2007 Edition Errata

Subgroup for Repairs and Alterations (Part 3)

General Requirements	Specific Requirements
P. Edwards, Chair *Stone & Webster, Inc.*	J. Sekely, Chair *Wayne Crouse Inc.*
B. Schulte, Vice Chair *NRG Texas, LP*	G. Galanes *Midwest Generation EME, LLC*
R. Aben *State of Michigan*	J. Given *State of North Carolina*
B. Juarez *OneBeacon America Insurance Company*	F. Pavlovicz *The Babcock and Wilcox Company*
J. Larson *OneBeacon America Insurance Company*	D. Peetz *ARISE, Inc.*
M. Webb *Xcel Energy*	J. Pillow *Common Arc Corporation*

Special Subgroups for Installation, Inspection, and Repairs and Alterations (Parts 1, 2, and 3)

Pressure Relief Devices	Locomotive Boilers
F. Hart, Chair *Furmanite America Inc.*	B. Withuhn, Chair *Smithsonian Institution*
A. Cox, Vice Chair *Industrial Value*	S. Butler *Midwest Locomotive & Machine Works*
M. Brodeur *International Valve & Instr. Corp.*	D. Conrad *Valley Railroad Co.*
S. Cammeresi *CCR*	R. ~~Frazen~~ Franzen ~~*Great Smoky Mountain Railroad*~~ Steam Services of America
D. DeMichael *DuPont*	S. Jackson *D & SNG*
R. Donalson *Tyco Valves and Controls*	S. Lee *Union Pacific Railroad*
K. Fitzimmons *Carter Chambers, LLC*	D. McCormack *Consultant*
T. Patel Farris *Engineering*	L. Moedinger *Strasburg Railroad*
	G. Scerbo *Federal Railroad Administration*
	R. Schueler *The National Board of Boiler andPressure Vessel Inspectors*
	R. Stone *ABB/Combustion Engineering*
	R. Yuill *Consultant*
	D. Griner Wasatch Railroad Contractors
	M. Janssen Vapor Locomotive Company
	R. Reetz State of North Dakota

- Part 3, Repairs and Alterations – This Part provides information and guidance to perform, verify, and document acceptable repairs or alterations to pressure-retaining items regardless of code of construction. Alternative methods for examination, testing, heat treatment, etc. are provided when the original code of construction requirements cannot be met. Specific acceptable and proven repair methods are also provided.

Each NBIC Part is divided into major Sections as outlined in the Table of Contents.

Tables, charts, and figures provide relevant illustrations or supporting information for text passages, and are designated with numbers corresponding to the paragraph they illustrate or support within each Section. Multiple tables, charts, or figures referenced by the same paragraph will have additional letters reflecting the order of reference. Tables, charts, and figures are located in or after each major Section within each NBIC Part.

Text Identification and Numbering

Each page in the text will be designated in the top header with the publication's name, part number, and part title. The numbering sequence for each section begins with the section number followed by a dot to further designate major sections (e.g., 1.1, 1.2, 1.3). Major sections are further subdivided using dots to designate subsections within that major section (e.g. 1.1.1, 1.2.1. 1.3.1). Subsections can further be divided as necessary.

Paragraphs under sections or subsections shall be designated with small letters in parenthesis (e.g., (a), (b), (c)) and further subdivided using numbers in parenthesis (e.g., (1), (2), (3)). Subdivisions of paragraphs beyond this point will be designated using a hierarchical sequence of letters and numbers followed by a dot.

Delete front parenthesis

Example:
2.1 Major Section
2.1.1 Section
2.1.2 Section
2.1.2. Subsection
a) paragraph
b) paragraph
1) subparagraph
2) subparagraph
a. subdivisions
1. subdivisions
2. subdivisions
b. subdivisions
1. subdivisions
2. subdivisions

Tables and figures will be designated with the referencing section or subsection identification. When more than one table or figure is referenced in the same section or subsection, letters or numbers in sequential order will be used following each section or subsection identification.

Supplements

Supplements are contained in each Part of the NBIC to designate information only pertaining to a specific type of pressure-retaining item (e.g., Locomotive Boilers, Historical Boilers, Graphite

piping, and other pressure-retaining items shall not be operated until the required documentation has been provided by the installer to the owner and the Jurisdiction.

b) The National Board Commissioned Inspector providing inservice inspection for the facility in which the pressure-retaining item is installed has the following responsibilities:

1) verify the Boiler ~~Inspection~~ Installation Report (I-1 Report) has been completed and signed by the installer, when required by the jurisidication;

2) verify pressure-retaining items comply with the laws and regulations of the jurisdiction governing the specific type of boiler or pressure vessel;

3) verify any repairs or alterations to pressure-retaining items, which are conducted prior to, or during, the initial installation, are in accordance with the NBIC;

4) request or assign jurisdictional identification number, when required by the jurisdiction; and

5) complete and submit the first inservice inspection/certificate report to the jurisdiction when required by the jurisdication.

Unless otherwise specifically required by the jurisdiction, the duties of the inservice inspector do not include the installation's compliance to other standards and requirements (environmental, construction, electrical, undefined industry standards, etc.) for which other regulatory agencies have authority and responsibility to oversee.

1.4.2 EQUIPMENT CERTIFICATION

a) All boilers, pressure vessels, piping, and other pressure-retaining items shall have documented certification from the manufacturer indicating that the boiler, pressure vessel, piping, or any other pressure-retaining items complies with the requirements of the code of construction. The certification shall identify the 'Addenda' for a code of construction to which the boiler was fabricated.

b) Package boilers having external piping disassembled and shipped with the boiler shall have a method for traceability of the disassembled piping that can be verified at the time of installation and inspection. The manufacturer of the package boiler is responsible for determining a method of traceability.

1.4.3 JURISDICTIONAL REVIEW

a) The owner shall determine jurisdictional requirements (i.e., certificates, permits, licenses, etc.) before installing the equipment. The organization responsible for installation shall obtain all permits required by the Jurisdiction prior to commencing installation.

b) The owner shall determine jurisdictional requirements (i.e., certificates, permits, licenses, etc.) before operating the equipment. The owner shall obtain operating certificates, permits, etc., required by the Jurisdiction prior to commencing operation.

Table 3.7.9.1-b
Expansion Tank Capacities for Forced Hot-Water Systems (Note)

(Based on average operating water temperature 195°F [91°C], fill pressure 12 psig [83 kPa], and maximum operating pressure 30 psig [200 kPa])

	Tank Capacities, gal (l)	
System Volume, gal (l)	Prepressurized Diaphragm type	Nonpressurized type
100 (380)	9 (34)	18 (57)
200 (760)	17 (64)	30 (114)
300 (1140)	25 (95)	45 (170)
400 (1514)	33 (125)	60 (227)
500 (1890)	42 (159)	75 (284)
1,000 (3790)	83 (315)	150 (568)
2,000 (7570)	165 (625)	300 (1136)

Note: System volume includes volume of water in boiler, radiation, and piping, not including the expansion tank. Expansion tank capacities are based on an acceptance factor of 0.4027 for prepressurized types and 0.222 for nonpressurized types.

For other cases or metric calculations see Chapter 12 of the 1996 *HVAC Systems and Equipment* Volume of the ASHRAE Handbook.

Table 3.7.9.1-c
Expansion Tank Capacities for a Water Heater (Note)

	Tank Capacities, gal. (l)	
System Volume, gal. (l)	Prepressurized Diaphragm type	Nonpressurized type
50 (190)	1 (4)	3 (11)
100 (380)	2 (8)	6 (23)
200 (760)	3 (11)	12 (45)
300 (1140)	4 (15)	18 (68)
400 (1514)	5 (19)	24 (91)
500 (1890)	6 (23)	30 (114)
1,000 (3790)	12 (45)	60 (227)
2,000 (7570)	24 (91)	120 (454)

Note: Capacities in this table are given as a guide to reduce or eliminate relief valve weeping under conditions of partial water system demands or occasional water draw during recovery.

System volume includes water heater capacity plus all piping capacity for a recirculation system or water heater capacity only for a nonrecirculation system.

The capacities are based upon a water temperature rise from 40°F to 180°F (4°C to 80°C), 60 psig (414 kPa) fill pressure, maximum operating pressure of 125 psig (862 kPa) 20% water recovery, and an acceptance factor of 0.465 for prepressurized types, and 0.09156 for nonpressurized types. For other cases or metric calculations see Chapter 12 of the 1996 *HVAC Systems and Equipment* Volume of the ASHRAE Handbook.

3.7.9.2 EXPANSION TANKS AND PIPING FOR POTABLE WATER HEATERS

a) Expansion Tanks
If a system is equipped with a check valve or pressure-reducing valve in the cold water inlet line, consideration should be given to the installation of an airtight expansion tank or other suitable air cushion. Otherwise, due to the thermal expansion of the water, the safety relief valve may lift periodically. If an expansion tank is provided, it shall be constructed in accordance with an acceptable code of construction. The minimum capacity of the expansion tank may be determined from Table 3.7.9.1-c. See Figures 3.7.5-d and 3.7.5-e for a typical acceptable installation. Except for prepressurized diaphragm-type tanks, which should be installed on the cold water side, provisions shall be made for draining the tank without emptying the system.

b) Piping
Provisions shall be made for the expansion and contraction of hot water mains connected to water heater(s) so that there will be no undue stress transmitted to the water heater(s). See Figures 3.7.5-d and 3.7.5-e for typical schematic arrangements of piping incorporating strain absorbing joints.

ducing boiler pressure into the low-pressure system:

1) the failure of the pressure-reducing valve so that it remains wide open; and

2) the possibility of the bypass valve being open.

b) It is necessary therefore, to determine the flow under both circumstances (a) and (b) and check that the size of the safety valve under either condition will be adequate. The following formula should be used:

1) steam flow, W in lbs/hr through the pressure-reducing valve

W = AKC

where,

A = internal area in sq. in. of the inlet pipe size of the pressure-reducing valve (ref. ~~2.5~~) S2.5

K = flow coefficient for the pressure-reducing valve (see ~~2.4~~) S2.4

C = flow of saturated steam through a 1 sq. in. pipe at various pressure differentials from Table S2.3-a, Table S2.3-b, or Table S2.3-c.

2) steam flow, W in lbs/hr through the bypass valve

$W = A_1 K_1 C_1$

where,

A_1 = internal area in sq. in. of the pipe size of the bypass around the pressure-reducing valve

K_1 = flow coefficient for the bypass valves (see 2.4)

C_1 = flow of saturated steam through a 1 sq. in. pipe at various pressure differentials from Table S2.3-a, Table S2.3-b, and Table S2.3-c.

S2.4 STEAM FLOW WHEN FLOW COEFFICIENTS ARE NOT KNOWN

a) It is possible that the flow coefficients K and K_1 may not be known and in such instances for approximating the flow, a factor of 1/3 may be substituted for K and 1/2 for K_1.

The formulas in S2.3 then becomes:

W = 1/3 AC for the capacity through the pressure-reducing valve; and

$W = 1/2\ A_1\ C_1$ for the capacity through the bypass valve.

b) Caution should be exercised when substituting these factors for the actual coefficients since this method will provide approximate values only and the capacities so obtained may in fact be lower than actual. It is recommended that the actual flow coefficient be obtained from the pressure-reducing valve manufacturer and reference books be consulted for the flow coefficient of the bypass valve.

S2.5 TWO-STAGE PRESSURE-REDUCING VALVE STATIONS

The safety relief valve for two-stage pressure-reducing valve stations shall be sized on the basis of the high-side pressure and the inlet size of the first pressure-reducing valve in the line. If an intermediate pressure line is taken off between the pressure-reducing valves then this line and the final low side shall be protected by safety relief valves sized on the basis of the high-side pressure and the inlet size of the first pressure-reducing valve. See Table S2.5.

The return to normal condition such as the restart of the burner, the silencing of an alarm, or stopping of a feed pump should be noted. A sluggish response could indicate an obstruction in the connections to the boiler.

b) The operation of a submerged low water fuel cutoff mounted directly in a steam boiler shell should be tested by lowering the boiler water level carefully. This should be done only after being assured that the water level gage glass is indicating correctly.

c) On a high-temperature water boiler, it is often not possible to test the control by cutoff indication, but where the control is of the float type, externally mounted, the float chamber should be drained to check for the accumulation of sediment.

d) In the event controls are inoperative or the correct water level is not indicated, the boiler shall be taken out of service until the unsafe condition has been corrected.

e) All automatic low water fuel cutoff and water feeding devices should be examined by the Inspector to ensure that they are properly installed. The Inspector should have the float chamber types of control devices disassembled and the float linkage and connections examined for wear. The float chamber should be examined to ensure that it is free of sludge or other accumulation. Any necessary corrective action shall be taken before the device is placed back into service. The Inspector should check that the operating instructions for the devices are readily available.

f) Check that the following controls/devices are provided:

1) Each automatically-fired steam boiler is protected from over pressure by not less than two pressure operated controls, one of which may be an operating control.

2) Each automatically-fired hot-water boiler is protected from over-temperature by not less than two temperature operated controls, one of which may be an operating control.

3) Each hot-water boiler is fitted with a thermometer that will, at all times, indicate the water temperature at or near the boiler outlet.

2.2.11 RECORDS REVIEW

a) A review of the boiler log, records of maintenance, and feedwater treatment should be made by the Inspector to ensure that regular and adequate tests have been made on the boiler and controls.

b) The owner or user should be consulted regarding repairs or alterations, if any, which have been made since the last inspection. Such repairs or alterations should be reviewed for compliance with the jurisdictional requirements, if applicable.

2.2.12 DESCRIPTION AND CONCERNS OF SPECIFIC TYPES OF BOILERS

The following details are unique to specific type boilers and should be considered when performing inspections along with the general requirements as previously outlined.

2.2.12.1 WATERTUBE BOILERS

a) Typically constructed of drums, headers, and tubes, watertube boilers are used to produce steam or hot water commonly in large quantities. They range in size and pressure from small package units to extremely large field erected boilers with pressures in excess of 3000 psig (21 7 MPa ~~gage~~). These boilers may be fired by many types of fuels such as wood, coal,

tion, including while under pressure, may be used to satisfy inspection requirements provided the accuracy of the method can be demonstrated.

c) New pressure vessels are placed in service to operate under their design conditions for a period of time determined by the service conditions and the corrosion rate. If the pressure vessel is to remain in operation, the allowable conditions of service and the length of time before the next inspection shall be based on the conditions of the vessel as determined by the inspection. See 4.4.7 for determining remaining service life and inspection intervals.

2.3.3 EXTERNAL INSPECTION

The purpose of an external inspection is to provide information regarding the general condition of the pressure vessel. The following should be reviewed:

a) Insulation or Other Coverings
If it is found that external coverings such as insulation and corrosion-resistant linings are in good condition and there is no reason to suspect any unsafe condition behind them, it is not necessary to remove them for inspection of the vessel. However, it may be advisable to remove small portions of the coverings in order to investigate attachments, nozzles, and material conditions.

Note: Precautions should be taken when removing insulation while vessel is under pressure.

b) Evidence of Leakage
Any leakage of gas, vapor, or liquid should be investigated. Leakage coming from behind insulation coverings, supports or settings, or evidence of past leakage should be thoroughly investigated by removing any covering necessary until the source of leakage is established.

c) Structural Attachments
The pressure vessel mountings should be checked for adequate allowance for expansion and contraction, such as provided by slotted bolt holes or unobstructed saddle mountings. Attachments of legs, saddles, skirts, or other supports should be examined for distortion or cracks at welds.

d) Vessel Connections
Manholes, reinforcing plates, nozzles, or other connections should be examined for cracks, deformation, or other defects. Bolts and nuts should be checked for corrosion or defects. Weep holes in reinforcing plates should remain open to provide visual evidence of leakage as well as to prevent pressure buildup between the vessel and the reinforcing plate. Accessible flange faces should be examined for distortion and to determine the condition of gasket-seating surfaces.

e) Miscellaneous Conditions

1) Abrasives — The surfaces of the vessel should be checked for erosion.

2) Dents — Dents in a vessel are deformations caused by their coming in contact with a blunt object in such a way that the thickness of metal is not materially impaired. Dents can create stress risers that may lead to cracking.

3) Distortion — If any distortion is suspected or observed, the overall dimensions of the vessel shall be checked to determine the extent and seriousness of the distortion.

4) Cuts or Gouges — Cuts or gouges can cause high stress concentrations and decrease the wall thickness. Depending upon the extent of the defect, it may be necessary to repair.

5) Surface Inspection — The surfaces of shells and heads should be examined

construction. The set pressure of additional devices may exceed the MAWP, as permitted by the original code of construction.

c) Verify nameplate capacity and, if possible, compare to system capacity requirements.

d) Check identification on seals and ensure they match nameplates or other identification (repair or reset nameplate) on the valve or device.

2.5.3 CONDITIONS

a) Check for evidence that the valve or device is leaking or not sealing properly.

b) Seals for adjustments should be intact and show no evidence of tampering.

c) Connecting bolting should be tight and all bolts intact.

d) The valve or device should be examined for deposits or material buildup.

e) Evidence of rust or corrosion should be checked.

f) Check for damaged or misapplied parts.

g) If a drain hole is visible, ensure it is not clogged with debris or deposits.

h) Check for test gags left in place after pressure testing of the unit.

i) Bellows valves shall be checked to ensure the bonnet vent is open or piped to a safe location. The vent shall not be plugged since this will cause the valve set pressure to be high if the bellows develops a leak. Leakage noted from the vent indicates the bellows is damaged and will no longer protect the valve from the effects of back pressure.

2.5.4 INSERVICE INSPECTION REQUIREMENTS FOR PRESSURE RELIEF DEVICES

a) Inspect inlet piping and ensure it meets the requirements of the original code of construction. For pressure relief valves, check that the inlet pipe size is not smaller than the device inlet size.

b) Inspect discharge piping and ensure it meets the original code of construction. Check that the discharge pipe size is not smaller than the device outlet size.

c) Check that the valve drain piping is open.

d) Check drainage of discharge piping.

e) Check that inlet and discharge piping are not binding or placing excessive stress on the valve body which can lead to distortion of the valve body and leakage or malfunction.

f) Check the condition and adequacy of piping supports. Discharge piping should be supported independent of the device itself.

g) Check for possible hazards to personnel from the valve discharge or discharge pipe.

h) Check that there are no intervening isolation valves between the pressure source and the valve inlet or between the valve outlet and its point of discharge. (Isolation valves may be permitted in some pressure vessel service. See Part 1, 5.3.6 e) and jurisdictional requirements. Isolation valves are not permitted for power boilers, heating boilers, or water heaters.)

i) A change-over valve, which is used to install two pressure relief devices on a single vessel location for the purpose of switching from one device to a spare device, is not considered a block valve if it is arranged

i) Longitudinal Stresses
If because of wind loads or other factors the longitudinal stresses would be of importance, the least thicknesses in a length of arc in the most critical plane perpendicular to the axis of the pressure vessel may be averaged for computation of the longitudinal stresses. The thicknesses used for determining corrosion rates at the respective locations shall be the most critical value of average thickness. The potential for buckling shall also be considered.

j) Local Metal Loss
Corrosion pitting shall be evaluated in accordance with 4.4.8.7 Widely scattered corrosion pits may be left in the pressure-retaining item in accordance with the following requirements:

1) Their depth is not more than one-half the required thickness of the pressure-retaining item wall (exclusive of corrosion allowance);

2) the total area of the pits does not exceed 7 sq. in. (4500 sq mm) within any 50 sq. inches (32000 sq mm); and

3) the sum of their dimensions (depth and width) along any straight line within this area does not exceed 2 in. (50 mm).

k) Weld Joint Efficiency Factor
When the surface at a weld having a joint efficiency factor of other than one is corroded as well as surfaces remote from the weld, an independent calculation using the appropriate weld joint efficiency factor shall be made to determine if the thickness at the weld or remote from the weld governs the maximum allowable working pressure. For the purpose of this calculation, the surface at a weld includes 1 in. (25 mm) on either side of the weld, or two times the minimum thickness on either side of the weld, whichever is greater.

l) Formed Heads

1) When evaluating the remaining service life for ellipsoidal, hemispherical, torispherical or toriconical shaped heads, the minimum thickness may be calculated by:

a. Formulas used in original construction, or

b. Where the head contains more than one radii of curvature, the appropriate strength formula for a given radius.

2) When either integral or non-integral attachments exist in the area of a knuckle radius, the fatigue and strain effects that these attachments create shall also be considered.

m) Adjustments in Corrosion Rate
If, upon measuring the wall thickness at any inspection, it is found that an inaccurate rate of corrosion has been assumed, the corrosion rate to be used for determining the inspection frequency shall be adjusted to conform with the actual rate found.

n) Riveted Construction
For a pressure-retaining item with riveted joints, in which the strength of one or more of the joints is a governing factor in establishing the maximum allowable working pressure, consideration shall be given as to whether and to what extent corrosion will change the possible modes of failure through such joints. Also, even though no additional thickness may have originally been provided for corrosion allowance at such joints, credit may be taken for the corrosion allowance inherent in the joint design.

5.3.3 NEW BUSINESS OR DISCONTINUANCE OF BUSINESS FORM (NB-4)

FORM NB-4
NEW BUSINESS OR DISCONTINUANCE
USED BY AUTHORIZED INSPECTION AGENCIES

To: _____ _____
JURISDICTION 1. DATE OF SERVICE

2. Notice of: ☐ New ~~insurance~~ business ☐ Discontinuance or cancellation ☐ Refusal to inspect

Effective

3. ~~Effective~~ date _____

4. Type of object: ☐ High pressure boiler ☐ Low pressure boiler ☐ Pressure vessel

5. OBJECT	6. OWNER'S NO.	7. JURISDICTION NO.	8. NATIONAL BOARD NO,	9. NAME OF MANUFACTURER

10. NAME OF OWNER

11. NAME OF OWNER INCLUDING COUNTY

12. LOCATION OF OBJECT INCLUDING COUNTY

13. USER OF OBJECT (IF SAME AS OWNER SHOW "SAME")

14. DATE OF LAST CERTIFICATE INSPECT., IF ANY	15. CERTIFICATE ISSUED ☐ Yes ☐ No	16. REASON FOR DISCONTINUANCE OR CANCELLATION ☐ Phys. condition ☐ Out of use ☐ Other

17. REMARKS (USE REVERSE SIDE)

18. By: _____ BRANCH OFFICE

Inspection Agency Rep.

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Ave., Columbus, OH 43229 NB-4 Rev. 2

Original steel stamp marks, original material certifications, or current laboratory tests are acceptable sources for verification of tensile strength. Catalogs and advertising literature are not acceptable sources for tensile strength values.

b) In computing the ultimate strength of rivets in shear, the following values shall be used:

1) Iron rivets in single shear
38,000 psi (262 MPa)

2) Iron rivets in double shear
76,000 psi (524 MPa)

3) Steel rivets in single shear
44,000 psi (303 MPa)

4) Steel rivets in double shear
88,000 psi (607 MPa)

c) The resistance to crushing of mild steel shall be taken as 95,000 psi (655 MPa) unless otherwise known.

d) S = TS/FS. See definitions of nomenclature in S2.10.6.

S2.10.2 RIVETS

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

S2.10.3 CYLINDRICAL COMPONENTS

The MAWP of cylindrical components under internal pressure shall be determined by the strength of weakest course computed from the minimum thickness of the plate, the tensile strength of the plate, the efficiency of the longitudinal joint, the inside diameter of weakest course, and the design margin allowed by these rules using the following formula or Tables S2.10.3.1 through S2.10.3.6:

$$MAWP = \frac{TS \times t \times E}{R \times FS}$$

$$\boxed{\frac{TS \times t \times E}{(R \times FS)}}$$

See definitions of nomenclature in S2.10.6.

TABLE S2.10.2
Sizes for Rivets Based on Plate Thickness

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

TABLE S2.10.4
Maximum Allowable Working Pressure for Stayed Surfaces per ASME Section 1, PG 46.1

Thickness of Stayed Surface	Staybolt Spacing (Maximum Pitch)																	
	3-1/2	4	4-1/8	4-1/4	4-3/8	4-1/2	4-5/8	4-3/4	4-7/8	5	5-1/8	5-1/4	5-3/8	5-1/2	5-5/8	5-3/4	5-7/8	6
0.19	85	65	61	58	55	52	49	46	44	42	40	38	36	35	33	32	30	29
0.2	95	72	68	64	61	57	54	51	49	46	44	42	40	38	37	35	34	32
0.21	104	80	75	71	67	63	60	57	54	51	49	46	44	42	40	39	37	36
0.22	115	88	82	78	73	69	66	62	59	56	53	51	49	46	44	42	41	39
0.23	125	96	90	85	80	76	72	68	65	61	58	56	53	51	48	46	44	43
0.24	136	104	98	92	87	82	78	74	70	67	64	61	58	55	53	50	48	46
0.25	148	113	106	100	95	89	85	80	76	72	69	66	63	60	57	55	52	50
0.26	160	122	115	108	102	97	92	87	82	78	75	71	68	65	62	59	57	54
0.27	172	132	124	117	110	104	99	94	89	85	80	77	73	70	67	64	61	59
0.28	185	142	134	126	119	112	106	101	96	91	87	82	79	75	72	69	66	63
0.29	199	152	143	135	127	120	114	108	103	97	93	88	84	81	77	74	71	68
0.3	213	163	153	144	136	129	122	116	110	104	99	95	90	86	82	79	76	72
0.31	227	174	164	154	146	138	130	123	117	111	106	101	96	92	88	84	81	77
0.32	242	185	174	164	155	147	139	132	125	119	113	108	103	98	94	90	86	82
0.33	258	197	185	175	165	156	148	140	133	126	120	115	109	104	100	95	91	88
0.34	273	209	197	185	175	165	157	148	141	134	128	122	116	111	106	101	97	93
0.35	290	222	209	197	185	175	166	157	149	142	135	129	123	117	112	107	103	99
0.36	307	235	221	208	196	185	176	166	158	150	143	136	130	124	119	114	109	104
0.37	324	248	233	220	207	196	185	176	167	159	151	144	137	131	125	120	115	110
0.38	342	262	246	232	219	207	196	185	176	167	159	152	145	138	132	127	121	116
0.39	360	275	259	244	230	218	206	195	185	176	168	160	153	146	139	133	128	122
0.4	379	290	273	257	242	229	217	206	195	185	177	168	160	153	147	140	134	129
0.41	398	304	286	270	255	241	228	216	205	195	185	177	169	161	154	147	141	135
0.42	417	320	300	283	267	252	239	227	215	204	195	185	177	169	162	155	148	142
0.43	437	335	315	297	280	265	251	237	225	214	204	194	185	177	169	162	155	149
0.44	480	367	345	325	307	290	275	261	247	235	224	213	203	194	186	178	170	163
0.45	502	384	361	340	321	304	287	272	259	246	234	223	213	203	194	186	178	171
0.46	524	402	378	356	336	317	300	285	270	257	245	233	222	212	203	194	186	178
0.47	547	419	394	371	350	331	314	297	282	268	255	243	232	222	212	203	194	186
0.48	571	437	411	387	365	345	327	310	294	280	266	254	242	231	221	212	203	194
0.49	595	456	428	404	381	360	341	323	307	292	278	264	252	241	230	220	211	202

TS = Tensile Strength (55,000)
t = Thickness of Stayed Surface
S = 13,800
P = MAWP

$P = t^2 \times SC/p^2$

C = 2.1 if 7/16 in. or less
C = 2.2 if more than 7/16 in.
p = Maximum Pitch

For values of t less than or equal to 0.4375 in., C=2.1

For values of t larger than 0.4.375 in., C=2.2

SUPPLEMENT 6
CONTINUED SERVICE AND INSPECTION OF DOT TRANSPORT TANKS

S6.1 SCOPE

a) This supplement provides rules for continued service inspections of transport tanks, i.e., cargo tanks, rail tanks, portable tanks, and Ton Tanks that transport dangerous goods as required in the Code of Federal Regulations, Title 49, Parts 100 through 185, and the United Nations Recommendations for Transport of Dangerous Goods-Model Regulations. This supplement, where applicable, shall be used in conjunction with other applicable Parts of the *National Board Inspection Code* (NBIC) and Section XII, *Transport Tanks*, of the *ASME Boiler and Pressure Vessel Code*.

S6.2 TERMINOLOGY

a) The terminology used in this supplement, in some cases may be in conflict with terms and definitions normally used in the repair and alteration of pressure-retaining items. Considering these differences, this supplement in the Definition Section has incorporated definitions and terms specified in CFR 49, Parts 100 through 185.

b) When conflicts are identified between this part and the regulations of the Competent Authority regarding the examination, inspection, testing, repair, and maintenance for the continued qualification of transport tanks, the regulations of the Competent Authority take precedence.

c) Rules for repairs and modifications of transport tanks are provided in Part 3, *Repairs and Alterations*, Supplement 6.

S6.3 ADMINISTRATION

a) The Competent Authority's requirements describe the frequency, scope, type of inspection, (internal, external, or both), type of examination (nondestructive, spark test, etc.), and the documentation requirements for the inspection.

b) For transport tanks under the Jurisdiction of the Department of Transportation, the Registered Inspector shall have a thorough knowledge of the Code of Federal Regulations, Title 49, Parts 100 through 185.

S6.4 INSPECTION

This section will establish the appropriate methods to be used for continued service inspections. Inspections for repairs and modifications of transport tanks is located in Part 3, *Repairs and Alterations*, Supplement 6.

S6.4.1 SCOPE

This section describes the duties, qualifications, and responsibilities of the Registered Inspector, and the scope of inspection activities permitted.

S6.4.2 GENERAL REQUIREMENTS FOR INSPECTORS

a) The Inspector shall be a National Board recognized Inspector, i.e., Authorized Inspector (AI), Qualified Inspector (QI), Certified Individual (CI), or a Registered Inspector (RI). The Registered Inspector is a position established by CFR 49 Parts 100 through 185 for Continued Service Inspections. This individual's duties and responsibilities are subject to DOT and not QAI-1.

b) For continued service inspections, the owner-user's Registered Inspector can be

nozzle attachments, and, if equipped, baffles, internal stiffeners, surge protection devices for defects, corrosion, and missing or loose attachment;

2) Lined, coated, or if the cargo tank is so designed to preclude an internal visual inspection — If the cargo tank is externally lined, coated, or of a design that would prevent a complete and thorough external visual examination, the internal areas of the cargo tank that are not obstructed by the lining or coating shall be internally inspected;

3) Lined, coated, or if the cargo tank is so designed to preclude access to the internal surfaces — The cargo tank shall be subjected to a hydrostatic or pneumatic test in accordance with S6.13.6 of this section;

4) All corroded or abraded areas of a cargo tank wall must be thickness tested in accordance with the following procedures:

   a. Measurements must be made using a device capable of accurately measuring thickness within ± 0.002 of an inch (± 0.051 mm);

   b. Any individual performing thickness testing must be trained in the proper use of the thickness testing device in accordance with the testing device manufacturer's instructions;

   c. The minimum thickness requirements for the heads, shell baffle, and bulkhead, when used as tank reinforcement, shall meet the minimum thickness requirements for in-service requirements for cargo tank specifications MC 300, MC 303, MC 304, MC 306, MC 307, MC

Table S6.13.1-a
Inservice Minimum Thicknesses for Steel and Steel Alloys

Minimum manufactured thickness (US "Manufacturers' Standard Gage for Steel Sheets" or inches)	Nominal decimal equivalent, ~~inches (mm)~~ mm (inches)	Inservice minimum reference, ~~inches (mm)~~ mm (inches)
19 gage	1.06 (0.0418)	0.97 (0.038)
18 gage	1.21 (0.0478)	1.09 (0.043)
17 gage	1.37 (0.0538)	1.22 (0.048)
16 gage	1.52 (0.0598)	1.37 (0.054)
15 gage	1.71 (0.0673)	1.55 (0.061)
14 gage	1.90 (0.0747)	1.70 (0.067)
13 gage	2.28 (0.0897)	2.06 (0.081)
12 gage	2.66 (0.1046)	2.39 (0.094)
11 gage	3.04 (0.1196)	2.74 (0.108)
10 gage	3.42 (0.1345)	3.07 (0.121)
9 gage	3.80 (0.1495)	3.43 (0.135)
8 gage	4.18 (0.1644)	3.76 (0.148)
7 gage	4.55 (0.1793)	4.09 (0.161)
3/16 inch	5 (0.1875)	4.29 (0.169)
1/4 inch	6 (0.2500)	5.72 (0.225)
5/16 inch	8 (0.3125)	7.14 (0.281)
3/8 inch	10 (0.3750)	8.59 (0.338)

310, MC 311 transport tanks, and MC 312 cargo tanks constructed of steel, steel alloys, aluminum, and aluminum alloys are based on 90% of the minimum manufactured thickness. Table S6.13.1-a, provides minimum inservice minimum thicknesses for steel and steel alloys. Table S6.13.1-b provides minimum thicknesses for aluminum and aluminum alloys.

S6.13.2 INSPECTION OF PIPING, VALVES, AND MANHOLES

a) The cargo tank piping, valves, and gaskets must be carefully inspected for corroded areas and the piping system and valve attachment welds or threads must be inspected for corrosion, leakage, or any other defects that might render the cargo tank unsafe for transportation service. This examination shall include:

b) All devices for securing manhole covers must be in satisfactory working condition, and the area must not show any evidence of leakage at either the manhole cover or the manhole gasket.

1) When inspecting gaskets on any full opening of the cargo tank, the inspector should visually examine the gasket for defects to include cracks and/or splits that may prevent the gasket material from sealing properly.

2) If the gasket shows any evidence of cuts or cracks that are likely to cause failure, the gasket shall be replaced.

c) All emergency devices and valves including self-closing stop valves, excess flow

Table S6.13.1-b
Inservice Minimum Thicknesses for Aluminum and Aluminum Alloys

Minimum manufactured thickness, ~~inches (mm)~~ mm (inches)	Inservice minimum thickness, ~~inches (mm)~~ mm (inches)
1.98 (0.078)	1.78 (0.070)
2.21 (0.087)	1.98 (0.078)
2.44 (0.096)	2.18 (0.086)
2.77 (0.109)	2.49 (0.098)
3.30 (0.130)	2.97 (0.117)
3.58 (0.141)	3.23 (0.127)
3.84 (0.151)	3.45 (0.136)
4.37 (0.172)	3.94 (0.155)
4.39 (0.173)	3.96 (0.156)
4.93 (0.194)	4.44 (0.175)
5.49 (0.216)	4.93 (0.194)
6.02 (0.237)	5.41 (0.213)
6.86 (0.270)	6.17 (0.243)
9.14 (0.360)	8.23 (0.324)
11.40 (0.450)	10.30 (0.405)
13.70 (0.540)	12.30 (0.486)

SUPPLEMENT 7
INSPECTION OF PRESSURE VESSELS IN LIQUEFIED PETROLEUM GAS (LPG) SERVICE

S7.1 SCOPE

a) Pressure vessels designed for storing LPG can be stationary or can be mounted on skids. LPG is ~~are~~ generally considered to be non-corrosive to the interior of the vessel. This part is provided for guidance of a general nature for the owner, user, or jurisdictional authority. There may be occasions where more detailed procedures will be required such as changing from one gas service to another (i.e., anhydrous ammonia to LPG).

b) The application of this Supplement to underground vessels will only be necessary when evidence of structural damage to the vessel has been observed, leakage has been determined, or the tank has been dug up, and is to be reinstalled.

S7.2 PRE-INSPECTION ACTIVITIES

a) A review of the known history of the pressure vessel should be performed. This should include a review of information, such as:

1) Operating conditions;

2) Historical contents of the vessel;

3) Results of any previous inspection;

4) Current jurisdictional inspection certificate, if required;

5) ASME Code symbol stamping or mark of code of construction, if required; and

6) National Board and/or jurisdictional registration number, if required.

b) The vessel should be sufficiently cleaned to allow for visual inspection.

S7.3 INSERVICE INSPECTION FOR VESSELS IN LP GAS SERVICE

The type of inspection given to pressure vessels should take into consideration the condition of the vessel and the environment in which it operates. The inspection may be external or internal, and use a variety of nondestructive examination methods. Where there is no reason to suspect an unsafe condition or where there are no inspection openings, internal inspections need not be performed. When service conditions change from one service to another, such as ammonia to LPG, an internal inspection may be required. The external inspection may be performed when the vessel is pressurized or depressurized, but shall provide the necessary information that the essential sections of the vessel are of a condition to operate.

S7.3.1 NONDESTRUCTIVE EXAMINATION (NDE)

Listed below are a variety of methods that may be employed to assess the condition of the pressure vessel. These examination methods should be implemented by experienced and qualified individuals. Generally, some form of surface preparation will be required prior to the use of these examination methods: visual, magnetic particle, liquid penetrant, ultrasonic, radiography, radioscopy, eddy current, metallographic examination, and acoustic emission. When there is doubt as to the extent of a defect or detrimental condition found in a pressure vessel, additional NDE may be required.

d) When dents are identified which exceed the limits set forth in these paragraphs, the vessel shall be removed from service until the dents are repaired by a qualified repair organization or permanently retired from service.

S7.8.3 BULGES

a) Shells
If a bulge is suspected, the circumference shall be measured at the suspect location and several places remote from the suspect location. The variation between measurements shall not exceed 1%.

b) Heads

1) If a bulge is suspected, the radius of curvature shall be measured by the use of templates. At any point the radius of curvature shall not exceed 1.25% of the diameter for the specified shape of the head.

2) When bulges are identified that exceed the limits set forth in these paragraphs, the vessel shall be removed from service until the bulges are repaired by a qualified repair organization or permanently retired from service.

S7.8.4 CUTS OR GOUGES

When a cut or a gouge exceeds 1/4 of the thickness of the vessel, the vessel shall be removed from service until it is repaired by a qualified repair organization or permanently removed from service.

S7.8.5 CORROSION

a) Line and Crevice Corrosion
For line and crevice corrosion, the depth of the corrosion shall not exceed 1/4 of the original wall thickness.

b) Isolated Pitting
Isolated pits may be disregarded provided that:

1) Their depth is not more than one-half the required thickness of the pressure vessel wall (exclusive of corrosion allowance);

2) The total area of the pits does not exceed 7 sq. in. (4500 sq. mm) within any 8 in. (200 mm) diameter circle; and

3) The sum of their dimensions along any straight line within this circle does not exceed 2 in. (50 mm).

c) General Corrosion
For a corroded area of considerable size, the thickness along the most critical plane of such area may be averaged over a length not exceeding 20 in. (500 mm). The thickness at the thinnest point shall not be less than 50% of the required wall thickness, and the average shall not be less than 75% of the required wall thickness. When general corrosion is identified that exceeds the limits set forth in this paragraph, the pressure vessel shall be removed from service until it is repaired by a qualified organization or permanently removed from service.

1.7.3 GENERAL RULES

The general rules of the National Board "VR" certification program apply only to the repair of National Board capacity certified ASME Code Section I "V" stamped, Section IV "HV" marked, and Section VIII "UV" stamped pressure relief valves that:

a) Have been in service or have been exposed to environmental or other conditions such that there is reason to question their ability to perform equivalent to the standards for new valves; or

b) Any or all of the valve's external adjustment seals have been broken, opened, or otherwise disturbed, regardless of the valve's age or service status.

1.7.4 REPAIR OF NUCLEAR VALVES

Provided that the requirements of Supplement 9 and applicable requirements of these rules are met, the "VR" certificate may be extended to apply to the repair of any ASME Code Section III, Class 1, 2, or 3, pressure relief devices that have been capacity certified by the National Board and have been in service, regardless of their intended function, in a nuclear system.

1.7.5 ISSUANCE AND RENEWAL OF THE "VR" *CERTIFICATE OF AUTHORIZATION*

1.7.5.1 GENERAL

Authorization to use the stamp bearing the official National Board "VR" symbol as shown in Section 5 of this Part, will be granted by the National Board pursuant to the provisions of the following administrative rules and procedures. Supplement 9 of this Part, provides rules for the repair of ASME Section III "NV" stamped pressure relief devices.

1.7.5.2 ISSUANCE OF CERTIFICATE

a) Repair organizations, manufacturers, assemblers, or users that make repairs to the American Society of Mechanical Engineers (ASME) Code symbol, stamped or marked (as applicable), and The National Board of Boiler and Pressure Vessel Inspectors (National Board) capacity certified pressure relief valves may apply to the National Board for a *Certificate of Authorization* to use the "VR" symbol. The National Board may at any time, through the NBIC Committee, modify the regulations concerning the issuance and use of such valve repair symbol. All such modified regulations shall become binding upon holders of valid Valve Repair *Certificates of Authorization*.

b) Authorization to use the "VR" stamp may be granted or withheld by the National Board in its absolute discretion. If authorization is granted and proper administrative fees paid, a *certificate of authorization* will be issued evidencing permission to use such a symbol, expiring on the triennial anniversary date. The certificate will be signed by the National Board Chairman of the National Board of Trustees, the Executive Director, or any other duly authorized officer.

c) The certificate shall list the physical, permanent address of record for the certificate holder's shop/plant. For field-only scopes, this address of record shown on the *Certificate of Authorization* is where administrative, technical, and quality aspects of the business are controlled.

1.7.5.3 RENEWAL OF CERTIFICATE

The *Certificate of Authorization* is renewable every three (3) years subject to a review of the Quality System by a representative of the National Board, review and acceptance of the representative's report by the National Board, and successful completion of capacity

1) If either or both of these replacement valves fail to meet the above criteria, the applicant shall document the cause of the noted deficiencies and actions taken to guard against future occurrence. Upon acceptance of this information by the National Board, one (1) additional valve for each replacement valve that failed shall be repaired and tested. The valve(s) shall be of the same ASME Code Section, fluid and set pressure scope, as the valve previously failing to meet the test requirement.

2) Failure of this valve(s) to meet the ASME Code to which the valve was manufactured shall be cause for consideration by the National Board of revocation of the "VR" *Certificate of Authorization* or acceptance of alternative corrective action.

1.7.5.6 VERIFICATION TESTING ALTERNATIVES

a) In such cases where all valves repaired by the applicant for a specified ASME Code Section or test fluid exceed the capabilities of the accepted testing laboratory, valves for that ASME Code Section or test fluid shall be selected as specified in 1.7.5.4, and a demonstration test shall be successfully performed in lieu of verification testing specified in 1.7.5.5 above. The demonstration tests shall be conducted at a facility mutually agreeable to the National Board representative, the facility owner, and the applicant. The purpose of these tests is to demonstrate, in the presence of a National Board representative, that the repaired valves shall have adequate seat tightness at the maximum expected operating pressure prior to lifting, shall open within the required set pressure tolerance, operate consistently without chatter, and reclose within the required blowdown.

b) If a valve lift-assist device is used by the applicant to establish set pressure after repairs, this device must also be used to set the demonstration valves.

c) If either of these valves fail to meet the above criteria, then replacement valves shall be repaired and tested at a rate of two valves for each one that failed.

1) If either or both of these replacement valves fail to meet the above criteria, the applicant shall document the cause of the noted deficiencies and actions taken to guard against future occurrence. Upon acceptance of this information by the National Board, one (1) additional valve for each replacement valve that failed shall be repaired and tested. The valve(s) shall be of the same ASME Code section, fluid, and set pressure scope as the valve previously failing to meet the test requirement.

2) Failure of this valve(s) to meet the ASME Code to which the valve was manufactured shall be cause for consideration by the National Board of revocation of the "VR" *Certificate of Authorization* or acceptance of alternative corrective action.

1.7.6 USE OF THE "VR" AUTHORIZATION

1.7.6.1 TECHNICAL REQUIREMENTS

The administrative requirements of 1.7 for use of the "VR" stamp shall be used in conjunction with the technical requirements for valve repair as described in Supplement 7 of the NBIC. Those requirements shall be mandatory when a "VR" repair is performed.

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) Group 4 - 250°F (120°C) 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 - Same as for P-No. 3 (Note 1) Group 6 - Same as for P-No. 5 (Note 1) Group 7 - Same as for P-No. 5 (Note 1)
Note 1: 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.	

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) 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 acceptance by the Inspector and, when required, by the Jurisdiction.

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 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.

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.

2) The length of the HB shall consist of the SB distance plus ~~4 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 ~~5 R*t~~. $4\sqrt{R*t}$ $5\sqrt{R*t}$.

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 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). $(SB + 4\sqrt{R*t})$

3) The GCB shall be kept as low as possible in all directions to avoid harm-

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 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 2.5.3.4. The repair depth for temper bead repairs to ~~P-No4~~ and ~~P-No 5A~~ materials shall be in accordance with the requirements of 2.5.3.4(a) .

P-No. 4 and P-No. 5A

e) The test material for the welding procedure qualification shall be of the same material specification (including specification type, grade, class, and condition of heat treatment) as the material being repaired. In the event that the notch toughness of the material to be repaired is unknown, evidence from tests of that material or from another acceptable source (see 2.5.3) may be used for the base metal notch toughness when qualifying the WPS as required in 2.5.3.2(h). In the event that the original material specification is obsolete, the test material used should conform as closely as possible to the original material used for construction based on nominal composition and carbon equivalent (IIW Formula)[7], but in no case shall the material be lower in strength.

f) The qualification thickness for the test plates and repair groove depths shall be in accordance with Table 2.5.3.

g) The organization making the repair shall include, when qualifying its WPS, sufficient tests to determine that the notch toughness of the weld metal and the heat-affected zone of the base metal in the as-welded condition is adequate at the minimum operating and pressure test temperatures (including start-up and shutdown). If for reasons of corrosion resistance, special hardness limits are necessary, such limits shall be included when qualifying the WPS.

h) Notch toughness shall be determined and evaluated by Charpy impact tests in accordance with the provisions of the original code of construction at the temperature determined in accordance with 2.5.3.2(d). Exemptions from impact testing described in the original code of construction are not applicable.

i) For the welding process in 2.5.3.2(c), use only electrodes and filler metals that are classified by the filler metal specification with a diffusible-hydrogen designator of H8 or lower. 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.

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

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).

7 The IIW Carbon Equivalent Formula is CE= C+ Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15. Elements are expressed in Weight Percent Amounts.

3.3 REPAIRS TO PRESSURE-RETAINING ITEMS

3.3.1 DEFECT REPAIRS

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.

3.3.2 ROUTINE REPAIRS

a) Routine repairs are repairs for which the requirements for in-process involvement by the Inspector and stamping by the 'R' Certificate Holder may be waived as determined appropriate by the Jurisdiction and the Inspector. All other applicable requirements of this Code shall be met. Prior to performing routine repairs, the "R" Certificate Holder should determine that routine repairs are acceptable to the Jurisdiction where the pressure-retaining item is installed.

b) The Inspector, with the knowledge and understanding of jurisdictional requirements, shall be responsible for meeting jurisdictional requirements and the requirements of this Code.

c) The 'R' Certificate Holder's quality system program shall describe the process for identifying, controlling, and implementing routine repairs. Routine repairs shall be documented on Form R-1 with this statement in the Remarks section: "Routine Repair."

d) Repairs falling within one or more of the following categories may be considered routine:

   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.

   3) Weld buildup of wasted areas not exceeding an area of 100 sq. inches (64,520 sq. mm) or a thickness of 25% of nominal wall thickness or ½ inch (13 mm), whichever is less.

   4) Corrosion resistance weld overlay not exceeding 100 sq. in. (64,520 sq. mm).

3.3.3 EXAMPLES OF REPAIRS

a) Weld repairs or replacement of pressure parts or attachments that have failed in a weld or in the base material;

b) The addition of welded attachments to pressure parts, such as:

   1) Studs for insulation or refractory lining

   2) Hex steel or expanded metal for Refractory lining

   3) Ladder clips

   4) Brackets having loadings that do not affect the design of the pressure-retaining item to which they are attached

   5) Tray support rings

c) Corrosion resistant strip lining, or weld overlay;

d) Weld buildup of wasted areas;

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 joints in the component being overlaid required postweld heat treatment (PWHT) by the code of construction, the WPS followed for the weld buildup shall be given PWHT.

e. The pressure-retaining item shall be taken out of service and internal contents emptied prior performing the weld metal buildup. The owner of the pressure-retaining item shall evaluate the flammability, volatility, or potential reaction of the contents that were in the vessel to assure safe working conditions during weld repair.

f. This method may be used more than once in the same areas to repair locally thinned areas; however , the cumulative weld buildup for all repairs shall not exceed the thickness (t) of the component at any point.

g. Repairs using this method shall not cover more than 25% of the circumference of the component.

3) External weld buildup shall be applied in accordance with the following requirements:

a. The area to be repaired shall be ultrasonically scanned for wall thickness, and the location and size of the thinned region shall be mapped.

b. The area requiring repairs and the boundaries of the weld buildup shall be marked on the external surface of the component.

c. The general design of the external weld buildup shall be in accordance with Figure 3.3.4.3-c. The finished weld buildup shall be circular, oval, or rectangular in shape.

d. The weld buildup shall extend, at full thickness, a minimum distance B in each direction beyond the boundaries of the thinned base metal area.

1. $B = \frac{3}{4}\sqrt{Rt_{nom}}$

2. R = outer radius of the component, or D/2

3. t_{nom} = nominal wall thickness of the component

The thickness shall be sufficient to maintain the predicted life of the repair. Any corrosion allowance that is determined to be necessary shall be added to the value of B.

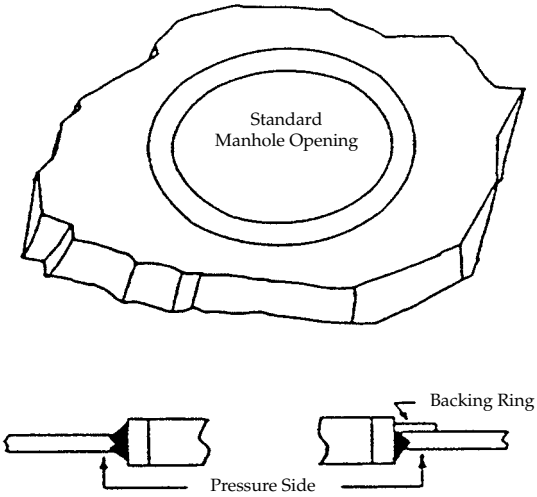
e. All edges of the weld buildup shall be tapered to the existing contour of the component, at a maximum angle (a) of 45°.

f. The thickness of the weld buildup shall be uniform except along tapered edges. As welded surfaces are acceptable provided they are free of coarse ridges and valleys and are suitable for any required nondestructive examinations

g. All corners of the weld buildup shall have a minimum radius (r), not less than the overlay thickness.

FIGURE 3.3.4.3-b
Repairs for Access Openings

A badly wasted manhole flange may be removed and replaced with a ring-type frame as shown below. The requirements for flush patches shall be met. A full penetration weld is required. May be either double or welded from one side with or without a backing ring.



A badly wasted area around a handhole opening may be repaired by adding a ring, as shown below, on the inside of the object.

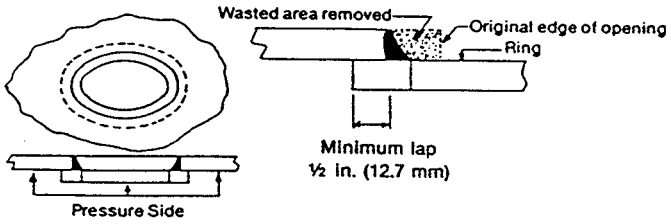
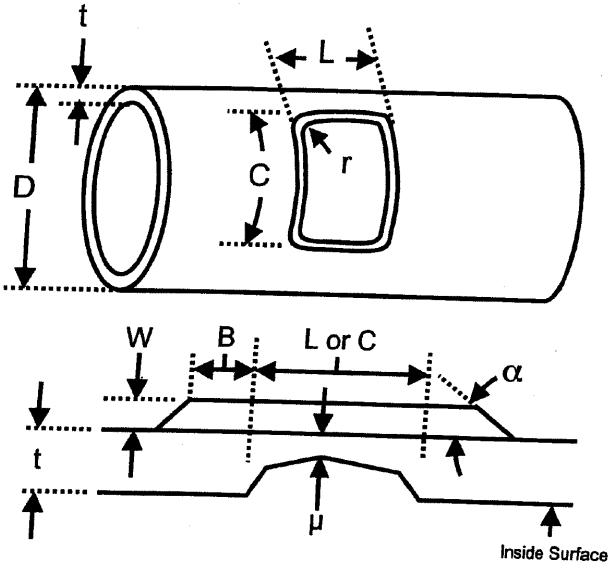


FIGURE 3.3.4.3-c
External Overlay Terms and Definitions



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
a = the angle between the component and the overlay (maximum 45°)
B = 3/4 √(R t) 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 or greater.

h. Any corrosion allowance that is determined to be necessary shall be added to the thickness of the weld buildup.

i. The thickness (W) pf the weld deposit plus the remaining wall thickness in the affected area (μ) of the component at it thinnest point shall not exceed the nominal wall thickness (t) of the component. This shall be verified by ultrasonic methods.

j. Final dimension and contour of the weld buildup may be achieved by grinding or machining. This work may be done before or after any PWHT.

k. The weld buildup shall be examined by liquid penetrant inspection or wet fluorescent magnetic particle inspection. If the butt welds in the component being built up were required to be volumetrically examined during the original construction, the built-up area shall be similarly volumetrically examined.

l. For each repair, the maximum dimension (L, length along axis) compensated by a circular or oval weld buildup shall not exceed the lesser of the 1/4 the nominal outside diameter or the component of 8 in. (200 mm). The length of a rectangular patch is not limited.

m. The distance between the weld toes of the multiple weld buildup regions on a component outer diameter surface area shall not be less than 3/4 $\sqrt{(Rt)}$.

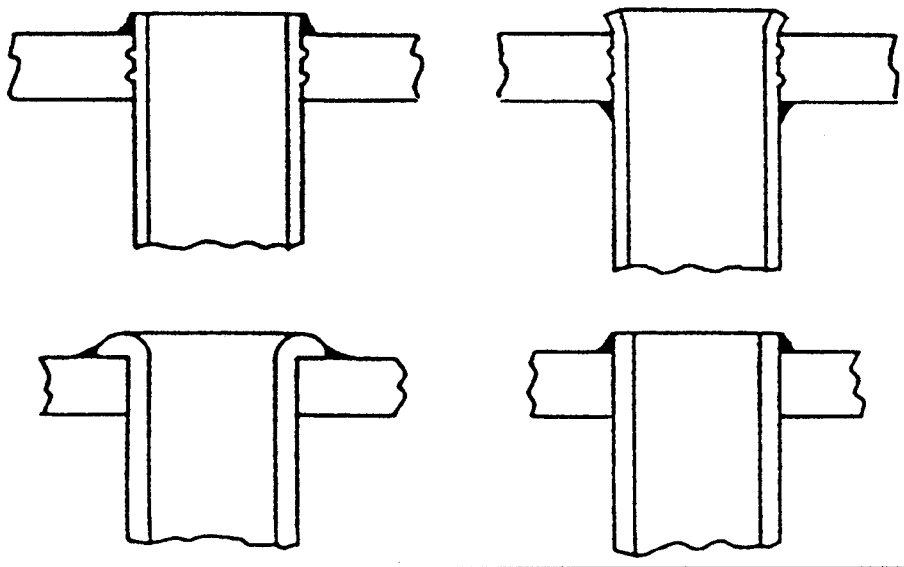
3.3.4.4 SEAL WELDING

a) Seal Welding of Tubes
Tubes may be seal welded, provided the ends of the tubes have sufficient wall thickness to prevent burn-through and the requirements of the original code of construction are satisfied as shown in Figure 3.3.4.4-a.

b) Seal Welding of Riveted Joints
Edges of buttstraps, plate laps, and nozzles,

FIGURE 3.3.4.4-a
Typical Examples of Seal Welding Tubes
Tubes may be seal welded provided the ends of the tubes have sufficient wall thickness to prevent burn-through. Seal welding shall be applied in strict accordance with the original code of construction for the requirements of the tube projection, welding, and tube expanding. Seal welding shall not be considered a strength weld.

In watertube boilers, tubes may be seal welded on the inside or outside of the tubesheet.



g) Except as permitted in 3.3.3 s) replacement of a pressure-retaining part in a pressure-retaining item with a material of different allowable stress or nominal composition from that used in the original design; and

h) The addition of a bracket or an increase in loading on an existing bracket that affects the design of the pressure-retaining item to which it is attached.

3.4.4 ALTERATION OF ASME CODE SECTION VIII, DIVISION 2 OR 3, PRESSURE VESSELS

3.4.4.1 ALTERATION PLAN

a) Professional Engineer Review
The alteration plan shall be reviewed and certified by a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable. The review and certification shall be such as to ensure the work involved in the alteration is compatible with the user's design specification and the *Manufacturer's Design Report*.

b) User's Design Specification
If the alteration is such that the work is not compatible with or changes one or more requirement(s) of the original user's design specification, the user's design specification shall be revised by the user with the new parameters or changes. The revisions shall be certified by a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable.

c) *Manufacturer's Design Report*
The "R" Certificate Holder shall prepare or cause to have prepared a supplement to the manufacturer's design report to reconcile the new parameters or changes with the user's design specification.

The supplement to the manufacturer's design report shall be certified by a Professional Engineer who is registered in one or more of the states of the United States of America or the provinces of Canada, is experienced in pressure vessel design, and is knowledgeable in ASME Section VIII, Division 2 or 3, as applicable.

d) Authorized Inspection Agency Acceptance
Following review and certification, the alteration plan shall be submitted for acceptance to the Authorized Inspection Agency/Owner-User Inspection Organization whose inspector will make the acceptance inspection and sign the Form R-2.

verification testing as specified in the quality system, or comparisons to field performance. This qualification shall be documented and provisions made to retain such documentation for a period of at least five years after the testing equipment is retired. Documentation of this qualification shall include but not be limited to:

a. Schematic of the performance test equipment;

b. Size and pressure ranges of valves to be tested and the test fluid to be used;

c. Dimensions of test vessels;

d. Accuracy of pressure measuring equipment;

e. Size and design type of valves used to control flow; and

f. Method of qualifying.

3) Prior to the implementation of any addition or modification to the testing equipment that would alter the contents of the document required in 4.5.1(b)(2), the Certificate Holder shall re-qualify the performance test equipment in accordance with 4.5.1(b)(2). If the equipment changed was used to satisfy the requirements of verification testing, the Certificate Holder shall notify the National Board and additional verification testing, in accordance with the quality system, may be required.

4.5.2 OWNER-USER ASME CODE SECTION VIII STEAM TESTING

When ASME Code Section VIII valves are repaired by the owner for the owner's own use, valves for steam service may be tested on air for set pressure and, if possible, blowdown adjustment provided the valve manufacturer's corrections for differential in set pressure between steam and air are applied to the set pressure.

4.5.3 LIFT ASSIST TESTING

a) A device may be used to apply an auxiliary lifting load on the spring of a repaired valve to establish the set pressure in lieu of the tests required in 4.5.1a)1) when such testing at full pressure:

1) may cause damage to the valve being tested; or

2) is impractical when system design considerations preclude testing at full pressure.

b) While actual valve blowdown and valve performance characteristics cannot be verified, valve set pressure may be determined to an acceptable degree of accuracy using this testing technique provided, as a minimum, that:

1) equipment utilized is calibrated as required in the quality system;

2) the device and test procedures that have proved to give accurate results are used and followed;

3) a static inlet pressure is applied with the test medium specified in 4.5.1; and

4) adjustments are made in accordance with the valve manufacturer's recommendations to ensure proper lift and blowdown.

4.5.4 PRESSURE TEST OF PARTS

a) Parts used in repaired valves shall be pressure tested and documentation provided according to the following categories

5.9 STAMPING REQUIREMENTS FOR PRESSURE RELIEF DEVICES

5.9.1 NAMEPLATES

Proper marking and identification of tested or repaired valves is critical to ensuring acceptance during subsequent inspections, and also provide for traceability and identification of any changes made to the valve. All operations that require the valve's seals to be replaced shall be identified by a nameplate as described in 5.9.2 or 5.9.4.

5.9.2 REPAIR NAMEPLATE

When a pressure relief valve is repaired, a metal repair nameplate stamped with the information required below shall be securely attached to the valve adjacent to the original manufacturer's stamping or nameplate. If not mounted directly on the valve, the nameplate shall be securely attached so as not to interfere with valve operation and sealed in accordance with the quality system.

a) Prior to attachment of the repair nameplate, the previous repair nameplate, if applicable, shall be removed from the repaired valve.

b) As a minimum, the information on the valve repair nameplate (See Figure 5.9.6-e) shall include:

   1) The name of the repair organization preceded by the words "repaired by";

   2) The "VR" repair symbol stamp and the "VR" Certificate Number;

   3) Unique identifier (e.g., repair serial number, shop order number, etc.);

   4) Date of repair;

   5) Set pressure;

   6) Capacity and capacity units (if changed from original nameplate due to set pressure or service fluid change);

   7) Type/Model number (if changed from original nameplate by a conversion. See Supplement S7.2; and

   8) When an adjustment is made to correct for service conditions of superimposed back pressure and/or temperature or the differential between popping pressure between steam and air (See 4.5.2), the information on the valve repair nameplate shall include the:

      a. Cold Differential Test Pressure (CDTP), and

      b. Superimposed Back Pressure (BP) (only when applicable).

5.9.3 CHANGES TO ORIGINAL PRESSURE RELIEF VALVE NAMEPLATE INFORMATION

a) If the set pressure is changed, the set pressure, capacity, and blowdown, if applicable, on the original nameplate or stamping shall be marked out but left legible. The new capacity shall be based on that for which the valve was originally certified.

b) If the service fluid is changed, the capacity, including units, on the original nameplate or stamping shall be marked out but left legible. The new capacity shall be based on that for which the valve was originally certified, or if a conversion has been made, as described in Supplement S7.2 on the capacity certification for the valve as converted.

c) If the Type/Model number is changed, the Type/Model number on the original nameplate shall be marked out but left legible.

d) If the blowdown is changed, the blowdown on the original nameplate or stamping shall

be marked out but left legible. The new blowdown may be based on the current ASME Code requirements.

e) Incorrect information on the original manufacturer's nameplate shall be marked out but left legible. Corrected information shall be indicated on the repair nameplate and noted on the document as required by the quality system.

5.9.4 TEST ONLY NAMEPLATE

a) Where a valve has been tested and adjusted, as permitted by Supplement S7.10.1 but not otherwise repaired, a "Test Only" nameplate shall be applied that contains the following information:

1) Name of responsible organization;

2) Date of test;

3) Set Pressure; and

4) Identification, such as "Test Only."

b) A "test only" nameplate is also recommended when periodic testing has been performed, even when no adjustments have been made, for the purpose of identifying the date the valve was tested.

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

5.9.5 REPLACEMENT OF ILLEGIBLE OR MISSING NAMEPLATES

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

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

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

5.9.6 REQUIREMENTS FOR STAMPING AND NAMEPLATE INFORMATION

5.9.6.1 SCOPE

When a pressure-retaining item is repaired or altered, the Certificate Holder shall attach a nameplate or stamp the item, except when otherwise permitted by these rules. Similarly, when pressure relief devices are repaired, the

FORM R-1 REPORT OF REPAIR

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

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

   _____ (PO 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.) _____ (other) _____ (year built)

6. NBIC Edition/Addenda: _____ (edition) _____ (addenda)

   Original Code of Construction for Item: _____ (name/section/division) _____ (edition/addenda)

   Construction Code Used for Repair Performed: _____ (name/section/division) _____ (edition/addenda)

7. Repair Type: ☐ Welded ☐ Graphite Pressure Equipment ☐ FRP Pressure Equipment

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

   _____ Pressure Test, if applied _____ psi MAWP _____ psi

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

   _____ (name of part, item number, data report type, mfg's name, and identifying stamp)

10. 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 _____, _____ _____ (name of repair organization) Signed _____ (authorized representative)

CERTIFICATE OF INSPECTION

I, _____, holding a valid Commission issued by The National Board of Boiler and Pressure Vessel Inspectors and certificate of competency issued **where required**, 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 and Jurisdiction No.)

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Ave., Columbus, OH 43229 NB-66 Rev. 11

5.13.5 FORM NR-1, *NUCLEAR COMPONENTS AND SYSTEMS IN NUCLEAR POWER PLANTS*

FORM NR–1 REPORT OF REPAIR ☐ ~~MODIFICATION~~ ☐ OR REPLACEMENT ☐
TO NUCLEAR COMPONENTS AND SYSTEMS IN NUCLEAR POWER PLANTS

1. Work performed by (1) _____ (name of "NR" certificate holder) (2) _____ (PO no., job no., etc.)

2. Owner (address) (4) _____ (name)

3. Name, address, and identification of nuclear power plant (address) (5) _____

4. System (6) _____

5a. Items that Required Repair, ~~Modification,~~ or Replacement Activities

Identification								Construction Code				Activity
No.	Type of Item	Mfg. Name	Mfg. Serial No.	Nat'l Bd No.	Juris. No.	Other	Year Built	Name / Section / Division	Edition / Addenda	Code Case(s)	Code Class	Repair / ~~Mod./~~ Replace
1	(8)	(9)	(11)	(12)	(15)	(16)	(17)	(18)	(19)	(19)	(19)	(20)
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

5b. Items Installed During Replacement Activities

Identification								Construction Code			
Type of Item	Installed or Replaced 5a Item No.	Mfg. Name	Mfg. Serial No.	Nat'l Bd No.	Juris. No.	Other	Year Built	Name / Section / Division	Edition / Addenda	Code Case(s)	Code Class
(10)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(29)	(29)

6. ASME Code Section XI applicable for inservice inspection: (30) _____ (30) _____ (30) _____

7. ASME Code Section XI used for repairs, ~~modifications,~~ or replacements: (31) _____ (31) _____ (31) _____

8. Construction Code used for repairs, ~~modifications,~~ or replacements: (32) _____ (32) _____ (32) _____

9. Design responsibilities (33) _____

10. Tests conducted: hydrostatic ☐ pneumatic ☐ design pressure ☐ pressure (34) _____ psi Code Case(s) (34) _____

(MPA)

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Ave., Columbus, OH 43229 NB-81

11. Description of work (39)
(use of properly identified additional sheet[s] or sketch[es] is acceptable)

12. Remarks (40)

CERTIFICATE OF COMPLIANCE

I, (41), certify that to the best of my knowledge and belief the statements made in this report are correct and the repair, ~~modification,~~ or replacement activities described above conform to Section XI of the ASME Code and the *National Board Inspection Code* "NR" rules.

National Board Certificate of Authorization No. (42) to use the "NR stamp expires (43), _____

NR Certificate Holder (44)
(name)

Date (45), _____ Signed (46) (47)
(authorized representative) (title)

CERTIFICATE OF INSPECTION

I, (48), holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and certificate of competency issued by the jurisdiction of (49) and employed by (50) of (51)

have inspected the repair, ~~modification,~~ or replacement described in this report on (52), _____ and state that to the best of my knowledge and belief, this repair, ~~modification,~~ or replacement activity has been completed in accordance with Section XI of the ASME Code and the *National Board Inspection Code* "NR" rules.

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 a loss of any kind arising from or connected with this inspection.

Date (52), _____ Signed (53) Commissions (54)
(inspector) (National Board and jurisdiction no.)

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5.13.6 FORM NVR-1, *NUCLEAR PRESSURE RELIEF DEVICES*

FORM NVR–1 REPORT OF REPAIR ☐ ~~MODIFICATION~~ ☐ OR REPLACEMENT ☐
OF NUCLEAR PRESSURE RELIEF DEVICES

1. Work performed by (1) _____ (2) _____
(name of certificate holder) (PO No., Job No., etc.)
(address)
2. Work performed for (3) _____
(name)
3. Owner (4) _____
(name)
(address)
4. Name, address, and identification of nuclear power plant (5) _____
5. a: Repaired pressure relief device: (7) _____
b: Name of manufacturer (9) _____
c: Identifying nos. (10) _____ (11) _____ (12) _____ (13) _____ (14) _____ (17) _____
(type) (mfg's serial no.) (Nat'l Bd no.) (service) (size) (year built)
d: Construction Code (18) _____ (19) _____ (19) _____ (19) _____ (19) _____
(name/section/division) (edition) (addenda) (Code Case[s]) (code class)
6. ASME Code Section XI applicable for inservice inspection: (30) _____ (30) _____ (30) _____
(edition) (addenda) (Code Case[s])
7. ASME Code Section XI used for repairs, ~~modifications,~~ or replacements: (31) _____ (31) _____ (31) _____
(edition) (addenda) (Code Case[s])
8. Construction Code used for repairs, ~~modifications,~~ or replacements: (32) _____ (32) _____ (32) _____
(edition) (addenda) (Code Case[s])
9. Design responsibility (33) _____
10. Opening pressure: (35) _____ Blowdown (if applicable) (36) _____ %. Set pressure and blowdown adjustment made at: (37) _____ using (38) _____
11. Description of work: (include name and identifying number of replacement parts) (39) _____
12. Remarks: (40) _____

CERTIFICATE OF COMPLIANCE

I, (41) _____, certify that to the best of my knowledge and belief the statements made in this report are correct and the repair, ~~modification,~~ or replacement of the pressure relief devices described above conforms to Section XI of the ASME Code and the *National Board Inspection Code* "VR" and "NR" rules.

National Board Certificate of Authorization No. (42) _____ to use the "VR" stamp expires (43) _____, _____

National Board Certificate of Authorization No. (42) _____ to use the "NR" stamp expires (43) _____, _____

Date (45) _____, _____ (44) _____ Signed (46) _____ (47) _____

CERTIFICATE OF INSPECTION

I, (48) _____, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and certificate of competency issued by the jurisdiction of (49) _____ and employed by (50) _____ of (51) _____ have inspected the repair, ~~modification,~~ or replacement described in this report on (52) _____, _____ and state that to the best of my knowledge and belief, this repair, ~~modification,~~ or replacement has been completed in accordance with Section XI of the ASME Code and the *National Board Inspection Code* "VR" and "NR" rules.

By signing this certificate, neither the undersigned nor my employer makes any warranty, expressed or implied, concerning the repair, ~~modification,~~ or replacement 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 (52) _____, _____ Signed (53) _____ Commissions (54) _____
(inspector) (National Board and jurisdiction no.)

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30. Identify the edition, addenda, and any applicable code cases of the ASME Section XI code used for the repair or replacement activity.

31. Identify the edition, addenda, and any applicable code cases of the ASME Section XI code for the repair/replacement activity.

32. Identify the edition, addenda, and any applicable code cases of the construction code for the repair/replacement activity.

33. Identify the organization responsible for design or design reconciliation, if applicable.

34. Identify the type of pressure test (e.g., hydrostatic, pneumatic, or design) and applied test pressure. Also indicate any code cases used in connection with the pressure test.

35. Indicate the set pressure of the valve.

36. Indicate blowdown, if applicable, as a percentage of set pressure.

37. Indicate the repair organization's name and address.

38. Indicate the medium (steam, air, etc.) used for the adjustment of set pressure and, if applicable, blowdown.

39. State exact scope of work for the repair/replacement activity. If necessary attach additional data, sketch, Form R-4, etc. If additional data is attached, so state.

40. Indicate any additional information pertaining to the work.

41. Type or print name of authorized representative from the certificate holder.

42. Indicate National Board *Certificate of Authorization* number.

43. Indicate month, day, and year the certificate expires.

44. Name of the certificate holder which performed the identified work.

45. Enter date certified.

46. Signature of authorized representative from the certificate holder.

47. Title of authorized representative.

48. Type or print name of Authorized Nuclear ~~Inservice~~ Inspector.

49. Indicate the jurisdiction where the work is performed.

50. Indicate Authorized Nuclear Inspector's employer.

51. Indicate address of Authorized Nuclear ~~Inservice~~ Inspector's employer (city and state or province).

52. Indicate month, day, and year of inspection by the Authorized Nuclear ~~Inservic~~e Inspector.

53. Signature of Authorized Nuclear I~~nservice~~ Inspector.

54. National Board Commission number of the Authorized Nuclear Inspector, including endorsements, and when required by the jurisdiction, the applicable State or Provincial numbers.

g) Weld seams parallel to a knuckle shall be located no closer to the knuckle than the point of tangency of the knuckle unless the weld is radiographically examined. Weld seams not located in the knuckle are preferred. See Figure S1.2.11.5-b.

h) Patches shall be made from material that is at least equal in quality and thickness to the original material.

S1.2.11.3 **REPAIR OF STAYED FIREBOX SHEETS GROOVED OR WASTED AT THE MUDRING**

a) Grooved or wasted firebox sheets having greater than 60% of the minimum required thickness remaining may be repaired by weld buildup provided the wastage does not extend below the waterside surface of the mudring and the strength of the structure will not be impaired. If extensive welding is required, the affected area shall be removed and replaced with a flush patch.

b) If the sheet thickness has been reduced to less than 60% of the minimum required thickness, the affected section shall be removed and replaced with a flush patch.

c) If wastage and grooving extends below the mudring waterside surface and if the plate thickness remaining has been reduced to less than the minimum required thickness, the affected section shall be removed and replaced with a flush patch.

d) Flush patches shall be arranged to include the mudring rivets and at least the first row of staybolts above the mudring.

S1.2.11.4 MUDRING REPAIRS (SEE FIGURE S1.2.11.4)

a) Pitted and wasted sections of mudrings may be built up by welding provided the strength of the mudring will not be impaired. Where extensive weld buildup is

FIGURE S1.2.11.3
Stayed Firebox Sheet Grooved or Wasted at Mudring

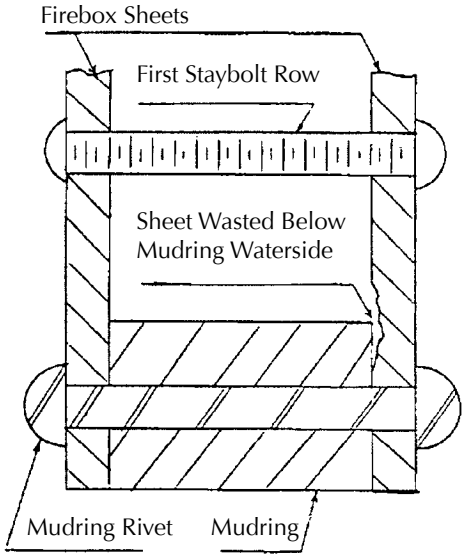
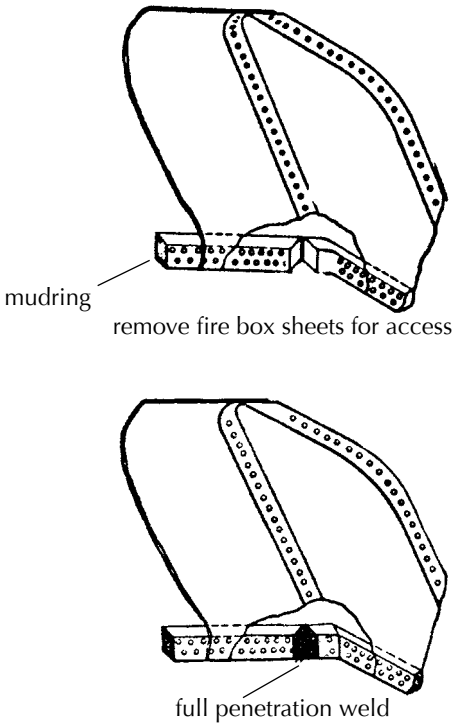


FIGURE S1.2.11.4
Mudring Repairs



S7.10 GUIDE TO JURISDICTIONS FOR AUTHORIZATION OF OWNERS-USERS TO MAKE ADJUSTMENTS TO PRESSURE RELIEF VALVES

S7.10.1 GENERAL

The Jurisdiction may authorize properly trained and qualified employees of boiler and pressure owners-users or their designees to restore set pressure and/or performance of pressure relief valves. All external adjustments shall be re-sealed with a seal identifying the responsible organization and a metal tag that identifies the organization and the date the adjustment shall be installed.

S7.10.2 TRAINING

a) The user shall establish a documented in-house training program. This program shall establish training objectives and provide a method of evaluating the training effectiveness. As a minimum, training objectives for knowledge level shall include:

   1) Applicable ASME Code and NBIC requirements;

   2) Responsibilities within the organization's quality system;

   3) Knowledge of the technical aspects and mechanical skills for making set pressure and/or blowdown adjustments to pressure relief valves;

   4) Knowledge of the technical aspects and mechanical skills for marking of pressure relief valve adjustments.

b) If the user established a designee, the designee shall establish a training program and make their documentation available to the user and the jurisdictional authority.

S7.10.3 DOCUMENTATION

Each user shall document the evaluation and acceptance of an employee's or designee's qualifications.

S7.10.4 QUALITY SYSTEM

a) A written quality system shall be established by either the user or the designee with a written description available to the jurisdictional authority.

b) The written description shall include at a minimum:

   1) Calibration of Test Equipment: This shall describe a system for the calibration of measuring and test equipment. Documentation of these calibrations shall include the standard used and the results. Calibration standards shall be calibrated against the equipment having valid relationships to nationally recognized standards.

   2) Valve Testing, Setting, and Sealing: This system shall include provisions that each valve shall be tested, set, and all external adjustments sealed according to the requirements of the applicable ASME Code Section and S7.10.1(a).

   3) Valve Marking: An effective marking system shall be established to ensure proper marking of the metal tag required by S7.10.1(a). The written quality system shall include a description of drawing of the metal tag.

S7.10.5 EXTERNAL ADJUSTMENTS

Only external adjustments to restore the required set pressure and/or performance of a pressure relief valve shall be made under the provisions of S7.10.1~~(a).~~ Remove a)

removed before the weld repair of the part is performed. Removal of the defect shall be verified by suitable NDE as required.

d) Consideration shall be given to the condition of the existing material, especially in the weld preparation area.

S7.12.1 WELDING PROCEDURE SPECIFICATIONS

Welding shall be performed in accordance with Welding Procedure Specifications (WPS) qualified in accordance with the original code of construction. When this is not possible or practicable, the WPS may be qualified in accordance with Section IX of the ASME Code.

S7.12.2 STANDARD WELDING PROCEDURE SPECIFICATIONS

A "VR" Certificate Holder may use one or more applicable Standard Welding Procedure Specifications shown in 2.3 of this part.

S7.12.3 PERFORMANCE QUALIFICATION

Welders or welding operators shall be qualified for the welding processes that are used. Such qualification shall be in accordance with the requirements of the original code of construction or Section IX of the ASME Code.

S7.12.4 WELDING RECORDS

The "VR" Certificate Holder shall maintain a record of the results obtained in welding procedure qualifications, except for those qualifications for which the provisions of Supplement S7.12.2 are used, and of the results obtained in welding performance qualifications. These records shall be certified by the "VR" Certificate Holder and shall be available to the National Board.

S7.12.5 WELDERS' IDENTIFICATION

The "VR" Certificate Holder shall establish a system for the assignment of a unique identification mark to each welder/welding operator qualified in accordance with the requirements of the NBIC. The "VR" Certificate Holder shall also establish a written procedure whereby welded joints can be identified as to the welder or welding operator who made them. This procedure shall use one or more of the following methods and shall be described in the quality control system written description. The welder's or welding operator's identification mark may be stamped (low stress stamp) adjacent to welded joints made by the individual, or the "VR" Certificate Holder may keep a documented record of welded joints and the welders or welding operators used in making the joints.

S7.12.6 WELDERS' CONTINUITY

The performance qualification of a welder or welding operator shall be affected when one of the following conditions occur:

a) When the welder or welding operator has not welded using a specific process during a period of six months or more, their qualifications for that process shall expire.

b) When there is specific reason to question their ability to make welds that meet the specification, the qualification that supports the welding that is being performed shall be revoked. All other qualifications not questioned remain in effect.

S7.13 HEAT TREATMENT

S7.13.1 PREHEATING

Preheating may be employed during welding to assist in completion of the welded joint (2.5.1 of