off; how could the repair work be performed within the scope of the ASME Code? The answer is, it is not possible, because the ASME Code stamp had been applied and the Manufacturer's Data Report had been certified by the Manufacturer and signed by the Inspector.

Ingenious fabricators, however, with concurrence of the Inspector, utilized their nonconformance system to control the additional work. In these instances a Nonconformance Report (NCR) was prepared with a proposed disposition and presented to the Inspector for concurrence of the work to be performed. The work was performed and inspected, the item was hydrostatically tested again and the Manufacturer's Data Report was again certified by the Manufacturer and signed by the Inspector. The work was accomplished "under the ASME Code" without application of an "R" stamp for the repair (Would you like buy a new item that was been repaired?).

There were no rules addressing repair or alteration of items that were not ASME Code stamped.

TODAY

New Construction

The current ASME Code has brought about several significant changes. In non-nuclear vessels: introduction of minimum design metal temperature for Section VIII Div.1. This change mandates that all vessels and material require impact testing (unless the use of an exemption is permitted by the Code). The lowering of safety factors from 4 to 3.5 for Section VIII Div 1 vessels. This change permits the use of thinner material for construction of pressure vessels.

In nuclear construction: introduction of Division 3 – for Containment systems for storage and transport of spent nuclear fuel.

Accreditation of Authorized Inspection Agencies: this change requires that inspection agencies be accredited for the inspection activities they perform.

SCOPE: NEW CONSTRUCTION ONLY

Post-Construction

Today, in terms of post construction, the requirement for inspections by a National Board Commissioned Inspector has survived as well as the need for a written description of the Quality Control System Manual. Also, the expansion of post construction activity such as repair or refurbishing, (in lieu of replacement) has steadily increased such that every state, except Wisconsin, in the United States and every province of Canada have adopted Section I of the ASME Code (every boiler installed in these jurisdictions are required to be ASME Code stamped). Additionally, every state except Arizona, New Mexico, Louisiana, Florida, West Virginia, Connecticut, Texas, Michigan, South Dakota and Montana have adopted Section VIII Div 1, 2 and 3 of the ASME Code for pressure vessels (these jurisdictions require pressure vessels to be built and stamped to the ASME Code). Along with adoption of the ASME Code these jurisdictions have also adopted the National Board Inspection Code for repair and alteration the ASME Code stamped boilers and pressure vessels.

With the increased adoption of the ASME and National Board Inspection Codes, one would expect compliance with the laws of the jurisdiction, and the installation of ASME Code stamped items exclusively. However, jurisdictions have been and are being approached by engineering contractors, utilities, chemical plant and oil refineries for a variance to the ASME Code stipulation required by law.

The non-code item's design, material and workmanship is closely scrutinized by engineers and inspectors employed by the jurisdiction to ensure public safety. Once all the criteria set forth by the jurisdiction is satisfied and evidence of compliance is presented to the jurisdictional entity, the variance is granted. The granting of the variance means that a non-code unit is installed within the jurisdictional boundary. These non-Code units operate to the specified requirements but may need repairs at a later date, what standard controls the repair or alteration of these non-code stamped boilers and pressure vessels? This question was the focus of the industry for several years and after a number of meetings by the chief inspectors of the states and municipalities who comprise the membership of the National Board, the need to address repair and alteration of any pressure retaining item (Code stamped or non-code

stamped) was realized. The result was a new National Board Inspection Code: The National Board Inspection Code 1995 Edition.

The 1995 Edition of the National Board Inspection Code (NBIC) introduced several new concepts:

1. The authorization to "R" stamp any repair (welded or non-welded) of any pressure retaining item (PRI) built to any code or non-code,
2. The authorization to "R" stamp any alteration of any pressure retaining item (PRI) built to any code or non-code,
3. The authorization to build, stamp and report parts on an "R-3" form, except for parts built for ASME stamped PRI,
4. The elimination of the need for a copy of the original Manufacturer's Data Reports for alterations,
5. The repair and alteration of plastic reinforced (ASME Section X) vessels (no welding),
6. Acceptance of Authorized Inspection Agencies for new construction and in-service work,
7. All repairs require a pressure test, unless an alternative examination or test, with concurrence of the Inspector and the jurisdiction where required and
8. Routine repairs were limited to four categories:
    a. Welded repair or replacement of pipe, tubes or sections thereof, 5 NPS in diameter and under and their attachments,
    b. The addition or repair of non-load bearing attachments to pressure retaining attachments where postweld heat treatment is not required,
    c. Weld build-up of wasted areas not exceeding 100 sq. in. or 25 % of the nominal wall thickness or ½" whichever is less in shells and heads and
    d. Corrosion resistance weld overlay no exceeding 100 sq. in.

For routine repairs, the Inspector must concur with the work and the extent of the routine repair, but in process inspection and stamping is still waived. The requirement for "R" Form preparation and execution is not waived.

Obtaining an "R" Stamp – Joint Review Process

How does a fabricator obtain a National Board "R" stamp?

1. The fabricator must submit an application to the National Board and the required fees for the Certificate of Authorization, the "R" stamp and the National Board Inspection Code.
2. The applicant must obtain an agreement with an Authorized Inspection Agency.
3. The applicant must develop and write a quality control system manual to address:
    a. Scope of Work
    b. Manual Control
    c. Design Controls
    d. Material Control
    e. Method of Performing the Work
    f. Welding and Non-Destructive Examination
    g. Postweld Heat Treatment
    h. Examinations and Tests
    i. Inspection
    j. Construction Code
    k. Nonconforming Items
    l. Exhibits (forms used for documenting activities)

On the date designated by the National Board the applicant must implement and demonstrate the quality control system to a Joint Review Team comprised of a Team Leader (assigned by the National Board), a supervisor from the Authorized Inspection Agency and an Inspector. The demonstration of the implementation is performed by simulation of a repair or alteration or by an actual alteration or repair of pressure retaining item complete with documentation of design (Note that if design is not demonstrated the scope of the certificate is repair only), procurement and receipt of material, in-process fabrication, inspection and final testing. At the termination of the Joint Review a recommendation is made by the Review Team and a report of the Joint Review is filed with the National Board. The National Board will review the report filed and will vote on the recommendation made by the team.

Application of an “R” Stamp to a Non-Code Item

How is the concept of “R” stamping non-ASME PRI possible?
The “R” Certificate Holder must first determine the construction code or standard to be used for the work planned. If a code other than the ASME Code is to be used, the code or standard must be acceptable to the Inspector and the jurisdiction where the PRI is to be located.
If the PRI was not constructed to a code or standard the ASME Code may be used as a default Code.
In any case, a copy of the standard used, if other than ASME, must be made available to the Inspector.

The fabricator must start a repair plan (EXHIBIT 1), traveler, or work plan which details the work to be performed and the sequence of activities to accomplish the work.

The details of repair plan, traveler or work plan should be commensurate with actual work planned. The repair plan, traveler or work planned must be presented to the Inspector for concurrence prior to the start of any work and selection of inspections desired by the Inspector. The importance of the repair plan, traveler or work plan cannot be over emphasized for the Inspector’s concurrence and acceptance of any work is documented on the document.
If any design work is performed (for verification of the MAWP, pressure retaining thickness, rerating, etc.,) the construction code used will determine the stress values to be used, but the material identity for any existing pressure retaining part in the vessel must be known.

If welding is performed, the base metals to be welded must be identified for the purposes of assigning a qualified Welding Procedure Specification. This means that the materials used in the non-code item must somehow be identified.

Since a copy of the Manufacturer’s Data Report is not available, the National Board Inspection Code states that inspection records, original data, or unit drawings may be used to establish existing material identification. If none of this data is available, each piece of materials in question must be subjected to chemical and physical tests. In any case, the method used to establish material identification must be made available to the Inspector.

The inspector must review welding procedures, verify welder qualification and continuity and review any material certification for new materials.

Nondestructive examination results, if any, and heat treatment records must be reviewed and verified.
The pressure retaining item must be subjected to a pressure test or an alternative examination to verify the integrity of work performed. This work must be witnessed by the Inspector.

Work may proceed until an inspection point for the Inspector is reached. Work may not proceed beyond the Inspector’s inspection points unless authorized to do so by the Inspector.

Once all inspection and examinations and fabrication is complete the “R” stamp may be applied to a nameplate provided concurrence from the Inspector is obtained.

The respective “R” form (Form R-1 Report of Repair (EXHIBIT 2), Form R-2 Report of Alteration, Form R-3 Report of Parts Fabricated by Welding and Form R-4 Report Supplemental Sheet) is prepared and certified by the Certificate Holder and presented to Inspector for his signature. The certified and signed “R” Form signifies that the PRI was repaired or altered by an “R” Certificate Holder using a quality control system that was reviewed and accepted by the National Board and that the PRI was inspected by an Inspector employed by and Authorized Inspection Agency that has been accredited by the National Board. **This is a Code repair or alteration.**

Caution is recommended on repair or alteration of non-code PRI. The original fabrication methods or techniques may not be verifiable. Therefore, it is recommended that the description of the work performed on the PRI be as specific and descriptive as possible. While the “R” Certificate Holder is only responsible for the work he performed and described in the repair form, sub-standard work performed by others could be attributed to the “R” Certificate Holder if not excluded on the “R” Form or if the scope of work described is not accurate.

Repair or Alteration of Code stamped Pressure Retaining Items

To apply an "R" stamp to a repair or alteration the steps above would also apply except that for an ASME Code stamped Vessel, a Manufacturer's Data Report exists (a report which describes the item, details the materials, extent of radiography & heat treatment performed, the Code Edition and Addenda applicable Code Case, was signed by an Authorized Inspector and certified by the Certificate Holder's representative) therefore testing of the materials would normally not be a requirement.

If all requirements of the QC Manual, National Board Inspection Code and jurisdiction are met and the proper "R" Form is signed the by Inspector and certified by the "R" Certificate Holder, the completed work constitutes a **Code repair or alteration. This also constitutes "maintaining the Code integrity" of the PRI.**

As before, it is recommended that a complete description of the work performed be included on the "R" Form.

Company Size

Is it possible to obtain an "R" stamp if the fabricator is a one person company?
Neither ASME nor the National Board specifies the number of personnel required to implement and demonstrate a quality control system. In the scenario where there is only one person performing all the Code required duties it must be understood that the Code requirements must satisfied at each process. Compromising the Code and the QC Manual is prohibited.

For the purpose of ensuring compliance, the National Board details the Inspector's duties, one of which is monitoring.

The Inspector must monitor compliance with the Code and the QC Manual on a regular basis. Also prior to signing the "R" Form and authorizing application of the "R" stamp, the work being performed must be inspected as required by the National Board Inspection Code, regardless of the size of the company.

Code Welders

Because of the advances made in welding technology, both in welding materials and welding equipment, there are operators of portable welders with the capability of performing repairs any where at any given time. A large number of these welders are called or call themselves code welders. Is there such a thing?
The reply to the question can come only after a few questions are answered. These are:

1. What Code, is "the Code" in reference to? If the Code is the ASME Code, the welder must be qualified using a procedure qualified in accordance with Section IX of the ASME Code.
2. Was the welder qualified for backing, pipe diameter, F-No., deposited weld metal thickness and position?
3. Did the physical tests of the test specimens comply with number, type and results required by ASME Section IX?
4. Does the welder qualification record document the actual values used and the qualification range for each filler metal or process and is the document certified?
5. Has the welder been assigned an identification symbol for identification of the welds performed?
6. Can the welder provide evidence of qualification continuity?
7. Is the Performance Qualification Record signed by a representative?

If these questions are answered affirmative, the welder is a Code welder.
May this welder perform a Code repair or alteration? The welder may perform any work for which qualified. However, if the work is not inspected by a National Board Commissioned Inspector, if the welder has not been accredited by the National Board and does not have an inspection agreement with an Authorized Inspection Agency, the work performed is not Code.

The statement could be made that it was performed in accordance with the Code, but this is analogous to saying in the race we got to the line but we did not crossed the line.

To be accredited the entity must have both the Certificate of Authorization and the National Board "R" stamp. Both are issued by the National Board.

Fabricators

Just as some welders advertise themselves as code welders, fabricators also advertise a quality control system in accordance with the Code. Again, the fabricator may have all the elements such as design, material control, welding procedures qualified to ASME Section IX, welders qualified to these qualified welding procedures, examination and inspection program and record retention, addressed but without the inspection service agreement with an Authorized Inspection Agency, National Board Certificate of Authorization, and the National Board "R" stamp Code repairs or alterations are not possible.

Rerating

Since the ASME Code changed the safety factor from 4 to 3.5 many owners of pressure retaining equipment recognize the advantage of rerating their equipment using a later ASME Code edition. While this may indeed be a possibility the fabricator must be familiar with the jurisdictional requirements to ensure that use of a later Code edition is allowed. As a minimum the following is required:

1. The Certificate Holder must verify by calculation (for all pressure retaining parts) or other means (tests), that the PRI may be operated at the new service condition,
2. The PRI must not be used for lethal service
3. The PRI must not be cyclic service,
4. The PRI shall have been built to the 1968 edition of the Code or later
5. The fabricator must show that the PRI complies with all the requirements of the later Code edition and addenda,
6. The fabricator shall show that the PRI has a satisfactory operating history
7. The rerating shall be acceptable to the Inspector and where required, the jurisdiction.

Examination and Test

Pressure Test

The integrity of repairs and replacement parts must be verified by examination or test.
If pressure testing is conducted, water is the preferred medium but other liquids are permitted. The test pressure must be sufficient to verify the integrity of the work performed but must not exceed 150% of the MAWP stamped on the PRI. The test must be maintained for 10 minutes.
If the PRI does not tolerate a liquid medium alternative tests or examination noted below may be used:

Pneumatic Test

This test is not sanctioned by jurisdictions for boilers. When used for pressure vessels concurrence of the owner and the Inspector is required. The test pressure required is the minimum pressure required to verify the integrity of the work performed, but shall be not more than the maximum pneumatic test pressure required by the original code of construction, or

Other Tests

Initial service leak test, vacuum tests, and nondestructive may also be used.

"R" Forms

"R" Forms are required to be maintained for 5 years if not registered with the National Board.
Registration of Form "R-1" with the National Board is optional.

Registration of Form "R-2" is mandatory when the PRI is registered with the National Board. If the PRI being altered is not registered with the National Board, registration is optional.

When "R" Forms are registered with the National Board the fabricator must assign R-No.s for registration of "R" Forms from a single sequential log.

There is one additional possibility for repair and alteration of pressure retaining items. If written into law a jurisdiction may also permit Manufacturers with the appropriate ASME Certificate to perform repairs and/or alterations. All of the controls would apply, except that the ASME Certificate Holder would not be required to apply for an "R" stamp. It also stands to reason that since an application was not submitted to the National Board, an "R" stamp was not issued. Therefore a repair or alteration performed in this situation could not be "R" stamped. Also, the repair and alteration is valid but only in the state where the pressure retaining item is installed.

EXHIBIT 1

REPAIR PLAN

A.
☐ REPAIR ☐ ALTERATION NO. _____ DATE: _____ NBIC ____ EDITION ____ ADDENDA

Original Mfr. _____ Serial No. _____ Nat'l Bd No. _____ Yr Built _____
Description of ☐ Repair ☐ Alteration:

Jurisdictional Approval Req'd? YES ☐ NO ☐ Verified by: _____ Date: _____ ☐ see back
Acceptance of Repair/Alteration Plan:

QCM: _____ Date: _____ Insp. _____ Date: _____

IN-PROCESS & FINAL	QC / DATE	INSP / DATE
B. WPS No.(s):		
1. Welder's Identification:		
2. Welder's Qualifications		
C. Engineering		
1. Original Data Report reviewed		
2. Stamping checked to verify applicable Code		
3. Drawings & Calculations accepted		
D. New Material Issuance (see back)		
E. Fabrication: fit-up, prep, etc.		
1. Shell:		
2. Head(s):		
3. Nozzles:		
4. Patch:		
5. Tubes:		
6. Other:		
F. Internal		
G. NDE: ☐ RT1 ☐ RT2 ☐ RT3 ☐ RT4 -		
☐ PT ☐ MT ☐ UT ☐ Other -		
H. Heat Treatment:		
I. Pressure Test:		
J. Final		
K. Stamping Checked		
L. ☐R-1 ☐R-2 ☐R-3 ☐R-4 Report reviewed and signed		

Asterisk (*) indicates Inspector's Hold Points - NOTES:

EXHIBIT 2

FORM R-1 REPORT OF WELDED REPAIR

in accordance with provisions of the National Board Inspection Code

1 Work performed by _____ (name of repair organization) _____ (Form R No.)

_____ (address) _____ (P.O. No. Job No. etc)

2 Owner _____ (name)

_____ (address)

3 Location of installation _____ (name)

_____ (address)

4 Unit Identification _____ (boiler, pressure vessel) Name of original manufacturer _____

5 Identifying nos.: _____ (mfg serial no.) (National Board No.) (jurisdiction no.) others year built

6 NBIC Edition/Addenda: _____ (if known) Original Construction Code: _____ (incl edition and addenda)

7 Description of work: _____ (use supplemental sheet, Form R-4, if necessary)

_____

_____

_____

_____ Pressure test, if applied _____ psi

8 Replacement Parts. Attached are Manufacturer's Partial Data Reports or Form R-3s properly completed for the following item of this report:

_____

_____

_____

_____ (name of part, item number, data report type, ??? Name and identifying stamp)

9 Remarks: _____

_____

_____

_____

CERTIFICATE OF COMPLIANCE

I, _____ certify that to the best of my knowledge and belief the statements in this report are correct and that all material, construction and workmanship on this Repair conforms to the National Board Inspection Code.

National Board "R" Certificate of Authorization No. _____ expires on _____

Date _____ Signed _____

(name of repair organization)

CERTIFICATE OF INSPECTION

I, _____ holding a vaild Commission issued by The National Board of Boiler and Pressure Vessel Inspectors and certificate of competancy issued by the jurisdiction of _____ and employed by _____ of _____ have inspected the work described in this report on _____ and state that to the best of my knowledge and belief this work complies with the applicable requirements of the National Board Inspection Code. By signing this certificate, neither the undersigned nor my employer makes any warranty, expressed or implied, concerning the work described in this report. Furthermore, neither the undersigned nor my employer shall be liable in any manner for any personal injury, property damage or loss of any kind arising from or connected with this inspection.

Date _____ Signed _____ (inspector) Commissions _____ National Board (incl. endorsements), and jurisdiction, and no.)