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Comments must be submitted with the 'NBIC Public Review Comment Form'

All comments must be received by October 12, 2026

Deleted items are designated by strikethrough.
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Item NB15-0307, Item 25-28, Item 25-29, Item 26-14 and editorial All Parts, Glossary	9.1 GLOSSARY **Authorized Inspection Agency (AIA)** **Inservice:** An Authorized Inspection Agency is either: a) a Jurisdictional ~~authority~~ Authority as defined in the National Board Constitution; or b) an entity that is accredited by the National Board meeting the requirements of NB-369, *Accreditation of Authorized Inspection Agencies Performing Inservice Inspection Activities*~~;~~ or NB-371, *Accreditation of Owner-User Inspection Organizations* ~~(OUIO).; or NB-390, Accreditation of Federal Inspection Agencies (FIA).~~ **Brazing** — A group of metal--joining processes which produce coalescence of materials by heating them to a suitable temperature, and by using a ~~filler metal~~brazing consumable having a liquidus above 840°F (450°C) and below the solidus of the base materials. The filler metal is distributed between the closely fitted surfaces of the joint by capillary action. **Controlled Fill** – weld technique for a repair process to ensure satisfactory weld properties by controlling variables, including but not limited to, heat input, preheat and interpass temperatures, weld consumable type and size, weld technique (stringer or weave), and bead placement. **National Board Commissioned Inspector** — An individual who holds a valid ~~and current~~ National Board Commission. **Owner-User Inspector** — An individual who holds a valid ~~and current~~ National Board ~~Owner-User~~Inservice Commission and is employed by an organization holding a valid National Board OUIO *Certificate of Accreditation*. **Pin Device –** A pin device is a non-reclosing pressure relief device actuated by inlet static or differential pressure and designed to function by the activation of a load-bearing section of a pin that supports a pressure-containing member. A pin is the load-bearing activation component of a pin device. Its cross-sectional area is not limited to a circular shape. A pin device body is the structure that encloses the pressure-containing members. **Pin Device, Capacity-Certified** – A pin device certified in accordance with ASME BPVC Section XIII, paragraphs 9.7.3 through 9.7.6. **Pin Device, Flow-Resistance-Certified –** A pin device certified in accordance with ASME BPVC Section XIII, paragraph 9.7.7. **Pressure relief device (PRD)** — A device designed to prevent pressure or vacuum from exceeding a predetermined value in a pressure vessel by the transfer of fluid during emergency or abnormal conditions.

	Welding — A group of processes which produce a localized coalescence of metallic or nonmetallic materials by heating the materials to ~~the~~ a suitable temperature, with or without the application of pressure, and with or without the use of ~~filler material~~a weld consumable.
Item 25-03 Part 1, 1.6.1	**1.6.1 SUPPORTS, PIPING, FOUNDATIONS, AND SETTINGS** a) Each boiler, potable water heater, thermal fluid heater, pressure vessel and all associated piping shall be safely supported. Design of supports, foundations, and settings shall consider vibration (including seismic where necessary), movement (including thermal expansion and contraction), grounding/bonding to minimize electrolytic corrosion, and loadings (including the weight of the fluid in the system during a pressure test) in accordance with jurisdictional requirements, manufacturer's recommendations, and other industry standards, as applicable. b) Discharge piping shall be secured and located to prevent potential injury to personnel. c) Piping loads on vessel nozzles shall be considered. Piping loads include the weight of the pipe, weight of the pipe contents, and expansion of the pipe from temperature and pressure changes (wind and seismic loads). The effects of piping vibration on vessel nozzles shall also be considered.
Item 25-03 Part 1, 2.3.1	**2.3.1 SUPPORTS, PIPING, FOUNDATIONS, AND SETTINGS** See NBIC Part 1, Section 1.6.1, *Supports, Piping, Foundations, and Settings*.
Part 1, 2.5.3.1 Editorial	**2.5.3.1 WIRING** All wiring for controls, heat-generating apparatuses, and other appurtenances necessary for the operation of the boiler or boilers should be installed in accordance with the provisions of national or international standards and comply with the applicable local electrical codes.
Item 23-52 Part 1, 2.5.3.2	**2.5.3.2 REMOTE EMERGENCY SHUTDOWN SWITCHES** ~~a)~~ A manually operated remote emergency shutdown switch~~(es)~~ or circuit breaker shall be ~~located just outside the equipment room door~~ provided and marked for easy identification. ~~Consideration should also be given to the type and location of the switch(es) in order to safeguard against tampering. Where approved by the Jurisdiction, alternate locations of remote emergency switch(es) may be provided.~~ a) The default location for the switch or circuit breaker shall be just outside the boiler room door; though the following factors shall be considered when determining the appropriate location and number of switches to be installed:

	1) If the equipment room door is on the building exterior, the switch should be located just inside the door. 2) ~~b)~~ For equipment rooms exceeding 500 ft~~.~~^{2} (46 m^2) floor area or containing one or more boilers having a combined fuel capacity of 1,000,000 Btu/hr~~.~~ (293 kW) or more, additional manually operated remote emergency shutdown switches shall be located at suitably identified points of egress acceptable to the j~~J~~urisdiction. 3) ~~c)~~ Where a boiler is located indoors ~~in a facility~~ and not in an equipment room, a remote emergency shutdown switch shall be located within 50 ft~~.~~ (15 m) of the boiler along the primary egress route from the boiler area. 4) Additional consideration should be given to the type and location of the switch(es) to facilitate proper operation and safeguard against tampering. Where approved by the jurisdiction, alternate locations of remote emergency shutdown switches may be provided. 5) For utility boilers or other large-scale units operated from a control room, the switch should be installed in a location immediately accessible to the operator. ~~d)~~ b) For atmospheric ~~-~~gas burners and for oil burners where a fan is on the common shaft with the oil pump, the ~~emergency~~ remote emergency shutdown switch~~(es)~~ or circuit breaker~~(s)~~ ~~must~~ shall disconnect all power to the burner controls. ~~e)~~ c) For power burners with detached auxiliaries, the ~~emergency~~ remote emergency shutdown switch~~(es)~~ or circuit breaker~~(s)~~ need only shut off the fuel input to the burner. ~~f) When existing boiler installations do not include remote emergency shutdown switches, it is not required that these switches be retroactively installed unless required by the Jurisdiction.~~
Item 25-03 Part 1, 2.7.5 l) and	a) Except for forced-flow steam generators with no fixed steam or water line, each boiler shall have a blowoff pipe, fitted with a stop valve, in direct connection with the lowest water space practicable. When the maximum allowable working pressure of the boiler exceeds 100 psig (700 kPa), ~~there shall be~~ two valves shall be installed.

editorial (2.7.5)	b) The blowoff piping for each electric boiler pressure vessel having a nominal water content not exceeding 100 gal. (378 l) is required to extend through only one valve. c) When two valves are required, each bottom blowoff pipe shall have two slow-opening valves, or one quick-opening valve, at the boiler nozzle followed by a slow-opening valve. d) Two independent slow-opening valves or a slow-opening valve and quick-opening valve may be combined in one body, provided the combined fitting is the equivalent of two independent slow-opening valves or a slow-opening valve and a quick-opening valve, and the failure of one to operate cannot affect the operation of the other. e) Straight-run globe valves or valves where dams or pockets can exist for the collection of sediment shall not be used. f) The blowoff valve or valves and the pipe and fittings between them and the boiler shall be of the same size. The minimum size of pipe and fittings shall be NPS 1 (DN 25), except boilers with 100 ft.^{2} (9.3 m^2) or less of heating surface, which should be NPS 3/4 (DN 20). The maximum size of pipe and fittings shall not exceed NPS 2-1/2 (DN 65). g) For electric boilers, the minimum size of blowoff pipes and fittings shall be NPS 1 (DN 25), except for boilers of 200 kW input or less. The minimum size should be NPS 3/4 (DN 20). h) Fittings and valves shall comply with the appropriate national standard. ~~except that a~~Austenitic stainless steel and malleable iron are not permitted. i) When the maximum allowable working pressure exceeds 100 psig (700 kPa), blowoff piping shall be at least Schedule 80, and the required valves and fittings shall be rated for at least 1.25 times the maximum allowable working pressure of the boiler. When the maximum allowable working pressure exceeds 900 psig (6.2 MPa), blowoff piping shall be at least Schedule 80, and the required valves and fittings shall be rated for at least the maximum allowable working pressure of the boiler plus 225 psig (1.6 MPa). j) When exposed to furnace heat, a~~A~~ll blowoff piping~~, when exposed to furnace heat,~~ shall be protected by fire brick or other heat ~~resisting~~-resistant material so constructed that the piping may be readily inspected. k) On a boiler having multiple blowoff pipes, a single master stop valve should be placed on the common blowoff pipe from the boiler, and one stop valve should be placed on each individual blowoff. Either the master valve or the valves on the individual blowoff lines shall be ~~of~~ the slow-opening type. l) The discharge of blowoff pipes shall be located and anchored to the floor or other structural element ~~so as~~ to prevent injury to personnel.

	m) All waterwalls or water screens that do not drain back into the boiler and integral economizers forming part of a boiler shall be equipped with blowoff piping and valves conforming to the requirements of this paragraph. n) Blowoff piping from a boiler should not discharge directly into a sewer. A blowoff tank, constructed to the provisions of a code of construction acceptable to the ~~J~~jurisdiction, shall be used where conditions do not provide an adequate and safe open discharge. o) Galvanized pipe shall not be used. p) Boiler blowoff systems should be constructed in accordance with the NB-27, *Guide for Blowoff Vessels* ~~(NB-27): which can be found~~, located on the National Board website~~, www.nationalboard.org~~(nbbi.org). q) Where necessary to install a blowoff tank underground, it shall be enclosed in a concrete or brick pit with a removable cover ~~so that~~to allow inspection of the entire shell and heads of the tank ~~can be made~~. r) Piping connections used primarily for continuous operation, such as deconcentrators on continuous blowdown systems, are not classed as blowoffs; but the pipe connections and all fittings up to and including the first shutoff valve shall be at least equal ~~at least~~ to the pressure requirements for the lowest set pressure of any safety valve on the boiler drum and with the corresponding saturated ~~-~~steam temperature. Further, such connections shall not exceed NPS 2-1/2 (DN 65).
Item 25-03 Part 1, 3.3.1, 3.3.2, 3.3.3, and 3.3.4	**3.3.1 SUPPORTS, PIPING, FOUNDATIONS, AND SETTINGS** See NBIC Part 1, 1.6.1, *Supports, Piping, Foundations, and Settings*. ~~**3.3.2 SETTINGS**~~ ~~See NBIC Part 1, Section 1.6.1, *Supports, Foundations and Settings*~~ **3.3.~~3~~2 STRUCTURAL STEEL** See NBIC Part 1, Section 1.6.2, *Structural Steel* **3.3.~~4~~3 CLEARANCES** a) Heating boilers shall have a minimum distance of at least 36 in. (914 mm) between the top of the heating boiler and any overhead structure and at least 36 in. (914 mm) between all sides of the heating boiler and adjacent walls, structures, or other equipment. Heating boilers having manholes shall have at least 84 in. (2,135 mm) of clearance between the manhole opening and any wall, ceiling, piping, or other equipment that may prevent a person from entering the heating boiler. Alternative clearances in accordance with the manufacturer's recommendations are subject to acceptance by the j~~J~~urisdiction. b) Modular heating boilers that require individual units to be ~~set~~ placed side by side, front to back, or by stacking shall provide clearances in accordance with the manufacturer's recommendations, subject to acceptance by the ~~J~~jurisdiction. c) Heating boilers shall be located so that adequate space is provided for proper operation, maintenance, and inspection of equipment and appurtenances, which shall include the removal of tubes if applicable.

Item 23-52 Part 1, 3.5.3	**3.5.3 ELECTRICAL** A disconnecting means capable of being locked in the open position shall be installed at an accessible location at the boiler or water heater so that the boiler or water heater can be disconnected from all sources of potential energy. This disconnecting means shall be an integral part of the boiler or water heater or adjacent to it. **3.5.3.1 WIRING** All wiring for controls, heat-generating apparatuses, and other appurtenances necessary for the operation of the boiler(s) or water heater(s) should be installed in accordance with the provisions of national or international standards and comply with the applicable local electrical codes. **3.5.3.2 REMOTE EMERGENCY SHUTDOWN SWITCHES~~3.5.3.1 STEAM HEATING, HOT WATER HEATING, AND HOT WATER SUPPLY BOILERS~~** ~~a) All wiring for controls, heat generating apparatus, and other appurtenances necessary for the operation of the boiler or boilers shall be installed in accordance with the provisions of national or international standards and comply with the applicable local electrical codes.~~ ~~b) A disconnecting means capable of being locked in the open position shall be installed at an accessible location at the boiler so that the boiler can be disconnected from all sources of potential. This disconnecting means shall be an integral part of the boiler or adjacent to it.~~ ~~c)~~ A manually operated remote emergency shutdown switch or circuit breaker shall be ~~located just outside the equipment room door~~ provided and marked for easy identification. ~~Consideration should also be given to the type and location of the switch to safeguard against tampering.~~ a) The default location for the switch or circuit breaker shall be just outside the boiler room door; though the following factors shall be considered when determining the appropriate location and number of switches to be installed:

1) ~~d)~~ If the equipment room door is on the building exterior, the switch should be located just inside the door. ~~If there is more than one door to the equipment room, there should be a switch located at each door of egress.~~

2) For equipment rooms exceeding 500 ft^2 (46 m^2) floor area or containing one or more boilers and/or water heaters having a combined fuel capacity greater than or equal to 1,000,000 Btu/hr (293 kW), additional manually operated remote emergency shutdown switches shall be located at suitably identified points of egress acceptable to the jurisdiction.

3) Where a boiler or water heater is located indoors and not in an equipment room, a remote emergency shutdown switch shall be located within 50 ft (15 m) of the boiler along the primary egress route from the equipment area.

4) Additional consideration should be given to the type and location of the switch(es) to facilitate proper operation and safeguard against tampering. Where approved by the jurisdiction, alternate locations of remote emergency shutdown switches may be provided.

~~1)~~ b) For atmospheric =gas burners, and oil burners where a fan is on a common shaft with the oil pump, ~~the complete burner and controls should be shut off~~ the remote emergency shutdown switch or circuit breaker shall disconnect all power to the burner controls.

~~2)~~ c)For power burners with detached auxiliaries, ~~only the fuel input supply to the firebox need to be shut off~~ the remote emergency shutdown switch or circuit breaker need only shut off the fuel input to the burner.

~~**3.5.3.2 POTABLE WATER HEATERS**~~

~~a) All wiring for controls, heat generating apparatus, and other appurtenances necessary for the operation of the potable water heaters shall be installed in accordance with the provisions of national or international standards and comply with the applicable local electrical codes.~~

~~b) A manually operated remote shutdown switch or circuit breaker shall be located just outside the equipment room door and marked for easy identification. Consideration should also be given to the type and location of the switch to safeguard against tampering.~~

	~~c) A disconnecting means capable of being locked in the open position shall be installed at an accessible location at the heater so that the heater can be disconnected from all sources of potential. This disconnecting means shall be an integral part of the heater or adjacent to it.~~ ~~d) If the equipment room door is on the building exterior, the switch should be located just inside the door. If there is more than one door to the equipment room, there should be a switch located at each door of egress.~~ ~~1) For atmospheric-gas burners, and oil burners where a fan is on a common shaft with the oil pump, the complete burner and controls should be shut off.~~ ~~2) For power burners with detached auxiliaries, only the fuel input supply needs be shut off.~~
Item 25-03 Part 1, 3.7.7.1 a) and editorial (3.7.7.1 b))	**3.7.7.1 STEAM~~-~~HEATING, HOT-WATER~~-~~HEATING, AND HOT-WATER SUPPLY BOILERS** a) Bottom Blowoffs 1) Each steam boiler shall have a bottom blowoff connection fitted with a valve or cock connected to the lowest water space practicable with a minimum size as shown in NBIC Part 1, Table 3.7.7.1. The discharge piping shall be full size to the point of discharge and anchored to the floor or other structural element ~~so as~~ to prevent injury to personnel. 2) Boilers having a capacity of 25 gallons (95 l) or less are exempt from the requirements of 3.7.7.1 a) 1), above, except that they shall have an NPS 3/4 (DN 20) minimum drain valve. b) Drains 1) Each steam or hot-water boiler shall have one or more drain connections~~,~~ fitted with valves or cocks connecting to the lowest water~~-~~containing spaces. All parts of the boiler ~~must~~ shall be capable of being drained (the boiler design will dictate the number and size of drains). The minimum size of the drain piping, valves, and cocks shall be NPS 3/4 (DN 20). The discharge piping shall be full size to the point of discharge. 2) For hot-water boilers with potentially hazardous fluids, such as ethylene glycol, discharge to drains should consider any environmental requirements. 3) When the blowoff connection is located at the lowest water~~-~~containing space, a separate drain connection is not required. c) Minimum Pressure Rating

	The minimum pressure rating of valves and cocks used for blowoff or drain purposes shall be at least equal to the pressure stamped on the boiler but in no case less than 30 psig (200 kPa). The temperature rating of such valves and cocks shall not be less than 250°F (121°C).
Item 25-45 Part 1, 3.8.2.3	3.8.2.3 TEMPERATURE CONTROL Each automatically fired hot-water heating or hot-water supply boiler shall be protected from over-temperature by at least two temperature-operated controls. a) Each individual hot-water heating or hot-water supply boiler or each system of commonly connected boilers shall have at least one control that will cut off the fuel supply when the water temperature reaches an operating limit, which shall be less than the maximum allowable temperature. b) In addition to a) above, each individual automatically fired hot-water heating or hot-water supply boiler shall have at least one safety limit control with manual reset that will cut off the fuel supply at or below the maximum allowable temperature at the boiler outlet. This control shall be constructed to prevent a temperature setting above the maximum allowable temperature of the boiler. If the upper setpoint limit of the control exceeds the maximum allowable temperature of the boiler, a limiting mechanism shall be installed to prevent setting above the maximum allowable temperature. c) Each operating and safety limit control shall have its own sensing element and operating switch. The temperature--sensing elements shall be so located that they shall at all times sense the temperature of the water at or near the boiler outlet. d) Alternatively, integrated controls with multiple sensors may be used to meet the requirements of 3.8.2.3 a) and b).
Item 25-03 Part 1, 4.31., 4.3.2, 4.3.3, and 4.3.4	**4.3.1 SUPPORTS, PIPING, FOUNDATIONS, AND SETTINGS** See NBIC Part 1, Section 1.6.1, *Supports, Piping, Foundations, and Settings.* **4.3.2 CLEARANCES** a) All pressure vessel installations ~~must~~ shall allow sufficient clearance for normal operation, maintenance, and inspection (internal and external). b) Orientation of nozzles, manways, and attachments shall ~~be such that~~allow sufficient clearance between the nozzles, manways and attachments, and the surrounding structure(s) ~~is~~ to be maintained during installation, the attachment of associated piping, and operation.

	~~**4.3.3 PIPING**~~ ~~Piping loads on the vessel nozzles shall be considered. Piping loads include weight of the pipe, weight of the contents of the pipe, expansion of the pipe from temperature and pressure changes (wind and seismic loads). The effects of piping vibration on the vessel nozzles shall also be considered.~~ **4.3.~~4~~ 3 BOLTING** All mechanical joints and connections shall conform to manufacturers' installation instructions and recognized standards acceptable to the jurisdiction having authority.
Item 23-67 Part 1, 4.4.2 and editorial (4.4.1)	**4.4.1 LEVEL--INDICATING DEVICES** Steam drums of unfired steam boilers shall be provided with two level--indicating devices. Direct level--indicating devices should be connected to a single water column or connected directly to the drum, and the connections and pipe shall ~~be~~ not be less than NPS 1/2 (DN 15). Indirect level--indicating devices acceptable to the ~~j~~jurisdiction may be used. 4.4.2 PRESSURE--INDICATING DEVICES The need for pressure--indicating devices should be considered in the design of the pressure vessel ~~and~~. When required, the scale on the dial of the pressure gage shall be at least ~~25% above the highest set pressure of the pressure relief device~~: a) 25% above the highest set pressure of the pressure relief device, for set pressures below 500 psig (3.45 MPa); or b) 20% above the highest set pressure of the pressure relief device, for set pressures of 500 psig (3.45 MPa) or greater.
Item 25-03 Part 1, S5.3.1	**S5.3.1 SUPPORTS, PIPING, FOUNDATIONS, AND SETTINGS** See NBIC Part 1, 1.6.1 *Supports, Piping, Foundations, and Settings*.
Part 1, S5.5.7 e) 2) c Editorial	c. High--temperature--limit safety switch located on the thermal fluid heater outlet. This limit shall prevent the fluid temperature from exceeding the maximum allowable temperature of the specific fluid. The high--temperature-limit safety switch set point should be set no higher than the maximum temperature specified by the fluid manufacturer, heater designer, or downstream process limits, whichever is lowest. Functioning of this control shall cause a safety shutdown and lockout. The manual reset may be incorporated in the temperature limit control. Where a reset device is separate from the temperature limit control, a means shall be provided to indicate actuation of the temperature--sensing

	element. Each limit and operating control shall have its own sensing element and operating switch.
Item 25-07 Part 1, S5.7.6 h) And editorial (S5.7.6)	**S5.7.6 INSTALLATION** Pressure relief valves and the associated discharge piping shall be installed in accordance with the heater m~~M~~anufacturer's recommendations. The installation of the pressure relief valves required for t~~T~~hermal ~~F~~fluid h~~H~~eaters shall include but not be limited to following requirements. a) The pressure relief valve shall be provided with discharge piping. The cross-sectional area of the discharge piping shall not be less than the full area of the valve outlet. The size of the discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity or adversely affect the operation of the attached pressure vessel relief valves. Discharge piping shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief valve. b) The pressure relief valve shall be connected to the pressure vessel in accordance with the original code of construction. c) The cross~~-~~-sectional area of the piping between the heater and the relief valve shall be sized either to avoid restricting the flow to the pressure relief valves or made at least equal to the inlet area of the pressure relief valves connected to it. d) When two or more required pressure relief valves are placed on one connection, the inlet cross-sectional area of this connection shall be sized either to avoid restricting the flow to the pressure relief valves or made at least equal to the combined inlet areas of the pressure relief valves connected to it. e) Unless permitted by the code of construction, there shall be no intervening stop valve between the vessel and its pressure relief valve(s)~~,~~ or between the pressure relief valve and the point of discharge. f) Pressure relief valve discharges shall be arranged ~~such~~ so that they are not a hazard to personnel or other equipment, and~~,~~ when necessary, lead to a safe location, such as a catchment tank, for the disposal of fluids being relieved. g) Discharge lines from pressure relief valves shall be designed to facilitate drainage. Drain piping shall discharge to a safe location for the disposal of the fluids being relieved. The possibility of solidification of fluid leakage into the discharge piping system shall be considered. h) The pressure relief valve discharge shall be connected to a closed, ~~steel~~ vented metal ~~storage~~ catchment tank with solid piping (e.g., with no drip pan elbow or other air gap). The ~~storage~~ catchment tank should be located as close to the system as possible~~,~~ but away from flammable surfaces. Overflow or high-level protection should be considered. The capacity, materials of construction, and design of the ~~storage~~ catchment tank ~~should~~ shall consider the volume, pressure, and temperature of fluid which may be relieved, or the catchment tank

	shall be sized in accordance with the heater manufacturer's recommendations. ~~Storage~~ An outdoor catchment tank shall ~~Catchment tanks located outdoors shall~~ be located ~~such~~ so that water cannot collect in ~~the vessel~~it. The following shall be considered for discharge piping hazards: 1) Both thermal and chemical reactions (personnel hazard); 2) Combustible materials (fire hazard); 3) Surface drains (pollution and fire hazard); and 4) Heat tracing for systems using high freeze point fluids along the discharge lines (to prevent blockage). i) Pressure relief valve discharge capacity for liquid service shall be determined from the following equation: U.S. Customary Units: $W = 2{,}407\ KA\sqrt{(P - Pd)w}$ SI Units: $W = 5.092\ KA\sqrt{(P - Pd)w}$ Where: W = l~~L~~iquid ~~C~~capacity in lb/hr (kg/hr) A = ~~D~~discharge a~~A~~rea of p~~P~~ressure relief v~~V~~alve, in² (mm²) K = coefficient of discharge for valve design P = (s~~S~~et pressure + OP + a~~A~~tmosphere pressure, psia [~~(~~MPa]) OP = o~~O~~verpressure required for pressure relief valve to reach capacity specified in code of construction Pd = ~~P~~pressure at discharge of valve, psia (MPa) w = s~~S~~pecific weight of liquid at inlet condition lb/ft³ (kg/m³) To convert lb/hr of water to gal/min, multiply the capacity in lb/hr by 1/500.
Item 25-03 Part 1, S7.3.3	**S7.3.3 ~~SUPPORTS/FOUNDATIONS~~SUPPORTS, PIPING, FOUNDATIONS, AND SETTINGS** See NBIC Part 1, 1.6.1 for general requirements on supports, piping, foundations, and settings.
Item 25-03 Part 1, S11.2 and editorial (S11.3)	**S11.2 SUPPORTS, PIPING, FOUNDATIONS, AND SETTINGS** See NBIC Part 1, 1.6.1 for general requirements on supports, piping, foundations, and settings. Design of supports, foundations, and settings shall consider the dead loads, live loads, wind, and seismic loads. Vibration and thermal expansion shall also be considered. The design of supports, foundations, and settings shall be in accordance with the American Society of Civil Engineers (ASCE)'s ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*. The importance factors used in calculating the seismic and wind loads shall be the highest value specified for any category in ASCE/SEI 7. **S11.3 CLEARANCES**

	The pressure vessel installation shall allow sufficient clearance for normal operation, maintenance, and inspection. Stacking of pressure vessels is permitted. The minimum clear space between pressure vessels shall be 1 ft~~.~~ (0.3 m) vertical and 2 ft~~.~~ (0.6 m) horizontal. Vessel nameplates shall be visible for inspection after installation. The location of vessels containing flammable compressed natural gas fluids shall comply with the requirements of the National Fire Protection Association~~'s~~ (NFPA)'s NFPA 52, *Vehicular Natural Gas Fuel Systems Code*. The location of vessels containing hydrogen or other flammable fluids shall comply with NFPA 2, *Hydrogen Technologies Code*. The vessel owner shall document the vessel pressure and pipe diameters used as a basis for compliance with NFPA 2 location requirements.
Item 22-32; Item 26-15 Part 1, New Supplement 12	SUPPLEMENT 12 INSTALLATION OF ELECTRICALLY HEATED OR GAS-FIRED JACKETED STEAM KETTLES S12.1 SCOPE This supplement provides requirements and guidelines for the installation of electrically heated or gas-fired jacketed steam kettles. Jacketed steam kettles are pressure vessels with inner and outer walls subject to steam pressure. S12.2 GENERAL REQUIREMENTS Electrically heated or gas-fired jacketed steam kettles shall meet all the requirements of NBIC Part 1, Section 1, Section 4, and this supplement. S12.3 SERVICE LIMITATIONS No steam or water shall be withdrawn from the jacket for use external to the vessel, and the operating pressure of the jacket shall not exceed 50 psig (350 kPa). S12.4 APPURTENANCES AND CONTROLS The jacket shall be furnished, at a minimum, with the following appurtenances and controls: a) a pressure gage;

	b) a water gage glass; or alternatively, for electrically heated jacketed steam kettles with immersion-type heating elements, a low-level warning light; c) a separate connection, fitted with a stop valve for venting air or adding water to the jacket (the water may be added while the vessel is not under pressure); d) an electric heater control or automatic gas valve controlled by pressure or temperature to maintain the steam pressure in the jacket below the pressure relief device setting; e) a low-water cutoff that will cut off the fuel supply to the burner or power to the electric heating element if the water level in the jacket falls below the lowest permissible level established by the manufacturer; f) a safety pilot control that will cut off the fuel supply to both the main burner and pilot burner in case of pilot flame failure; and g) a safety limit control that will cut off the fuel supply to the burner or power of the electric heating element to prevent steam pressure from exceeding the set point of the pressure relief device installed on the kettle. Each control shall be constructed or limited to prevent a pressure setting above the maximum allowable working pressure of the kettle. S12.5 PRESSURE RELIEF DEVICES The capacity of the pressure relief device in pounds of steam per hour shall be at least equal to the Btu per hour rating of the burner divided by 1,000 Btu/lb (646 W/hr/kg) or the kilowatt rating of the electric heating element multiplied by 3.5 lbs/hr/kW (1.6 kg/hr/kW).
Item 20-86 Part 1, new Supplement 13	Supplement 13 Boil-Out and Steam Blow Guidelines S13.1 Scope This supplement provides guidelines for the boil-out of new power boilers, steam-heating boilers, and unfired steam pressure vessels. Newly installed units should be boiled out prior to operation. Internal surfaces of new units may contain oil, grease, other protective coatings, mill scale, rust, welding flux, or other foreign material associated with manufacturing, shipping, preparation, and installation. All contaminants should be removed as they may reduce heat transfer, cause localized overheating, and result in erratic water-level control or surging. a) Proper boil-out procedures or recommended chemicals should be

	obtained from the boiler or pressure vessel manufacturer or from a qualified water treatment specialist. Safety relief valves shall be removed before the boil-out solution is added to prevent contamination by the solution or the grease carried with it. All valves in the supply and return piping shall be closed to prevent the cleaning solution from entering the system. b) Following the boil-out, the water should be cooled to 120 °F (49 °C) and discharged safely in accordance with applicable local, state, and federal regulations. Procedures should be reported to the jurisdiction where required. c) Installing new condensate return piping should also be considered because contaminants may be in the piping. The condensate should be cooled to 120° F (49° C) and drained to ensure the piping has been flushed free of contaminants and debris. d) Prior to commissioning a steam supply and distribution piping system, steam blowing in conjunction with chemical cleaning is recommended to remove foreign material remaining after plant erection. To minimize the risk of personnel injury and equipment damage, the design and location of the associated piping should be addressed by the designer or installer of the boiler and associated piping. e) Existing boilers that have undergone tube replacement, re-rolling, or other extensive pressure part repairs should also be boiled out. Protective coatings on new tubes and lubricants used for rolling tubes should be removed by boil-out before the boiler is returned to service.
Item 23-27 Part 2, 1.1	1.1 SCOPE This section ~~provides~~ establishes general requirements and guidelines for ~~conducting~~ inservice inspections of pressure-retaining items~~, and~~ includinges~~s~~ precautions for the safety of inspection personnel. The safety of the public and ~~the~~ Inspector is ~~the most important~~an essential aspect of any inspection activity. Inservice inspections shall be conducted on location and in person by the Inspector, unless otherwise permitted by the jurisdiction.
Item 24-104	**PART 2, SECTION 2** **INSPECTION — DETAILED REQUIREMENTS FOR INSERVICE INSPECTION OF PRESSURE-RETAINING ITEMS**

Part 2, 2.1	**2.1 SCOPE** This section ~~provides~~ establishes general and detailed inspection requirements and guidelines for pressure-retaining items to ~~determine~~ identify corrosion-related deterioration and ~~possible prevention of~~help prevent failures ~~for~~ in boilers, pressure vessels, piping, and pressure relief devices. Visual inspection of pressure-retaining items may be inherently limited by physical design features that may not permit observation of the entire pressure-retaining item. Insulation, attachments, or other obstructions may impede inspection, and certain defects may not be visible. The Inspector should make a reasonable effort to safely access and examine all physically accessible areas. The Inspector shall not be responsible for defects, damage, or conditions that were not visible or accessible at the time of inspection. Materials to be inspected shall be suitably prepared so that surface irregularities ~~will not be confused with~~do not obscure or mask ~~any~~ defects. Material conditioning ~~such as~~may include cleaning, buffing, wire brushing, or grinding ~~may be~~as required by procedure or~~,~~ ~~if~~ when requested~~,~~ by the Inspector. To permit adequate inspection, ~~T~~the Inspector may require the removal of insulation or component parts ~~to be removed~~.
Item 24-37 Part 2, 2.2.5 a)	**2.2.5 EXTERNAL INSPECTION** The external inspection is intended to be conducted while the boiler is in operation. ~~However, if acceptable to the jurisdiction, an external inspection may be performed while the boiler is not operational to assess whether it is in a safe operating condition.~~ Some items to consider are: a) The boiler fittings, valves, controls, safety devices, and piping should be checked for compliance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) or other standards or equivalent requirements. ~~Particular attention should be paid to pressure relief devices, controls and safety devices;~~ b) Firing equipment controls; c) Adequacy of structure, boiler supports, and any associated support steel; d) Boiler casing should be free from cracks, combustion gas or fluid leaks, and excessive corrosion or other degradation that could interfere with proper operation;

	e) Soot blowers, valves, and actuating mechanisms; f) Gaskets on observation doors, access doors, drums, and handhole and manhole covers and caps; g) Valves and actuators, whether chains, motors, or handwheels; and h) Leakage of fluids or combustion gases.
Item 24-37 Part 2, 2.2.10.6	**2.2.10.6 CONTROLS** Establishing proper operation and maintenance of controls and safety devices is essential to safe boiler operation. Owners or users are responsible for establishing and implementing management programs which will ensure such action is taken. In addition, any repairs to controls and safety devices ~~must~~ shall ~~only~~ be made only by qualified individuals or organizations. Documentation of compliance with these management systems and repairs is an essential element of demonstrating the effectiveness of such systems. ~~When required by the Jurisdiction, t~~The following guidelines are provided to aid in the evaluation of installed operating control devices: a) Verify that the burner is labeled and listed by a recognized testing agency, that piping and wiring diagrams exist, that commissioning tests have been conducted, and that a contractor/manufacturer's installation report has been completed and is available for review. b) Verify that the owner or user has established function tests, inspection requirements, maintenance, and testing of all controls and safety devices in accordance with manufacturer's recommendations. Verify that these activities are conducted at assigned intervals in accordance with a written procedure, that non-conformances which impact continued safe operation of the boiler are corrected, and that the results are properly documented. These activities shall be conducted at a frequency recommended by the manufacturer or required by the jurisdiction. Where no frequencies are recommended or prescribed, the activity should be conducted at least annually. When permitted by the jurisdiction, performance evaluation may be used to increase or decrease the frequencies of activities based on document review and approval by an appropriate engineer. c) Verify that combustion air is supplied to the boiler room as required by the jurisdiction, or~~,~~ if no jurisdictional requirements exist, see NBIC Part 1, ~~2.5.4 and 3.5.4~~1.6.6 for additional guidance. d) Verify that a manually operated remote boiler emergency stop button exists at each boiler room exit door, when required by the jurisdiction.

	e) Verify operation of low-water protection devices by observing the blowdown of these controls or the actual lowering of the boiler water level under carefully controlled conditions with the burner operating. This test should shut off the heat source to the boiler. 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. If it is not practicable to test the control during this inspection, a review of relevant documentation may be conducted to confirm that the control is being properly maintained, and no known deficiencies exist. f) 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. If it is not practicable to test the control during this inspection, a review of relevant documentation may be conducted to confirm that the control is being properly maintained, and no known deficiencies exist. g) 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~~,~~ and externally mounted, the float chamber should be drained to check for the accumulation of sediment. h) On forced circulation boilers, the flow-~~-~~sensing device shall be tested to verify that the burner will shut down the boiler on a loss of flow. If it is not practicable to test the control during this inspection, a review of relevant documentation may be conducted to confirm that the control is being properly maintained, and no known deficiencies exist. i) On electric boilers, it should be verified that the boiler is protected from a low-~~-~~water condition either by construction, ~~or~~ a low-~~-~~water cutoff, or a low-~~-~~flow-sensing device. j) ~~In the event~~If any required control~~s~~ or safety device is not functioning as designed ~~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. k) All automatic low-water fuel cutoffs 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.~~ l) Check that the following controls/devices are provided: 1) Each automatically fired steam boiler is protected from overpressure by not less than two pressure~~-~~-operated controls, one of which may be an operating control. When required by the code of construction or the jurisdiction, the ~~high pressure~~high-pressure limit control shall be of the manual reset type. 2) Each automatically fired hot-water boiler or hot-water boiler system is protected from over-temperature by not less than two temperature~~-~~-operating controls, one of which may be an operating control. When required by the code of construction or the jurisdiction, the high~~-~~-temperature limit control shall be of the manual reset type. 3) Each hot-water boiler is fitted with a thermometer that will always~~at all times,~~ indicate the water temperature at or near the boiler outlet. m) Verify that any repair, alteration, or replacement of a control or safety device complies with the following: 1) The requirements of the original installation code or jurisdiction, as appropriate. 2) The work is conducted by trained and qualified individuals, with any additional certification as required by the jurisdiction. 3) The work is documented.
Item 26-29 Part 2, 2.2.12.2 c)	**2.2.12.2 FIRETUBE BOILERS** a) The distinguishing characteristic of a firetube boiler is that ~~the~~ products of combustion pass within its tubes that are surrounded by the water that is being heated. Combustion of fuel ~~takes place~~occurs within the furnace area, with the resultant products of combustion traveling through one or more groups of tubes before exiting the boiler. Firetube boilers are classified by the arrangement of the furnace and tubes, such as a h~~H~~orizontal r~~R~~eturn t~~T~~ubular (HRT) boiler, ~~F~~firetube f~~F~~irebox ~~Box (FTFB)~~ boiler (FTFB), or v~~V~~ertical t~~T~~ubular (VT) boiler. The number of passes that the products of combustion make through the tubes is also used in classifying the type of boiler, such as a two-pass or three-pass boiler. b) Firetube boilers may be used in hot ~~-~~water or steam applications. They may be either low-pressure or high-pressure construction~~,~~ but ~~typically~~ are not typically

designed for pressures greater than 250 psig (1,720 kPa). Steam capacities are generally less than 30,000 lb/hr (13,600 kg/hr). Firetube boilers are found in a wide variety of applications ranging from heating, to process steam, to small power generation.

c) Firetube boilers are subject to thermal stresses due to cycling, which may cause tube leakage and corrosion of joints. The following items are common areas of inspection:

1) Waterside — Scale buildup on and around the furnace tube. Scale on or around the firetubes in the first pass after the furnace (gas temperatures >1,800°F [980°C]). Scale and corrosion buildup on stay rods ~~hiding~~ obstructing the ~~actual~~ full diameter. Corrosion pitting on all pressure boundaries;

2) Fireside — Tube-to-tube-sheet joint leakage. Look for rust trails left by weeping joints. ~~When in doubt where the leakage is coming from~~Where the origin of the leak is unclear, perform a liquid penetrant exam. Take note of refractory locations protecting steel that is not water- cooled. Partial or complete removal of the refractory may be required for inspection purposes. Condensation of combustion gas dripping ~~out of~~from the fireside gaskets during a cold boiler start-up is expected. However, if it continues after the water temperature in the boiler is at least 150°F (65°C), then further investigation to determine the source of water shall be conducted;

3) The fireside surfaces of tubes in horizontal firetube boilers usually deteriorate more rapidly at the ends nearest the fire. The Inspector should examine the tube ends to determine if there has been serious reduction in thickness. The tube surfaces in some vertical tube boilers are more susceptible to deterioration at the upper ends when exposed to the heat of combustion. These tube ends should be closely examined to determine if there has been a ~~serious~~ severe reduction in thickness. The upper tube-sheet in a vertical “dry top” boiler should be inspected for evidence of overheating;

4) ~~All~~ Any type of stay~~s~~ (e.g., staybolts and stayrods), whether diagonal or through, should be inspected to determine whether ~~or not~~ they are in even tension. ~~Staybolt~~ Stay ends and the stayed plates should be examined ~~to determine whether~~ for cracks ~~exist~~. In addition, stayed plates should be inspected for bulging in the general area of the stay. Each ~~staybolt~~ stay end should be checked for excessive cold working (heading) and seal welds as

	evidence of ~~a~~ possible leakage ~~problem~~. Stays ~~or staybolts~~ that are not in tension or adjustment should be repaired. Broken stays ~~or staybolts~~ shall be replaced; and 5) The Inspector should test firebox ~~staybolts~~ and water-back section stays by tapping one end of each ~~bolt~~ stay with a hammer, and~~,~~ where practicable, a hammer or other heavy tool should be held on the opposite end to make the test more effective. An unbroken ~~bolt~~ stay should give a ringing sound, while a broken ~~bolt~~ stay will give a hollow or non-responsive sound. Ultrasonic testing may be used at the end of the stays to verify the stay is unbroken. ~~Staybolts~~ Stays with telltale holes should be examined for evidence of leakage, which will indicate a broken or cracked ~~bolt~~ stay. Broken ~~staybolts~~ stays shall be replaced.
Item 25-27 Part 2, 2.3.6.2 b) and editorial (2.3.6.2)	**2.3.6.2 COMPRESSED AIR VESSELS** a) Compressed air vessels include receivers, separators, filters, and coolers. Considerations of concern include temperature variances, pressure limitations, vibration, and condensation. Drain connections should be verified to be free of any foreign material that may cause plugging. b) Inspection shall consist of the following: 1) Welds — Inspect all welds for cracking or gouging, corrosion, and erosion. Particular attention should be given to the welds that attach brackets supporting the compressor. These welds may fail due to vibration~~;~~. 2) Shells/~~H~~heads — Externally~~,~~ inspect the base material for environmental deterioration and impacts from objects. Hot spots and bulges are signs of overheating and should be noted and evaluated for acceptability. Particular attention for corrosion and leakage should be ~~paid~~ given to the lower half of the vessel ~~for corrosion and leakage~~. For vessels with manways or inspection openings, an internal inspection should be performed for corrosion, erosion, pitting, excessive deposit buildup, and leakage around inspection openings. Ultrasonic thickness (UT) ~~thickness~~ testing may be used where internal inspection access is limited or to determine actual thickness when corrosion is suspected~~;~~. a. UT a~~A~~cceptance c~~C~~riteria 1. For line or crevice corrosion, the depth of the corrosion shall not exceed 25% of the required wall thickness. 2. Isolated pits may be disregarded, provided ~~that~~ their depth is not more than 50% of the required thickness of the pressure vessel wall (exclusive of any corrosion allowance), provided the total area of the pits does not exceed 7 ~~sq.~~ in.^{2} (4,500 ~~sq.~~ mm^2) within any 8 in. (200 mm) diameter circle, and provided the sum of their dimensions along any straight line within that circle does not exceed 2 in. (50 mm).

	3. For a corroded area of considerable size, the thickness along the most critical plane of such an area may be averaged over a length not exceeding 10 in. (250 mm). The thickness at the thinnest point shall not be less than 75% of the required wall thickness. b. If the corrosion exceeds any of the above criteria, the following options are available to the ~~owner/user~~owner or user. 1. The ~~owner/user~~owner or user may conduct a complete UT survey of the vessel to verify the remaining vessel wall thickness. 2. The vessel shall be removed from service until the vessel is repaired by an "R" ~~stamp~~ Certificate Holder~~holder~~. 3. The vessel shall be removed from service until it can be de-rated to a lower maximum allowable working pressure (MAWP), subject to review and approval by the ~~J~~jurisdiction. 4. A fitness-for-service analysis ~~is~~ may be performed by a qualified organization. (Refer to NBIC Part 2, 4.4.1 and 4.4.2 for further information.) 5. The vessel is permanently removed from service. 3) Fittings and a~~A~~ttachments — Inspect all fittings and attachments for alignment, support, deterioration, damage, and leakage around threaded joints. Any internal attachments, such as supports, brackets, or rings, shall be visually examined for wear, corrosion, erosion, and cracks.~~;~~ 4) Operation — Check the vessel nameplate to determine the ~~maximum allowed working pressure~~MAWP and maximum allowable working temperature of the vessel. Ensure the set pressure of the safety valve does not exceed that allowed on the vessel nameplate, and determine that the capacity of the safety valve is greater than the capacity of the compressor. Ensure there is a functioning manual or automatic condensate drain.~~; and~~ 5) Quick-~~C~~closure ~~A~~attachments — Filter-type vessels usually have one quick-type closure head for making filter changes.~~,~~ S~~s~~ee NBIC Part 2, 2.3.6.5.
Item 25-27 Part 2, 2.3.6.4 f) and editorial (2.3.6.4)	**2.3.6.4 LIQUID AMMONIA VESSELS** Vessels in liquid ammonia service are susceptible to stress corrosion cracking (SCC) in areas of high stress. ~~[~~(S~~s~~ee NBIC Part 2, 3.3.2 b).)~~]~~. High-strength and coarse-grained materials seem to be more at risk of SCC than fine-grained or more moderate strength materials; although no commonly used steels appear to be immune to the ~~problem~~issue. Postweld heat treatment (PWHT) of new or weld-repaired vessels or cold-formed heads is beneficial in reducing the incidence of SCC. The presence of 0.2% minimum water in the liquid ammonia also inhibits SCC. Any leak should be thoroughly investigated and the necessary corrective action initiated. a) Internal inspection 1) Where existing openings permit, perform a visual internal inspection of the vessel. Look for any ~~obvious~~ cracks (very advanced SCC) and note areas that are subject to high stress, such as welds, welded repairs, head-to-shell

transitions, sharp interior corners, and interior surfaces opposite external attachments or supports.

2) Fittings, such as liquid level gage floats and excess flow valves, should be removed or otherwise protected from power buffing or light sandblasting when ~~preparing~~ the interior surface of the vessels is prepared for inspection.

3) Vessels in services where liquid ammonia is used as a reactant or is being preheated/vaporized should be inspected for localized corrosion in the reaction or vaporizing zones.

b) Examination and detection of SCC

1) All interior welds and highly stressed areas should be examined by the w~~W~~et f~~F~~luorescent m~~M~~agnetic p~~P~~article t~~T~~esting method (WFMT) using an A/C yoke for magnetization. Note that weld cracks are often transverse in orientation. It is ~~extremely important~~essential to ensure that the NDE method used will disclose cracks in any orientation.

2) If cracks are discovered, a calculation shall be made to determine what depth of grinding may be carried out for crack removal (without encroaching on the minimum thickness required by the original code of construction).

3) Where possible, crack removal by grinding is the preferred method of repair. Since the stresses at the crack tips are quite high, even very fine cracking shall be eliminated.

4) Where crack depth is such that removal requires welded repair, a weld procedure shall be employed that will minimize HAZ hardening and residual stresses. Welded repairs, regardless of the depth of the repair, shall be ~~postweld heat treated~~undergo PWHT. The use of alternative welding methods in lieu of PWHT is permitted. Any required repairs ~~required~~ and associated ~~postweld heat treatment~~PWHT shall be completed in accordance with NBIC Part 3.

5) Re-inspection by WFMT after welded repair shall be ~~done~~ performed to ensure complete crack removal.

6) It is not intended to inhibit or limit the use of other NDE ~~evaluation~~ methods. ~~It is recognized that a~~Acoustic emission and fracture mechanics are acceptable techniques for assessing the structural integrity of vessels. Analysis by fracture mechanics may be used to assess the structural integrity of vessels when complete removal of all ammonia stress cracks is not practical. If alternative methods are used, the above recommendation that all cracks be removed, including fine cracks, may not apply.

In addition to NDE and repair of liquid ammonia vessels that are susceptible to SCC, it is acceptable to use fitness~~-~~ for~~-~~ service evaluation methods to determine acceptability of a pressure-retaining item to perform its intended function. These methods shall be ~~consistent~~ employed in accordance with the requirements of NBIC Part 2, 4.4.

c) Inspection of parts and appurtenances

1) If valves or fittings are in place, ~~check to~~ ensure ~~these~~ they are complete and functional. Parts made of copper, zinc, silver, or alloys of these metals

	are unsuitable for ammonia service and shall be replaced with parts fabricated of steel or other suitable materials. 2) Check that globe valves are installed with the direction of flow away from the vessel. 3) Observe that excess flow valves are properly installed and fit for continued service. 4) Check that hydrostatic relief valves are installed in the system piping where required. 5) Piping shall be observed to be a minimum of Schedule 80 if threaded and Schedule 40 if welded. Seamless or electric resistance welded (ERW) piping is acceptable. Type F piping shall not be used for ammonia service. 6) Fittings shall be forged or Class 300 malleable iron. Seal welding is permitted only with forged fittings. 7) The Inspector shall note the pressure indicated by the gage and compare it with other gages on the same system. If the pressure gage is not mounted on the vessel itself, it should be ~~ascertained~~ verified that the gage's installation position ~~is installed on the system in such a manner that it~~ allows it to ~~correctly~~ accurately indicate~~s~~ ~~actual~~ the pressure in the vessel. 8) The Inspector shall note the liquid level in the vessel by observing the liquid level gage or other liquid level ~~-~~ indicating device. d) Inspection of pressure relief devices 1) See NBIC Part 2, 2.5 for the inspection of pressure relief devices used to prevent the overpressure of liquid ammonia vessels. Pressure relief devices in ammonia service shall not be tested in place using system pressure. Bench testing or replacement is required, depending on the type of pressure relief device used. 2) The Inspector shall note the replacement date marked on the vessel safety valves and the date indicated on the piping system hydrostatic relief valves (these valves require~~ing~~ replacement every five years). e) External inspection of insulated vessels 1) Insulated pressure vessels can suffer from aggressive external corrosion that is often found beneath moist insulation. The Inspector should closely examine the external insulation scaling surfaces for cold spots, bulges, rust stains, or any unusual conditions in previous repair areas. Bulging or distorted insulation on refrigerated vessels may indicate the formation of ice patches between the vessel shell and insulation due to trapped moisture. Careful observation is also required where the temperatures of insulated vessels cycle continually through the freezing temperature range. 2) The lower half and ~~the~~ bottom portions of insulated vessels should receive ~~special focus~~particular attention, as condensation or moisture may gravitate down the vessel shell, ~~and~~ soaking into the insulation~~,~~ and keeping it moist for ~~long periods of time~~prolonged periods. Penetration locations in the insulation or fireproofing, such as saddle supports, sphere support legs, nozzles, or fittings, should be examined closely for ~~potential~~ moisture ingress

paths. When moisture penetrates the insulation, the insulation may actually work in reverse, holding moisture in the insulation and/or near the vessel shell. Deterioration of the vessel due to this mechanism is called corrosion under insulation (CUI).

3) Inspecting for CUI

3) Insulated vessels that are run on an intermittent basis or that have been out of service require close scrutiny. In general, a visual inspection of the vessel's insulated surfaces should be conducted once per year.

a. 4) The most common and superior suitable method to inspect for suspected corrosion under insulation (CUI) damage is visual inspection to where insulation has been completely or partially removed the insulation for visual inspection.

b. The method most commonly utilized to inspect for CUI without When insulation removal is not possible, radiography methods may be used. This includes by xX-ray and isotope radiography (film or digital) or by real-time radiography, (utilizing imaging scopes and surface profilers). The real-time imaging tools will work wellare suitable if the vessel geometry and insulation thickness allows.

c. Other lLess common methods to detect CUI include specialized electromagnetic methods (pulsed eddy current and electromagnetic waves) and long-range ultrasonic techniques (guided waves).

d. Insulated vessels that are operated on an intermittent basis or that have been out of service require scrutiny. In general, a visual inspection of the vessel's insulated surfaces should be conducted annually.

4)5) There are also s Several methods to detect moisture- soaked insulation, which is often the beginning for potentialprecedes CUI damage., include Mmoisture probe detectors, neutron backscatter, and thermography are tools that can be used for CUI moisture screening.

6) Proper surface treatment (coating) of the vessel external shell and maintaining weather-tight external insulation are the keysessential to prevention of CUI damage.

f) Acceptance criteria

The following are the acceptance criteria for liquid ammonia vessels. Vessels showing indications or imperfections exceeding the conditions noted below are considered unacceptable. (Refer to Section 4.4.1)

1) Cracks

Cracks in the pressure vessel boundary (e.g., heads, shells, welds) are unacceptable. When a crack is identified, the vessel shall be removed from service until the crack is repaired by an "R" Stamp Certificate hHolder, or the vessel shall be permanently removed from service. (See NBIC Part 3, *Repairs and Alterations*.)

2) Dents

When dents are identified that exceed the limits set forth below are identified, the vessel shall be removed from service until the dents are

repaired by an “R” ~~Stamp~~ Certificate ~~h~~Holder or~~,~~ a fitness-~~-~~for-~~-~~service analysis is performed~~,~~. ~~or~~ Otherwise, the vessel shall be permanently retired from service.

a. Dents in s~~S~~hells

The maximum mean dent diameter in shells shall not exceed 10% of the shell diameter, and the maximum depth of the dent shall not exceed 10% of the mean dent diameter. The mean dent diameter is defined as the average of the maximum dent diameter and the minimum dent diameter. If any portion of the dent is closer to a weld than 5% of the shell diameter, the dent shall be treated as a dent in a weld area, as shown in 2.3.6.4 f) 2) b., below.

b. Dents in ~~W~~welds

The maximum mean dent diameter on welds (i.e., part of the deformation includes a weld) shall not exceed 10% of the shell diameter. The maximum depth shall not exceed 5% of the mean dent diameter.

c. Dents in ~~H~~heads

The maximum mean dent diameter on heads shall not exceed 10% of the shell diameter. The maximum depth shall not exceed 5% of the mean dent diameter. The use of a template may be required to measure dents on heads.

3) Bulges

When bulges ~~are identified~~ that exceed the limits set forth below are identified, the vessel shall be removed from service until the bulges are repaired by an “R” ~~Stamp~~ Certificate Holder~~holder~~ or a fitness-~~-~~for-~~-~~service analysis is performed.~~,~~ Otherwise, the vessel ~~may also~~ shall be permanently retired from service.

a. Bulges in s~~S~~hells

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

b. Bulges in h~~H~~eads

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

4) Cuts or g~~G~~ouges

When a cut or gouge exceeds 25% of the thickness of the vessel, the vessel shall be removed from service until it is repaired by an “R” ~~Stamp~~ Certificate Holder or a fitness-for-service analysis is performed. ~~The~~ Otherwise, the vessel ~~may also~~shall be permanently retired from service.

5) Corrosion

a. For line or crevice corrosion, the depth of the corrosion shall not exceed 25% of the original wall thickness.

	b. Isolated pits may be disregarded, provided ~~that~~ their depth is not more than 50% of the required thickness of the pressure vessel wall (exclusive of any corrosion allowance), provided the total area of the pits does not exceed 7 ~~sq.~~ in.^{2} (4,500 ~~sq.~~ mm^2) within any 8 in. (200 mm) diameter circle, and provided the sum of their dimensions along any straight line within that circle does not exceed 2 in. (50 mm). c. For a corroded area of considerable size, the thickness along the most critical plane of such an area may be averaged over a length not exceeding 10 in. (250 mm). The thickness at the thinnest point 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 is identified, the pressure vessel shall be removed from service until it is repaired by an "R" ~~Stamp~~ Certificate ~~h~~Holder or a fitness-for-service analysis is performed., ~~or~~ Otherwise, the vessel ~~may~~ shall be permanently retired from service.
Item 24-94 Part 2, 2.3.6.8 e) and g) and editorial (2.3.6.8)	**2.3.6.8 INSPECTION OF PRESSURE VESSELS FOR HUMAN OCCUPANCY ~~(PVHO's)~~** A pressure vessel for human occupancy (PVHO), as defined by ASME PVHO-1-*Safety Standard for Pressure Vessels for Human Occupancy*, is a pressure vessel that encloses a human being or animal within its pressure boundary while it is subject to internal or external pressure that exceeds a 2 psig (14 kPa) differential pressure. PVHOs include, but are not limited to, submersibles, diving bells, personal transfer capsules, decompression chambers, recompression chambers, hyperbaric chambers, high--altitude chambers, and medical hyperbaric oxygenation facilities. This section provides guidelines for inspection of PVHOs. Due to the ~~many different~~varying designs and applications of PVHOs, potential component failures ~~of components~~ or safety concerns that are not ~~specifically covered~~addressed here, such as rapid decompression or fire/sparking issues, should also be considered. a) General/operational 1) PVHOs should be constructed in accordance with ASME PVHO-1. This code adopts ASME BPVC Section VIII and therefore the vessels should bear an ASME ~~"~~U~~"~~ or ~~"~~U2~~"~~ ~~ASME designator~~Designator. Inspections may be conducted using ASME PVHO-2 for reference. ASME PVHO-1 also has several Code Cases that address PVHOs manufactured from non-traditional materials such as various fabrics. PVHOs built under such Code Cases shall have all the documentation required by the Code Case~~,~~ but may not necessarily have any related ASME BPVC Section VIII forms. 2) Cast and ductile iron fittings are not ~~allowed~~permitted. 3) The installation should ~~be such that there is~~allow adequate clearance ~~to~~ for proper inspection ~~it properly~~. b) Internal i~~I~~nspection

1) Where existing openings permit, perform a visual internal inspection of the vessel. Look for any ~~obvious~~ cracks and note areas that are subject to high stress, such as welds, welded repairs, head-to-shell transitions, sharp interior corners, and interior surfaces opposite external attachments or supports.

2) The vessel should be free of corrosion, damage, dents, gouges, or other damage. ~~Special attention~~Careful consideration should be ~~paid~~ given to areas under chamber floors and the interiors of chamber drain fittings.

3) All openings leading to external fittings or controls should be free from obstruction.

4) All exhaust inlets should be checked for the presence of fittings that prevent a chamber occupant from ~~blocking~~ obstructing the opening.

5) The inlets to all chamber pressure gage lines should be located where they are either protected from possible blockage or ~~are~~ fitted with multiple openings.

6) Chamber doors:

a. should operate freely and smoothly. However, doors should not move on their own when released;

b. that close/seal with pressure and which are fitted with ~~"dogs" or other restraints~~ restraint mechanisms to hold them in place until an initial seal is obtained, shall be fitted with features to prevent the door from maintaining a seal in the event the pressure differential on the door is reversed;

c. should have seals that are supple, free from flat spots, cracking, etc.; and

d. that close/seal against pressure shall have provisions as follows:

1. p~~P~~ositive protection against pressurization of the vessel unless the restraint mechanism is fully engaged. This includes when pressurization can occur by primary and/or back-up methods ~~as well as primary methods~~; and

2. ~~P~~positive protection against release of the restraint mechanism unless pressure in the vessel is fully relieved.

c) External i~~I~~nspection

1) The Inspector should ~~closely~~ thoroughly examine the external condition of the pressure vessel for corrosion, dents, gouges, or other damage.

2) The lower half and ~~the~~ bottom portions of insulated vessels should receive ~~special focus~~particular attention, as condensation or moisture may gravitate down the vessel shell, ~~and~~ soaking into the insulation~~,~~ and keeping it moist

for ~~long~~ prolonged periods ~~of time~~. Penetration locations in the insulation or fireproofing, such as saddle supports, sphere support legs, nozzles, or fittings, should be examined closely for ~~potential~~ moisture ingress. When moisture penetrates the insulation, the insulation may ~~actually~~ work in reverse, holding moisture in the insulation and/or near the vessel shell. Deterioration of the vessel due to this mechanism is called corrosion under insulation (CUI).

3) Inspecting for CUI

a. The most common and ~~superior~~ suitable method to inspect for suspected ~~corrosion under insulation (~~CUI~~) damage~~ is visual inspection where the insulation has been ~~to~~ completely or partially remove~~d the insulation for visual inspection~~.

b. ~~The method most commonly utilized to inspect for CUI without~~When insulation removal is not possible, radiography methods may be used. ~~by~~ This includes X-ray and isotope radiography (film or digital) or ~~by~~ real-time radiography~~,~~ (utilizing imaging scopes and surface profilers). ~~The r~~Real-time imaging tools ~~will work well~~are suitable if the vessel geometry and insulation thickness allow~~s~~.

c. ~~Other l~~Less common methods to detect CUI include specialized electromagnetic methods (pulsed eddy current and electromagnetic waves) and long-range ultrasonic techniques (guided waves).

4) ~~There are also s~~Several methods to detect moisture-soaked insulation, which ~~is~~ often ~~the beginning for potential~~precedes CUI damage~~.~~, include ~~M~~moisture probe detectors, neutron backscatter, and thermography ~~are tools that can be used for CUI moisture screening~~.

5) Couplers and doors that open with pressure:

a. should operate freely and smoothly;

b. should have seals that are supple, and free from flat spots, cracking, etc.; and

c. that close/seal against pressure shall have provisions as follows:

1. p~~P~~ositive protection against pressurization of the vessel unless the restraint mechanism is fully engaged. This includes when pressurization can occur by primary and/or back-up methods ~~as well as primary methods~~; and

2. p~~P~~ositive protection against release of the restraint mechanism unless pressure in the vessel is fully released.

d) Inspection of parts and appurtenances (e.g., piping systems, pressure gage, bottom drain)

1) As stated above, cast iron is not ~~allowed~~ permitted on PVHOs and shall be replaced with parts fabricated with ~~other~~ suitable materials, in accordance with ASME ~~Code~~ BPVC Section II.

2) If valves or fittings are in place, ~~check to~~ ensure ~~that these~~they are complete and functional.

3) The Inspector shall note the pressure indicated by the gage and compare it with other gages on the same system. If the pressure gage is not mounted on the vessel itself, it should be ~~ascertained~~ verified that the gage is installed on the system in such a manner that it ~~correctly~~ accurately indicates ~~actual~~ the pressure in the vessel. Lines leading to chamber primary depth gages should connect only to the depth gage.

4) The system should have a pressure gage designed for the most severe condition of pressure in normal operation. This gage should be clearly visible to the person adjusting ~~the setting of~~ the pressure control valve setting. The graduation on the pressure gage should be graduated to not less than 1.5 times the pressure at which the lowest safety/relief valve is set.

5) Provisions should be made to calibrate pressure gages or ~~to~~ have them checked against a standard test gage.

6) The exhaust~~s~~ from the depressurization of PVHOs located inside enclosures should be piped to a location outside the enclosure and located at least 10 ft~~.~~ (3~~.0~~ m) from any air intake.

e) Inspection of ~~view ports *I*~~ viewports/windows

1) Each window should be individually identified and ~~be~~ marked in accordance with ASME PVHO-1.

2) If there are any window penetrations ~~through windows~~, they ~~must~~ shall be circular in accordance with ASME PVHO-1 requirements.~~.~~

3) Windows ~~must~~ shall be free of crazing, cracks, and scratches that exceed "superficial" defects as defined by ASME PVHO-2.

4) Windows and viewports have a maximum interval for seat/seal inspection and refurbishment. Documentation should be ~~checked~~ reviewed to ensure compliance with ASME PVHO-2, Section 2-4.4.

5) Windows typically have a maximum service life ranging from 10 to 20 years depending on the type of window and service conditions.

6) Documentation should be checked to ensure compliance with ASME PVHO-2 inspection and refurbishment requirements (ASME PVHO-2~~-2016~~, Tables 2-4.3-1 and 2-4.3-2) and service life limitations (ASME PVHO-2~~-2016~~, Section 2-4.4).

f) Inspection of pressure relief devices

1) Pressure relief devices for chambers only ~~must~~ shall have a quick-opening manual shutoff valve installed between the chamber and ~~the~~ pressure relief device, with a frangible seal in place~~.~~; the quick-opening manual shutoff valve shall be ~~within easy access~~easily accessible to the operator.

2) The pressure relief device shall be constructed in accordance with ASME ~~Code~~ BPVC Section VIII.

3) The discharge from the chamber pressure relief device shall be piped ~~outside~~ outdoors to a safe point of discharge ~~as~~ determined by the jurisdictional authority~~Authority having Jurisdiction (AHJ)~~.

4) Rupture disks shall not be used, except in series upstream of pressure relief valves to prevent gas leakage.

5) Verify that the safety valve is periodically tested, either manually by ~~raising~~ lifting the disk from the seat or by removing and testing the valve on a test stand.

g) Acceptance criteria

The following forms ~~are required to~~shall be available for review:

1) ASME BPVC Section VIII, Division 1 Forms U-1, *Manufacturer's Data Report for Pressure Vessels*; U-1A, *Manufacturer's Data Report for Pressure Vessels (Alternative Form for Single-Chamber, Completely Shop or Field-Fabricated Vessels Only)*; or U-2, *Manufacturer's Partial Data Report*, as appropriate for vessels built to ASME B~~&~~PVC ~~Code~~ Section VIII. For vessels built to other rule sets, the equivalent forms shall be available;

2) ASME PVHO-1 ~~2016~~ Form GR-1, *Manufacturer's Data Report for Pressure Vessels for Human Occupancy*;

3) ASME PVHO-1 ~~2016~~ Form VP-1, *Fabrication Certification for Acrylic Windows* (one for each window);

4) ASME PVHO-1 ~~2016~~ Form VP-2, ~~Design Certification for~~ *Acrylic Window~~s~~ Design Certification* (one for each window);

5) ASME PVHO-2 ~~2016~~ Form VM-1, *Viewport Inspection* (one for each window, current within ASME PVHO-2 inspection interval requirements); and

6) For any repaired windows, ASME PVHO-2 ~~2016~~ Form VM-2, *Acrylic Window Repair ~~Certificate~~ Certification for Severely Damaged Windows~~. Repaired by the User (or his Authorized Agent)~~* or ASME PVHO-2 ~~2016~~ Form VM-3, *Acrylic Window Repair ~~Certificate~~ Certification for ~~Severely~~*

	Slightly Damaged Windows Repaired by the User (or the User's Authorized Agent). h) All PVHOs under the jurisdiction of the ~~U.S.~~United States Coast Guard ~~must~~ shall also comply with 46 CFR Part 197.
Item NB15-0307 Part 2, 2.5.4	Part 2, 2.5.4 INSERVICE INSPECTION REQUIREMENTS FOR PRESSURE RELIEF DEVICE INSTALLATION CONDITION a) Ensure all covers, caps, plugs, and lift lever wires utilized for shipping or transport are removed. b) Inlet piping shall be inspected to ensure it meets the requirements of the original code of construction. For pressure relief valves (PRV)s and pin devices certified for capacity, the inlet pipe shall be checked to ensure the inlet pipe size is not smaller than the device inlet size. This requirement is not applicable for flow-resistance-certified pin devices. c) Discharge piping shall be inspected to ensure it meets the requirements of the original code of construction. For ~~pressure relief valve~~PRVs and pin devices certified for capacity, the discharge pipe shall be checked to ensure the discharge pipe size is not smaller than the device outlet size. This requirement is not applicable for flow-resistance-certified pin devices. d) The ~~valve~~ drain piping shall be checked to ensure the piping is open. e) The discharge piping shall be checked to ensure it drains properly. f) The inlet and discharge piping shall be checked to ensure they are not binding or placing excessive stress on the ~~pressure relief valve~~PRV or pin device body, which can lead to distortion of the ~~valve~~ body~~, and~~ leakage, or malfunction.

g) The condition and adequacy of the pipe supports shall be inspected. Discharge piping should be supported independent of the device itself.

h) The ~~valve~~ discharge and discharge pipe shall be checked for possible hazards to personnel.

i) The installation shall be checked to ensure ~~that~~ there are no intervening isolation valves between the pressure source and the ~~valve~~ pressure relief device (PRD) inlet or between the ~~valve pressure relief device~~PRD outlet and its point of discharge. Isolation valves may be permitted in some pressure vessel service. (See NBIC Part 4, 2.6.6 e) and jurisdictional requirements.) ~~.~~ Isolation valves shall not be used for power boilers, heating boilers, or water heaters.

j) Change-over valves are commonly used in pressure vessel service. They may also be used in some boiler applications. ~~A change-over valve, which is~~They are used to install two ~~pressure relief device~~PRDs on a single vessel location for the purpose of switching from one device to a spare device~~,~~. This is not considered a block valve if it is arranged ~~such~~ so that there is no intermediate position that will isolate both ~~pressure relief device~~PRDs from the protected system. Change-over valves should be carefully evaluated to ensure they do not have excessive pressure drop that could affect the ~~pressure relief device~~PRD operation or capacity. ~~These devices are commonly used in pressure vessel service. They may also be used in some boiler applications.~~ It is recommended that the ~~J~~jurisdiction be contacted to determine their acceptability on boiler applications.

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2.5 PRESSURE RELIEF DEVICES

2.5.1 SCOPE

a) ~~The most important~~PRDs are the primary appurtenances provided to protect~~on any~~ pressurized systems ~~are the pressure relief devices (PRDs) provided for~~from overpressure ~~protection of that system~~. These ~~are~~ devices, ~~such as~~including ~~pressure relief valve~~PRVs, ~~and~~ rupture disks, and ~~or~~ other non-reclosing devices, are designed to relieve pressure during ~~that are called upon to operate and reduce an~~ overpressure conditions.

b) These devices are not designed or intended to control the pressure in the system during normal operation. Instead, they are intended to function when normal operating controls fail or abnormal system conditions are encountered.

c) Periodic inspection and maintenance of these ~~important~~ safety devices ~~is~~ are critical to ensure their continued functioning ~~and availability when called upon to operate~~. See NBIC Part 2, 2.5.8 for recommended testing frequency for PRDs.

d) Inspection areas of concern include:

1) c~~C~~orrect set pressure (matching of set pressure to MAWP);
2) s~~S~~afety considerations;
3) ~~D~~device data;
4) ~~C~~condition of the device;
5) ~~C~~condition of the installation; and
6) ~~T~~testing and operational inspection.

2.5.5.1 POWER BOILERS

If boilers with maximum allowable working pressures differing by more than 6% are piped together ~~with maximum allowable working pressures differing by more than 6%~~, additional protective devices may be required on the lower-pressure units to protect them from overpressure from the higher-pressure unit(s).

2.5.5.2 HOT-WATER-HEATING BOILERS, HOT WATER SUPPLY BOILERS, AND POTABLE WATER HEATERS

a) ~~These~~ Because these units ~~generally~~ typically do not ~~use~~ receive any water treatment, ~~and therefore~~they may be more prone to ~~problems~~ issues ~~with~~ (e.g., deposit~~s~~ ~~forming~~ formation) that ~~may~~ can impair ~~a~~ safety device~~'s~~ operation. ~~Particular attention should be paid to~~The Inspector should look for signs of leakage through ~~valves~~ the valve ~~or~~ as well as buildup~~s~~ of deposits.

b) Hot-water boilers tend to have buildups of corrosion products since the system is closed with little makeup. These products can foul or ~~block~~ obstruct the valve inlet.

c) Water heaters ~~will~~ typically have cleaner water due to continuous makeup. ~~However, t~~These valves usually have a thermal element that will cause the valve to open slightly when the water is heated, ~~and~~however the heat is not removed from

the system. When this hot water evaporates in the discharge piping, scale deposits ~~may tend to~~can form in the valve inlet and outlet.

2.5.5.3 PRESSURE VESSELS AND PIPING

Standard practice for overpressure protection devices is to not permit the use of any type of isolation valve either before or after the device. However, some pressure vessel standards permit the use of isolation valves under ~~certain~~ controlled conditions when ~~shutting down~~ the vessel is shut down~~to~~ for the repair of a damaged or leaking valve. If isolation block valves are employed, their use should be carefully controlled by written procedures. Block valves should have provisions to be either car-sealed or locked in an open position when not ~~being~~ in use~~d~~. For ASME Section VIII, Div~~.~~ision 1 pressure vessels, see UG-156, Appendix M~~,~~ and jurisdictional ~~rules~~ requirements for more information.

2.5.5.4 NON-RECLOSING PRESSURE RELIEF DEVICES

a) Rupture disks or other non-reclosing devices may be used as sole relieving devices or in combination with safety relief valves to protect pressure vessels.

b) ~~The selection of the c~~Correct rupture disk device selection~~for the intended service~~ is critical to obtaining ~~acceptable~~ disk performance that is acceptable for the intended service. ~~Different d~~Disks are designed ~~are intended~~ for various purposes, such as constant pressure, varying pressure, or pulsating pressure. Some designs include features that make them suitable for back pressure and/or internal vacuum in the pressure vessel.

c) The margin between the operating pressure and the burst pressure is an important factor in obtaining acceptable performance and service life of the disk. Flat and pre-bulged solid metal disks are ~~typically~~ used with an operating pressure that is typically no more than 60% to 70% of the burst pressure. Other designs ~~are available~~ that increase the operating pressure to as much as 90% of the burst pressure are also available. Disks that have been exposed to pressures above the normal operating pressure for which they are designed are subject to fatigue or creep and may fail at unexpectedly low pressures. Disks used in cyclic service are also subject to fatigue and may require a greater operating margin or selection of a device suitable for such service.

d) The correct disk material is also critical ~~to obtaining acceptable service life from~~for the disk's service life. Disks are available in a variety of materials and coatings, and materials that are unaffected by the process fluid should be used. Disks that experience corrosion may fail and open at an unexpectedly low pressure.

e) Disk designs ~~must~~ shall also be properly selected for the fluid state. Some disk types are not suitable for use in liquid service. Some disks may have a different flow resistance when used in liquid service, which may affect the sizing of the disk.

f) Information from the rupture disk manufacturer, including catalog data and installation instructions, should be consulted when selecting a disk for a particular service.

g) For rupture disks and other non-reclosing devices, the following additional items should be considered during inspections.

1) The rupture disk nameplate information, including stamped burst pressure and coincident temperature, should be checked to ensure it is compatible with the intended service. The ~~coincident temperature on the~~ rupture disk's coincident

temperature shall be the expected temperature of the disk when the disk is expected to burst; ~~and~~ this will usually be related to the process temperature, not the temperature on the pressure vessel nameplate.

2) Markings indicating direction of flow should be checked carefully to ensure they are correct. ~~Some~~ If rupture disks ~~when~~ are installed in the incorrect position they may burst well above the stamped pressure.

3) The marked burst pressure for a rupture disk installed at the inlet of a safety relief valve shall be ~~equal to or~~ less than or equal to the safety relief valve set pressure. A marked burst pressure of 90% to 100% of the safety relief valve set pressure is recommended. A disk with a non-fragmenting design that cannot affect the safety relief valve shall be used.

Note: If the safety relief valve set pressure is less than the vessel MAWP, the marked burst pressure may be higher than the valve set pressure, but no higher than the MAWP.

4) ~~The rupture disk shall be checked~~Verify that the space between the rupture disk and ~~a~~ the ~~pressure relief valve~~PRV is supplied with a pressure gage, try cock, or telltale indicator to indicate signs of leakage through the rupture disk. The ~~pressure relief valve~~PRV shall be inspected, and the leaking disk shall be replaced if leakage through the disk is observed.

5) If a rupture disk is used on a valve outlet, the valve design shall be of a type not influenced by back pressure due to leakage through the valve. Otherwise, for nontoxic ~~and~~ or non-hazardous fluids, the space between the valve and the rupture disk shall be vented or drained to prevent ~~the~~ accumulation of pressure.

6) For rupture disks installed on the valve inlet, the installation should be reviewed to ensure that the combination rules of the original code of construction have been applied. A reduction in the valve capacity up to 10% is expected when used in combination with a non-reclosing device.

7) The frequency of inspection for rupture disks and other non-reclosing devices is ~~greatly~~ largely dependent on the nature of the contents and operation of the system, ~~and~~ so only general recommendations can be given. Inspection frequency should be based on previous inspection history. If a device~~s have been found to be~~is leaking, defective, or damaged by system contents during inspection, inspection intervals should be shortened until acceptable ~~inspection~~ results are obtained. ~~With this in mind, the~~The inspection frequency guidelines specified in NBIC Part 2, 2.5.8 are suggested for similar services.

8) Rupture disks are often used to isolate ~~pressure relief valve~~PRVs from services where fouling or plugging of the valve inlet occurs. This tendency should be considered in establishing the inspection frequency.

9) Since rupture disks are non-reclosing devices ~~single activation devices~~, only a visual inspection ~~is the only inspection that~~ can be performed. A rupture disk ~~that is~~ removed from its holder shall ~~should~~ not be reinstalled unless recommended by the manufacturer. A rupture disk ~~contained~~ installed in an assembly that can be removed from ~~a~~ the system without releasing the clamping force ~~maintaining the intimate contact~~ between the disk and ~~the~~ holder~~, such as~~ (e.g., pre-torqued, welded, soldered, ~~and some~~or certain threaded assemblies)~~,~~ may be suitable for reinstallation ~~after~~ following visual inspection. The manufacturer should be consulted for specific recommendations.

10) It is recommended that all rupture disks be replaced periodically to prevent unintended failure while in service due to deterioration of the device. Rupture disks should be checked carefully for damage prior to installation and handled by

the disk edges, if possible. Any damage to the surface of the ruptured disk can affect the burst pressure.

11) For pin devices, pins or bars shall be checked for permanent deformation (e.g., bent/deflection), cracks, or corrosion. Pin deflection may be the result of pin fasteners being overtightened.

12) For pin devices, markings on replaceable pins or bars shall be checked against information on the device nameplate to ensure that they are installed on the correct device. If markings are illegible or missing, the device should be taken out of service and the pin or bar should be replaced with a component specified by the manufacturer. Replacement shall not be performed while the device is pressurized.

13) For pin devices, check that there is no foreign object present that could interfere with the bar or pin, prevent proper device operation ~~of the device~~, or hold the device shut.

2.5.8.1 ESTABLISHMENT OF INSPECTION AND TEST INTERVALS

Where a recommended test frequency is not ~~listed~~specified, the valve user and Inspector ~~must~~ shall determine and agree ~~on a suitable~~upon an appropriate ~~interval for~~ inspection and test interval. Some ~~items~~ factors to be considered ~~in making this determination are~~include:

a) Jurisdictional requirements;

b) Records of inspections and test data ~~and inspections~~ from similar ~~processes and similar~~ devices ~~in operation~~operating under comparable service conditions at that facility;

c) Recommendations from the device manufacturer. ~~In particular~~For example, when the valve ~~includes~~ contains~~a~~ non-metallic ~~parts~~ components, such as ~~a~~ diaphragms or soft seats, periodic replacement of ~~those~~ these parts may be ~~specified~~necessary;

d) Operating history of the system. For example, ~~S~~systems with frequent upsets where a valve has actuated require more frequent inspection. ~~:~~ These upsets could lead to unanticipated damage to the valve and its operation. Frequent upsets should be investigated to identify a root cause, and a solution should be recommended.

e) Results of visual inspection ~~of the device~~ and installation conditions. ~~Signs~~ Evidence of valve leakage, corrosion, or damaged ~~parts~~ components ~~all~~ indicates that more ~~=~~frequent operational inspections are required;

f) Installation of a valve in a system with a common discharge header. Valves discharging into a common collection pipe may be affected by ~~the~~ discharge ~~of~~ from other valves, ~~by the~~including corrosion of ~~parts in the~~ outlet ~~portion~~ components of the valve or ~~the buildup~~accumulation of ~~products~~ discharged materials from those valves;

g) Ability to coordinate with planned system shutdowns. ~~The~~ A planned system shutdown ~~of a system~~ for ~~other~~ maintenance or inspection activities ~~is~~ provides an ideal ~~time~~ opportunity for the operational inspection and testing of a ~~pressure relief valve~~PRV;

	h) Critical nature of the system. Systems that are critical to plant operation, or systems whose fluid discharge ~~where the effects of the discharge of fluids from the system are particularly detrimental due to~~could result in fire hazards, environmental damage, or toxicity concerns, ~~all call for~~may require more frequent inspection intervals to ensure proper devices ~~are operating~~ operation~~properly~~; and i) Uncertain service conditions. Where the effects of corrosion, blockage by system fluid, or the ability of the valve to operate under ~~given~~ service conditions are unknown (~~such as~~e.g., in a new process or installation), a relatively ~~short~~ brief inspection interval, not to exceed one year or the first planned shutdown, whichever is shorter, shall be established. At that time, the device shall be visually inspected and tested. If unacceptable test results are obtained, the inspection interval shall be reduced by 50% until suitable results are obtained.
Part 2, 2.5.8.2 Editorial	a) The above intervals are guidelines for periodic inspection and testing. Typically, if there are no adverse findings, a ~~pressure relief valve~~PRV would be placed back in service until the next inspection. Any unacceptable conditions that are found by the inspection shall be corrected immediately by repair or replacement of the device. Many users will maintain spare ~~pressure relief device~~PRDs so the process or system is not affected by excessive downtime. b) ~~Pressure relief valve~~PRVs are mechanical devices that require periodic preventive maintenance even though external inspection and test results indicate acceptable performance. There may be wear on internal parts, galling between sliding surfaces, ~~or~~ internal corrosion, ~~and~~ or fouling which will not be evident from an external inspection or test. Periodic re-establishment of seating surfaces and the replacement of soft goods, such as O~~o~~-rings and diaphragms, are also ~~well advised~~recommended preventive maintenance activities ~~that can prevent future problems~~. If the PRV~~valve~~ is serviced, a complete disassembly, internal inspection, and repair as necessary, such that the valve's condition and performance are restored to a like new condition, should be ~~done~~ performed by a National Board "VR" Certificate Holder. c) Service records with test results and findings should be maintained for all overpressure protection devices. A service interval of no more than three inspection intervals or ten years, whichever is less, is recommended to maintain device condition. Results of the internal inspection and maintenance findings can then be used to establish future service intervals.
Item NB15-0307	Part 2, 2.5.7 GENERAL CONSIDERATIONS FOR TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF DEVICES

Part 2, 2.5.7	a) Pressure relief ~~devices (PRDs)~~valves and pin devices shall be subject to periodic inspection and/or testing based upon the type of device. b) The owner may perform testing on the unit wherever the ~~valve~~ PRD is installed or at a qualified test facility. In many cases, testing on the unit may be impractical, especially if the service fluid is hazardous or toxic. Testing on the unit may involve the bypassing of operating controls and should be performed only by qualified individuals under carefully controlled conditions. ~~It is recommended to have available a~~A written procedure to conduct this testing should be made available. 1) The Inspector should ensure that calibrated equipment has been used to perform this test, and the results should be documented by the owner. 2) If the testing is performed at a test facility, the record of this test should be reviewed to ensure the device meets the requirements of the original code of construction. Devices that have been in toxic, flammable, or other hazardous services shall be carefully decontaminated before being tested. ~~In particular~~For example, the closed bonnet of valves in these services may contain fluids that are not easily removed or neutralized. If a test cannot be safely performed, the device shall be disassembled, cleaned, decontaminated, repaired, and reset. 3) If a device has been removed for testing, the inlet and outlet connections should be checked for blockage due to product buildup or corrosion.
Item NB15-0307 Part 2, 2.5.8	Part 2, 2.5.8 RECOMMENDED INSPECTION AND TEST FREQUENCIES FOR PRESSURE RELIEF DEVICES Inspection and test frequencies for ~~pressure relief device~~PRDs are greatly dependent on service, external environment, and operation of the system; therefore, only general recommendations can be given. Inspection frequency should be based on previous inspection history, manufacturer's recommendations, or both. If ~~valves~~ devices are found to be defective or damaged during inspection, intervals should be shortened until acceptable inspection results are obtained. Where test records or inspection history is not available, the inspection and test frequencies in Table 2.5.8 are suggested.
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Part 2, Table 2.5.8

Service	Recommended Inspection Type/Frequency (See Note 4)
Power boilers less than 400 psig (2.76 MPa)	Lift lever test every six months; set pressure test annually or prior to planned boiler shutdown
Power boilers 400 psig (2.76 MPa) or greater	Set pressure test every three years or prior to planned boiler shutdown
High-temperature hot-water boilers (See Note 1)	Set pressure test annually
Low-pressure steam-heating boilers	Lift lever test quarterly; set pressure test annually prior to heating season
Organic fluid vaporizers	Remove, inspect, and set pressure test annually
Thermal fluid heaters	Remove, inspect, and set pressure test annually
Hot-water-heating boilers (See Note 2)	Lift lever test quarterly; set pressure test annually prior to heating season
Water heaters (See Note 3)	Lift lever test every two months; every three years, remove and inspect temperature probe for damage, buildup, or corrosion
Pressure vessels / piping-steam service	Set pressure test annually
Pressure vessels / piping-air/clean, dry gas	Set pressure test every three years
Pressure vessels /piping-propane/refrigerant	Set pressure test every five years
Pressure relief valves in combination with rupture disks	Set pressure test every five years
All others	Per inspection history

Part 2, Table 2.5.8 Editorial

Note 3:
The temperature probe shall be checked for the condition of the coating material and freedom of movement without the probe becoming detached. If the valve is damaged or fails the testing described in Table 2.5.8, above, it shall be repaired or replaced.

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Part 2, 4.2 and editorial

4.2 NONDESTRUCTIVE EXAMINATION METHODS ~~(NDE)~~

a) This section contains a variety of nondestructive examination (NDE) methods that may be employed to assess the condition of pressure-retaining items. The Inspector shall review the methods and procedures to be employed to ensure compliance with the requirements in the applicable codes, standards, and~~/or~~ when required, jurisdiction~~al requirements~~.

b) When the extent of a defect or detrimental condition ~~found~~ in a pressure-retaining item cannot be determined, the Inspector should seek competent technical advice for further evaluation of the finding. ~~Additionally,~~ S~~s~~upplemental NDE may be used to further evaluate the finding.

c) The NDE requirement shall include the technique, extent of coverage, procedures, personnel qualifications, and acceptance criteria. The acceptance criteria shall be in accordance with the original code of construction, standard, or other applicable specifications. If this is not possible or practical, and all other requirements are met, alternative NDE methods may be considered. The

	alternative NDE method(s) shall be acceptable to the Inspector, and when required, the jurisdiction ~~when required~~. d) NDE personnel shall be qualified to the requirements of ASME BPVC Section V, paragraph T-120, which references standards recognized nationally and internationally ~~accepted standards~~. When qualification in accordance with these requirements~~this~~ is not possible, NDE personnel may be qualified and certified in accordance with their employer's written practice. 1) The employer's written practice shall be established with one of the following recommended practices as a guideline: the American Society for Nondestructive Testing (ASNT)'s ASNT SNT-TC1A, *Personnel Qualification and Certification in Nondestructive Testing* or ANSI/ASNT CP-189, *Standard for Qualification and Certification of Nondestructive Testing Personnel*. 2) Personnel performing NDE shall have proper training and certification~~,~~ as required by the owner and acceptable to the Inspector, and when required, the jurisdiction ~~when required~~. Training and certification records shall be maintained by the employer of the NDE personnel. 3) Demonstrated Proficiency: Many types of NDE, especially Advanced Ultrasonic NDE, require the NDE examiner to demonstrate proficiency in the technique being utilized. A proficient examiner shall demonstrate to an owner or a third party the ability to follow a written procedure and ~~have~~ knowledge of the applicable c~~C~~odes and s~~S~~tandards relevant to this method. In addition, the NDE examiner shall be competent in ~~the~~ equipment and probe selection and~~,~~ equipment calibration.~~, and~~The examiner shall also be capable of detecting, characterizing, and documenting the type, size, and location of flaws based on anticipated degradation mechanisms common to the asset being examined.
Item 25-27 Part 2, 4.4.2	**4.4.2 GENERAL REQUIREMENTS** a) Organizations or qualified individuals with experience in pressure-retaining item inspection, design, construction, repair~~s~~, or failure analysis ~~of pressure-retaining items~~ should be consulted to assist in ~~identifying~~ damage mechanism~~s,~~ identification and to evaluate condition assessment results of pressure-retaining items. Understanding the operation of equipment or systems and interaction with their internal or external service environment is necessary to correctly identify damage mechanisms. ~~a)~~b) Documentation and inspection data used for conducting and completing a fitness -for-service assessment (FFSA) should be ~~evaluated for compliance, with~~based on the applicable codes, industry standards/experience or ~~good~~ sound engineering practices, and shall be acceptable to the j~~J~~urisdiction when required. ~~Understanding the operation of equipment or systems and interaction with their internal or external service environment is necessary to correctly identify damage mechanisms.~~

	c) ~~There are v~~Various condition assessment and ~~fitness for service~~FFSA methods ~~that~~ can be used to determine inspection intervals, based on calculating the remaining service life of the pressure-retaining item. ~~In NBIC Part 2:~~ 1) For items subject to corrosion or erosion, the method to determine or adjust inspection intervals is identified in NBIC Part 2, 4.4.7. 2) Methods for assessing other types of inservice damage (e.g., creep, brittle fracture, bulges~~, etc.~~) that affect the remaining service life of pressure-retaining items are identified in NBIC Part 2, 4.4.8. Refer to NBIC Part 2, 4.4.1 ~~(~~b) and ~~(~~c) for further clarification.
Item 23-81; Item 25-88 Part 2, 4.4.3	**RESPONSIBILITIES** a) Owner or User ~~The owner or user of the pressure-retaining item is responsible for the selection and application of a suitable fitness for service or condition assessment methodology described in this section, subject to review and approval by the Jurisdiction, if required.~~The owner or user of the pressure-retaining item is responsible for the selection of an organization or engineer experienced in fitness for service and the code of construction of the item being assessed. This engineer is responsible for determining the appropriate methods for assessing conditions and evaluating the remaining safe operation and service life of the pressure--retaining item and producing a report of the results. The owner or user is responsible for ensuring the methods for the assessment used are acceptable to the jurisdiction and ~~i~~Inspector. The owner or user is responsible for providing the assessment to the jurisdiction and maintaining a copy for future reference. b) Inspector The Inspector shall ~~review~~ confirm that the condition assessment has been performed~~,~~ and~~methodology and ensure~~ inspection data and applicable documentation are ~~in accordance with this section~~available.
Item 25-27	**4.4.7 DETERMINING INSPECTION INTERVALS** a) The maximum period between internal inspections or ~~a~~ complete inservice evaluations of pressure-retaining items shall not exceed one-half of the estimated

Part 2, 4.4.7	remaining service life of the vessel or ten years, whichever is less. The methods for estimating inspection intervals of pressure-retaining items subject to internal erosion or corrosion ~~is~~ are discussed in NBIC Part 2, 4.4.7.1 and 4.4.7.2. b) Inspection intervals ~~can be revised beyond the maximum period stated above, provided the owner or user has submitted technical justification for revising the inspection interval~~may be revised beyond the maximum period stated in 4.4.7 a), above, provided the owner or user has ~~submitted~~documented a technical justification for the revision, subject to review and acceptance by the Inspector, and j~~J~~urisdiction~~,~~ where required. 1) Risk-based inspection may be used to extend intervals and determine credible damage mechanisms. (Refer to NBIC Part 2, 4.5 for further information.) 2) Other engineering methods, including FFSA, may be used to determine a life-cycle, ~~and~~ thereby ~~used to~~ extending intervals based on the current condition of the equipment. (Refer to NBIC Part 2, 4.4.8 and 4.6 for further information.) ~~b)~~c) Data used in engineering assessment methods to develop revised inspection intervals for pressure-retaining items shall be re-evaluated every five years, when a change in operation occurs, or after discovery of new or altered damage mechanisms.
Part 2, 5.2.1 Editorial	**5.2.1 INDISTINCT STAMPING OR NAMEPLATE IS LOST, ILLEGIBLE, OR DETACHED.** a) When the stamping on a pressure~~-~~-retaining item becomes indistinct or the nameplate is lost, illegible, or detached, but traceability to the original pressure-retaining item is still possible, the Inspector shall instruct the owner or user to have the nameplate or stamped data replaced. All re~~-~~stamping shall be done in accordance with the original code of construction, except as modified herein. Request for permission to re~~-~~stamp data or replace nameplates shall be made to the ~~Jurisdiction~~ jurisdiction in which the nameplate or stamping is reapplied for approval. Application shall be made on the Form NB-136, *Replacement of Stamped Data ~~Form,~~* ~~NB-136~~ (see 5.3.2) which is available on the National Board website (nbbi.org). Proof of traceability to the original nameplate or stamping and other such data, as is available, shall be furnished with the request. The manufacturer of the pressure-retaining item, if available, shall be contacted prior to replacing a nameplate or stamped data in order to verify applicable code requirements. b) When there is no ~~J~~jurisdiction, documentation used to verify traceability~~,~~ and the ~~*Replacement of Stamped Data Form,*~~ Form NB-136 shall be submitted to a National Board Commissioned Inspector for approval. c) All re~~-~~stamping or replacement of nameplates shall be witnessed by a National Board Commissioned Inspector.

	d) When the nameplate is welded to the pressure-retaining boundary, the welding must be done by a National Board "R" ~~Stamp~~ Certificate Holder. e) Permission from the ~~Jurisdiction~~ jurisdiction or National Board Commissioned Inspector is not required for the reattachment of nameplates that are partially attached. f) The re-stamping or replacement of a code symbol stamp shall be performed only as permitted by the governing code of construction. g) Replacement nameplates or stamped data shall be clearly marked "Replacement."~~.~~ h) When traceability cannot be established, the ~~Jurisdiction~~ jurisdiction where the pressure-retaining item is installed shall be contacted for approval prior to replacing a nameplate or ~~re-applying~~ restamping.
Item 25-54 Part 2, (5.2.1 editorial) and 5.2.2 a)	**5.2.1 INDISTINCT STAMPING OR NAMEPLATE IS LOST, ILLEGIBLE, OR DETACHED** a) When ~~the~~a pressure-retaining item's stamping ~~on a pressure-retaining item~~ becomes indistinct or ~~the~~ its nameplate is lost, illegible, or detached~~,~~ but traceability to the original pressure-retaining item ~~is still possible~~can be provided, the Inspector shall instruct the owner or user to have the nameplate or stamped data replaced. All re-stamping shall be ~~done~~ completed in accordance with the original code of construction, except as modified herein. ~~Request for permission~~The owner or user shall request approval to re-stamp data or replace nameplates ~~shall be made to~~from the ~~J~~jurisdiction in which the nameplate or stamping ~~is~~ will be reapplied ~~for approval~~. Application shall be made on the Form NB-136, *Replacement of Stamped Data* ~~*Form*, NB-136~~ (see 5.3.2) ~~which is,~~ available on the National Board website (~~www.nationalboard~~nbbi.org). Any available data, such as ~~P~~proof of traceability to the original nameplate or stamping ~~and other such data, as is available~~, shall be ~~furnished~~ attached with the request. The manufacturer of the pressure-retaining item, if available, shall be contacted to verify applicable code requirements prior to replacement or reapplication~~replacing a nameplate or stamped data in order to verify applicable code requirements~~. b) When there is no j~~J~~urisdiction, ~~documentation used to verify traceability, and the Replacement of Stamped Data~~the Form~~,~~ NB-136 and documentation to verify traceability shall be submitted to a National Board Commissioned Inspector for approval. c) All re-stamping or ~~replacement of~~ nameplate~~s~~ replacement shall be witnessed by a National Board Commissioned Inspector.

	d) When the nameplate is welded to the pressure-~~-~~retaining boundary, the welding ~~must~~ shall be performed~~be done~~ by a National Board "R" ~~Stamp~~ Certificate Holder. e) Permission ~~from the Jurisdiction or National Board Commissioned Inspector~~ is not required for the reattachment of partially attached nameplates ~~that are partially attached~~. f) The re-~~-~~stamping or replacement of a code symbol stamp shall be performed only as permitted by the governing code of construction. g) Replacement nameplates or restamped data shall be clearly marked "Replacement."~~.~~ h) When traceability cannot be established, the ~~J~~jurisdiction ~~where~~ in which the pressure-~~-~~retaining item is installed shall be contacted for approval prior to stamping reapplication or nameplate replacement~~replacing a nameplate or re-applying stamping~~. **5.2.2 REPORTING** a) The owner, user, original manufacturer, or "R" Certificate Holder shall file ~~T~~the completed Form NB-136~~, *Replacement of Stamped Data Form*~~, any attachments, and ~~with~~ a facsimile of the replacement stamping or nameplate ~~applied and~~with appropriate signatures ~~shall be filed~~ with the National Board, and the j~~J~~urisdiction~~,~~ if applicable ~~and the National Board by the owner, user, original manufacturer, or "R" Certificate Holder~~. b) The owner or user shall retain all documentation provided for traceability with the completed F~~f~~orm NB-136 for as long as the pressure-retaining item is in their ownership or use. If the pressure-retaining item is sold, the Form NB-136, along with the supporting documentation, shall be provided to the new owner.
Item 25-61 and Editorial (5.3.2) Part 2, 5.3.2, 5.3.3 12) through 18)	**5.3.2 FORMS** The following forms are located at the end of Section 5. a) Form NB-136, **REPLACEMENT OF STAMPED DATA ~~FORM (NB-136), see Pg. 89~~** b) **FORM NB-4, *NEW BUSINESS OR DISCONTINUANCE used by Authorized Inspection Agencies~~OF BUSINESS, see Pg. 91~~*** c) **FORM NB-6, BOILER-FIRED PRESSURE VESSEL~~S~~ REPORT OF INSPECTION~~, see Pg. 92~~** d) **FORM NB-7, PRESSURE VESSELS REPORT OF INSPECTION~~, see Pg. 94~~**

e) **FORM NB-403, REPORT OF FITNESS FOR SERVICE ASSESSMENT** ~~see Pg. 97~~

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

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

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

7) Enter the name of the manufacturer of the pressure-retaining item.

8) Is the Manufacturer's Data Report attached to the form? Check the appropriate box.

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

…

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

~~12)~~13) Proposed representation of the nameplate to be provided to jurisdiction (when applicable) for review and acceptance.

~~13)~~14) Provide the name of the owner, user, original manufacturer, or "R" Certificate Holder making the request. If an "R" Certificate Holder is making the request, provide the "R" Certificate Number. Provide the signature of the requester and date requested.

Item ~~14~~ 15 shall be completed by the Authorized Jurisdictional Representative or Inspector.

~~14)~~15) If the original manufacturer is currently in business, concurrence shall be obtained by the owner or user.

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

	requester shall submit the form (and any attachments) to a National Board Commissioned Inspector for approval. After the form is authorized, it shall be returned to the owner, user, original manufacturer, or “R” Certificate Holder who made the request. The requester is required to contact the jurisdiction or an Authorized Inspection Agency to provide a National Board Commissioned Inspector to witness the re-stamping or installation of the new nameplate. If the nameplate is being welded to the pressure-retaining boundary of the vessel, the welding shall be performed by an “R” Certificate Holder. The requester shall provide the new nameplate or have on hand the tools to do the re-stamping in accordance with the original code of construction. Items ~~15~~16 ~~17~~ 18 shall be completed by the responsible party ~~as~~ indicated. ~~15)~~16) Once the re-stamping is completed~~,~~ or the new nameplate is attached, the requester shall provide a true facsimile of the replacement stamping. ~~16)~~17) The owner, user, original manufacturer, or "R" Certificate Holder shall ~~fill in~~record their name (and "R" Certificate Number if an "R" Certificate Holder), signature, and date of completion. ~~17)~~18) To be completed by the National Board Commissioned Inspector who witnessed the re-stamping or installation of the new nameplate. The requester shall file a copy of the completed form with: • the jurisdiction where the pressure-retaining item is installed (if applicable); • the National Board; • the owner or user of the pressure-retaining item (if the request was made by the original manufacturer or the “R” Certificate Holder); and • the Authorized Inspection Agency who witnessed the re-stamping or attachment of the new nameplate (upon request).
Item 23-81 Part 2, 5.3.4 and editorial	**5.3.4 GUIDE FOR COMPLETING FITNESS-FOR-SERVICE ASSESSMENT REPORTS** 1) For tracking and reference purposes, indicate the sequential f~~F~~itness-for-~~S~~service a~~A~~ssessment (FFSA) number. 2) Name and address of the owner of the equipment that is being assessed for f~~F~~itness for ~~S~~service. 3) Name and address of the organization or individual performing the ~~Fitness-for-Service Assessment~~FFSA. 4) Name and address of the facility where the equipment being assessed for ~~F~~fitness for ~~S~~service is located. 5) Name of the ~~J~~jurisdiction where the assessed equipment is located.

	6) Identification of equipment, including manufacturer, manufacturer's serial number, National Board number, Jurisdiction-assigned registration number, and year built. Also include equipment/component material specification/grade, design and operating pressures, and design and operating temperatures, if applicable. 7) Indicate the name, section, division, edition, and addenda of the original code of construction. 8) Name of the standard used to perform the ~~Fitness-for-Service Assessment~~FFSA. 9) Description of the equipment / component damage mechanism or flaw types considered in the ~~Fitness-for-Service Assessment~~FFSA. 10) Description of the ~~Fitness-for-Service Assessment~~FFSA level and technique. Attach all relevant ~~Fitness-for-Service Assessment~~FFSA procedures and detailed documentation. 11) Description of the ~~i~~inspection and NDE results as prescribed in the ~~Fitness-for-Service Assessment~~FFSA analysis. 12) Description of the failure, damage, and deterioration modes identified in the ~~Fitness-for-Service Assessment~~FFSA. 13) Indicate the results of the ~~Fitness-for-Service Assessment~~FFSA, including remediation recommendations. 14) Indicate if the equipment can continue current operation. 15) Indicate if repairs are required. 16) Indicate if equipment replacement is required. 17) Indicate if continued operation has a finite date. 18) Indicate finite date of continued operation (if applicable). 19) Indicate the required i~~I~~nspection intervals as determined by the ~~Fitness-for-Service Assessment~~FFSA. 20) Indicate the required inservice monitoring methods and intervals for the equipment as defined by the ~~Fitness-for-Service Assessment~~FFSA. 21) Describe any operating or inservice limitations for the equipment. This would include any reductions~~-~~/changes in operating pressures or temperatures. 22) Type or print the name of the representative of the o~~O~~rganization or individual performing the ~~Fitness-for-Service Assessment~~FFSA.

	23) Name of the owner of the equipment. 24) Signature of the owner's ~~-~~representative. 25) Indicate the month, day, and year of the owner review and acceptance of ~~Fitness-for-Service Assessment~~FFSA. 26) Indicate the name of the organization or individual performing the ~~Fitness-for-Service Assessment~~FFSA ~~(this may be the same name as in line 22).~~ 27) Signature of the ~~responsible engineer~~ representative of the organization or individual performing the ~~Fitness-for-Service Assessment~~FFSA. 28) Indicate the month, day, and year of the completion of the ~~Fitness-for-Service Assessment~~FFSA by the o~~O~~rganization responsible. 29) Type or print the name of the Inspector. 30) Name of the a~~A~~ccredited i~~I~~nspection a~~A~~gency employing the Inspector. 31) Signature of the Inspector. 32) Indicate the month, day, and year of the review ~~and acceptance~~ by the Inspector of the ~~Fitness-for-Service Assessment~~FFSA. 33) ~~National Board commission number of Inspector, Jurisdiction, and Certificate of Competency Numbers.~~ Inspector's National Board C~~c~~ommission number and endorsement that qualifies the Inspector to sign this report, and when required by the ~~J~~jurisdiction, the applicable s~~S~~tate or p~~P~~rovincial numbers. 34) Indicate the Inspector's Jurisdiction. 35) Indicate the address of the Inspector's employer (city and state or province). 36) Indicate the month, day, and year of Inspector signature.
Item 25-61 Part 2, Form NB-136 (page 2) And editorial (pg 1-2)	… 3. SUBMITTED BY: (Name of Owner, User, Original Manufacturer, or "R" Certificate Number [~~(~~if an "R" Certificate Holder~~)~~]) … 10. Item Identification …. _____(MAWP psig) SAFETY RELIEF VALVE SET AT: _____ (psig) … 12. TRACEABILITY DOCUMENTATION – PROVIDE ANY DOCUMENTATION THAT WILL HELP THE JURISDICTION OR INSPECTOR VERIFY THE REQUESTED RE-

	STAMPING OR REPLACEMENT NAMEPLATE IS IN ACCORDANCE WITH THE ORIGINAL CODE OF CONSTRUCTION FOR THIS PRESSURE-RETAINING ITEM. ATTACHED

13. THE FOLLOWING IS A PROPOSED REPRESENTATION OF THE ITEM'S REPLACEMENT STAMPING OR NAMEPLATE (shall clearly state "replacement")

(P.O. no., job no., etc. (From line 1)

Proposed nameplate supplied to jurisdiction for approval (when applicable) prior to attachment. Date supplied: _____

~~12~~. I REQUEST AUTHORIZATION TO REPLACE THE STAMPED DATA OR NAMEPLATE ON THE ABOVE-DESCRIBED PRESSURE-RETAINING ITEM IN ACCORDANCE WITH THE RULES OF THE ANSI/NB-23, *NATIONAL BOARD INSPECTION CODE* (NBIC).

NAME: _____ NUMBER: _____
(Owner, User, Original Manufacturer, "R" Certificate Holder) ("R" Certificate Holder only)

SIGNATURE: _____ DATE: _____
(Authorized Representative)

~~13~~. BASED ON THE TRACEABILITY PROVIDED, AUTHORIZATION IS GRANTED TO REPLACE THE STAMPED DATA OR TO REPLACE THE NAMEPLATE OF THE ABOVE-DESCRIBED PRESSURE-RETAINING ITEM.

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

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

~~14~~. THE FOLLOWING IS A TRUE FACSIMILE OF THE ITEM'S REPLACEMENT STAMPING OR NAMEPLATE
(~~must~~ shall clearly state "replacement")

~~15~~. I CERTIFY, ~~THAT~~ TO THE BEST OF MY KNOWLEDGE AND BELIEF, THAT THE STATEMENTS IN THIS REPORT ARE CORRECT, AND THAT THE REPLACEMENT INFORMATION, DATA, AND IDENTIFICATION NUMBERS ARE CORRECT AND IN ACCORDANCE WITH PROVISIONS OF THE ANSI/NB-23, *NATIONAL BOARD INSPECTION CODE* (NBIC).

NAME: _____ NUMBER: _____
(Owner, User, Original Manufacturer, "R" Certificate Holder) ("R" Certificate Holder only)

SIGNATURE: _____ DATE: _____
(Authorized Representative)

~~16~~. WITNESSED BY: _____ EMPLOYER: _____
(Name of Inspector)

SIGNATURE: _____ DATE: _____ NB COMMISSION: _____

Item 25-37 Part 2, Form NB-6 and editorial	THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS NB-6, Rev.7, (03/14/23) **FORM NB-6, *BOILER-FIRED PRESSURE VESSEL REPORT OF INSPECTION*** **Standard Form for Jurisdictions Operating Under the ASME Code** 1. DATE INSPECTED: _____ (Month/Day/Year) CERTIFICATE EXPIRATION DATE: _____ (Month/Day/Year) CERTIFICATE POSTED: ☐ YES ☐ NO USER NUMBER: _____ ~~NAT'L BD~~ NB NUMBER ☐ OR SERIAL # (IF CAST IRON) ☐ _____ FIRST INSPECTION: YES ☐ NO ☐ JURISDICTION NUMBER: _____ NATIONAL BOARD NUMBER: _____ OTHER NUMBER: _____ 6. USE: ☐ POWER ☐ PROCESS ☐ STEAM-HEATING ☐ HWH ☐ HWS ☐ OTHER FUEL TYPE: _____ METHOD OF FIRING: _____ LOCATION IN PLANT: _____ 7. LOW-WATER CUTOFF INSTALLED: YES ☐ NO ☐ TESTED: YES ☐ NO ☐ HIGH-LIMIT TEMP/PRESSURE INSTALLED: YES ☐ NO ☐ WAS BOILER FIRED: YES ☐ NO ☐ COMBUSTION CONTROLS: CSD-1 ☐ NFPA ☐ OTHER ☐ _____ COMBUSTION AIR VERIFIED: YES ☐ NO ☐ 8. ARE THERE ANY KNOWN OUTSTANDING (OPEN) VIOLATIONS FOR THIS EQUIPMENT? ☐ YES ☐ NO (IF YES, EXPLAIN FUL ADVERSE CONDITIONS FOUND) LOG/RECORD REVIEW: YES ☐ NO ☐ PRESSURE TEST: ☐ YES PSIG: _____ DATE: _____ ☐ NO 9. STAMPED MAWP: _____ MINIMUM PRD REQUIRED CAPACITY: _____ NUMBER OF PRDs ~~'S~~: _____ TOTAL CAPACITY: _____ SET PRESSURE: _____ CAPACITY: _____

	SECTION 5 9. STAMPED MAWP: _____ MINIMUM PRD REQUIRED CAPACITY: _____ NUMBER OF PRD'S: _____ TOTAL CAPACITY: _____ Pressure relief device(s) tested? ☐ yes ☐ no SET PRESSURE: _____ CAPACITY: _____ SET PRESSURE: _____ CAPACITY: _____ SET PRESSURE: _____ CAPACITY: _____ 10. INSPECTORS COMMENTS: (Verify any repairs were completed by a qualified repair company, and when applicable, the proper repair/ alterations forms are completed.) 11. ADVERSE CONDITIONS FOUND: _____ 12. REQUIREMENTS: _____ 13. PERSON TO WHOM REQUIREMENTS WERE EXPLAINED: _____ (Name) _____ (Title) _____ (Email) _____ (Phone Number) 14. I HEREBY CERTIFY THIS IS A TRUE REPORT OF MY INSPECTION: NB COMMISSION NUMBER: _____ EMPLOYED BY: _____ IDENTIFICATION NUMBER: _____ SIGNATURE OF INSPECTOR: _____ This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors • 1055 Crupper Avenue, Columbus, Ohio 43229-1183 Page 2 of 2 95 SECTION 5
Item 25-37 Part 2, Form NB-7 and editorial	**FORM NB-7, *PRESSURE VESSELS*** ***REPORT OF INSPECTION*** **Standard Form for Jurisdictions Operating Under the ASME Code** ..... 10. STAMPED MAWP: _____ MINIMUM PRD REQUIRED CAPACITY: _____ NUMBER OF PRDs'S: _____ TOTAL CAPACITY: _____ Pressure relief device(s) tested? ☐ yes ☐ no SET PRESSURE: _____ CAPACITY: _____ SET PRESSURE: _____ CAPACITY: _____ SET PRESSURE: _____ CAPACITY: _____

	OVERPRESSURE PROTECTION BY SYSTEM DESIGN: ☐ SIZE (ft³ or Gallons): _____ 11. ARE THERE ANY KNOWN OUTSTANDING (OPEN) VIOLATIONS FOR THIS EQUIPMENT? ☐ YES ☐ NO (IF YES, EXPLAIN FULLY UNDER ADVERSE CONDITIONS FOUND) PRESSURE TEST: YES ☐ PSIG_____ Date_____ NO☐ 12. INSPECTORS COMMENTS: (Verify any repairs were completed by a qualified repair company, and when applicable, the proper repair/alterations forms are completed.) 13. ADVERSE CONDITIONS FOUND: _____ 14. REQUIREMENTS: _____ 15. PERSON TO WHOM REQUIREMENTS WERE EXPLAINED: _____ (Name) _____ (Title) _____ (Email) _____ (Phone Number) 16. I HEREBY CERTIFY THIS IS A TRUE REPORT OF MY INSPECTION: NB COMMISSION NUMBER: _____ EMPLOYED BY: _____ IDENTIFICATION NUMBER: _____ SIGNATURE OF INSPECTOR: _____
Item 24-100 Part 2, Section 5 (Forms NB-6 and NB-7)	Wording to add to the bottom of NB-6 & NB-7: The owner or user is responsible for the proper operation, care, and maintenance of all jurisdictional objects, ensuring compliance with all applicable codes and regulations. The inspection notes the object's condition only at the time of the inspection. The object's condition can be altered when any variable affecting its operation and/or physical condition changes. 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.
Part 2, Section 5 (Form	**FORM NB-403, REPORT OF FITNESS–FOR–SERVICE ASSESSMENT** in accordance with provisions of the *National Board Inspection Code* FITNESS-FOR-SERVICE ASSESSMENT (F-F-SA) ~~ASSESSMENT~~ NO. _____(1)_____ 2. FFSA ~~ASSESSMENT~~ PERFORMED BY: ____(3)_____

NB-403) Editorial	…. FITNESS-FOR-SERVICE STANDARD USED FOR ASSESSMENT___(8)_____ 6. FLAW TYPE(S) AND-/-OR DAMAGE MECHANISMS CONSIDERED IN FFSA ~~ASSESSMENT~~: 7. FFSA ~~ASSESSMENT~~ PROCEDURES (ATTACH FFSA ~~ASSESSMENT~~ REFERENCE DOCUMENTS WITH DETAILS IF APPLICABLE): 8. FFSA ~~ASSESSMENTS~~ RESULTS / RECOMMENDATIONS (CHECK BOXES THAT APPLY AND PROVIDE DETAILS): **CERTIFICATE OF COMPLIANCE** I, _____, the undersigned, certify to the best of my knowledge and belief, that the statements in this report are correct and that the information, data, and identification numbers are correct and in accordance with provisions of the ANSI/NB-23, *National Board Inspection Code*, Part 2, 4.4. Applicable documentation is attached to support this assessment. ….. **CERTIFICATE OF INSPECTION** I,_____, holding a valid commission issued by ~~T~~the National Board of Boiler and Pressure Vessel Inspectors and certificate of competency, where required, issued by the Jurisdiction of _____ and employed by _____ of _____, have reviewed this report on _____, and state that, to the best of my knowledge and belief, this work complies with the applicable requirements of the ANSI/NB-23, *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 document review. Signature_____ Date_____ NB Commission #_____ (Inspector) (~~NB~~ National Board No. & Jurisdiction ~~Number~~No.)

Item 23-81 Part 2, Form NB-403	

FORM NB-403 REPORT OF FITNESS FOR SERVICE ASSESSMENT

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

Fitness for Service (FFS) ASSESSMENT NO. _____

1. EQUIPMENT OWNER INFORMATION: _____
(name)

_____
(address)

2. FFS ASSESSMENT PERFORMED BY: _____
(Name of ~~Engineering Organization or Engineer~~) Organization or Individual Performing Assessment)

_____
(address)

3. LOCATION OF EQUIPMENT INSTALLATION: _____
(Name of Company)

_____ _____
(address) (Jurisdiction)

4. EQUIPMENT OR COMPONENT INFORMATION: _____
(MFG ~~SRR~~, ~~NBR~~, JURISDICTION~~#~~, YEAR BUILT, OTHER)

_____
(Equipment Material Specification, Grade)

_____
(Design & Operating Pressures, Design & Operating Temperatures)

5. ORIGINAL CODE OF CONSTRUCTION: _____ _____ _____ _____ _____
(Name) (Section) (Division) (Edition) ~~(Addendum)~~

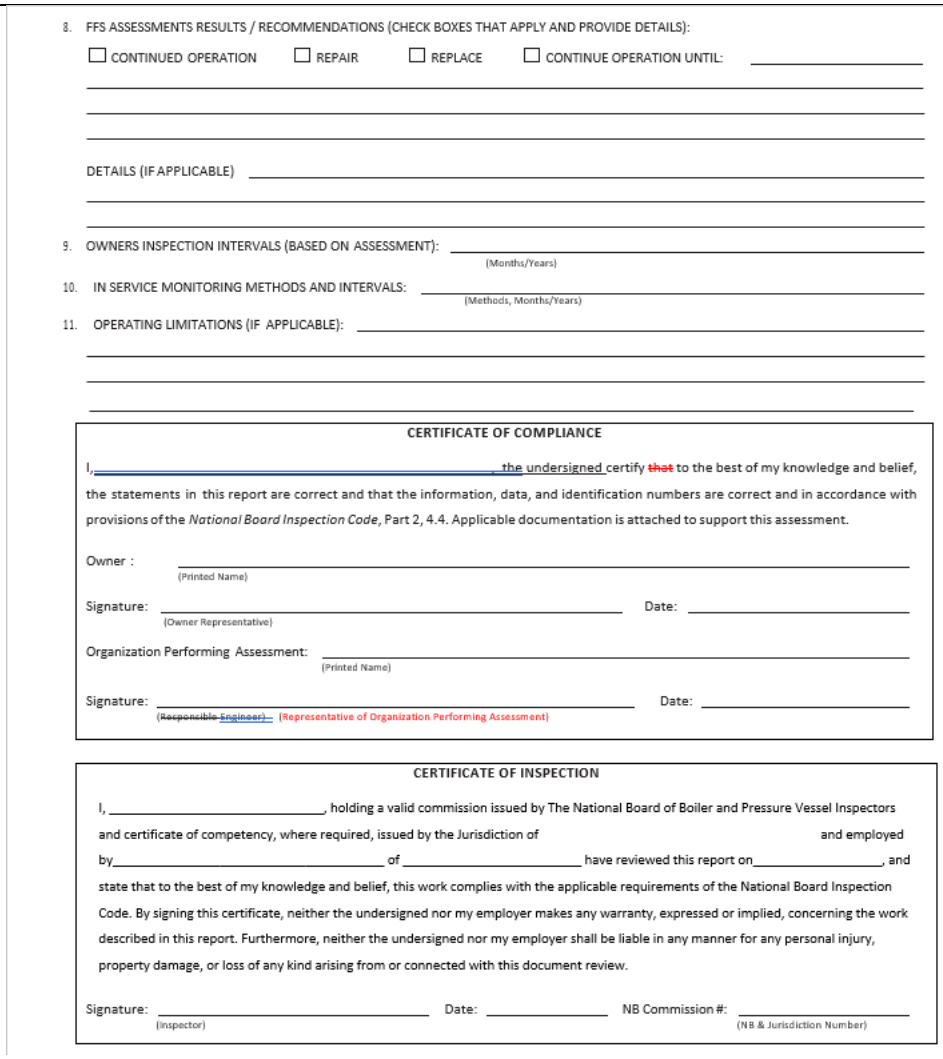
FFS STANDARD USED FOR ASSESSMENT _____

6. FLAW TYPE(S) AND / OR DAMAGE MECHANISMS CONSIDERED IN FFS ASSESSMENT: _____

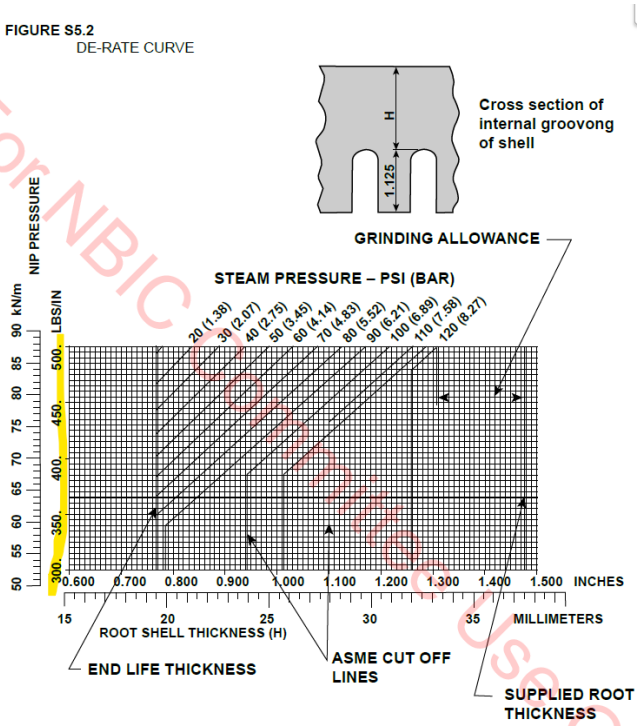
7. FFS ASSESSMENT PROCEDURES (ATTACH FFS ASSESSMENT REFERENCE DOCUMENTS WITH DETAILS IF APPLICABLE):

INSPECTION RESULTS: _____
(Type of NDE Performed, Pressure Tests, Thickness Measurements, etc.)

FAILURE MODES IDENTIFIED: _____
(Crack-Like Flaws, Pitting, Bulges/Blisters, General or Localized Corrosion, etc.)

	 8. FFS ASSESSMENTS RESULTS / RECOMMENDATIONS (CHECK BOXES THAT APPLY AND PROVIDE DETAILS): ☐ CONTINUED OPERATION ☐ REPAIR ☐ REPLACE ☐ CONTINUE OPERATION UNTIL: _____ DETAILS (IF APPLICABLE) _____ 9. OWNERS INSPECTION INTERVALS (BASED ON ASSESSMENT): _____ (Months/Years) 10. IN SERVICE MONITORING METHODS AND INTERVALS: _____ (Methods, Months/Years) 11. OPERATING LIMITATIONS (IF APPLICABLE): _____ **CERTIFICATE OF COMPLIANCE** I, _____, the undersigned certify ~~that~~ to the best of my knowledge and belief, the statements in this report are correct and that the information, data, and identification numbers are correct and in accordance with provisions of the *National Board Inspection Code*, Part 2, 4.4. Applicable documentation is attached to support this assessment. Owner : _____ (Printed Name) Signature: _____ (Owner Representative) Date: _____ Organization Performing Assessment: _____ (Printed Name) Signature: _____ (~~Responsible Engineer~~) (Representative of Organization Performing Assessment) Date: _____ **CERTIFICATE OF INSPECTION** I, _____, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and certificate of competency, where required, issued by the Jurisdiction of and employed by _____ of _____ have reviewed 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 document review. Signature: _____ (Inspector) Date: _____ NB Commission #: _____ (NB & Jurisdiction Number)
Part 2, Section 5 (Form NB-136) Editorial	**Form NB-136, REPLACEMENT OF STAMPED DATA ~~FORM, NB-136~~** in accordance with provisions of the *National Board Inspection Code* 12. TRACEABILITY DOCUMENTATION – PROVIDE ANY DOCUMENTATION THAT WILL HELP THE JURISDICTION OR INSPECTOR VERIFY THE REQUESTED ~~RE-STAMPING~~RESTAMPING OR REPLACEMENT NAMEPLATE IS IN ACCORDANCE WITH THE ORIGINAL CODE OF CONSTRUCTION FOR THIS PRESSURE-RETAINING ITEM.
Editorial Part 2, Figure S2.10.4.2 -a	DETERIORATED PEENED OVER STAY-BOLT HEAD MAY RESULT. THREAD'S IN BOILER ~~PLT.~~PLATE PULLED AWAY FROM STAY-BOLT
Item 25-14 Part 2, S2.10.8	**~~S2.10.8~~S2.6.2.1 ULTRASONIC THICKNESS TESTING OF BOILER WITH INSULATION AND JACKETING**

	a) The pressure-retaining item shall be subjected to ~~ultrasonic thickness testing (~~UT~~)~~ per S2.6.2 to establish a baseline thickness for all ~~of the~~ boiler components. The original Manufacturer's Data Report may be used to establish baseline thickness. Recurring UT inspections per S2.6.2 e~~f~~) may be taken at the bottom of the barrel and around the bottom of the ~~firebox~~wrapper sheet, throat sheet, and back head. b) Should the Inspector request removal of the insulation and jacket ~~be requested by the Inspector~~, agreement should be obtained by the owner or user, Inspector, and jurisdiction if required.
Editorial Part 2, S2.14.16	FIRING OF HISTORICAL BOILERS WITH LIQUID OR GASEOUS FUELS~~.~~ Hand-~~-~~firing of historical boilers with liquid or gaseous fuels poses significant ~~additional~~ safety concerns beyond those encountered when firing with solid fuels for which these boilers were originally designed, such as coal, straw, or wood. The cautionary notes listed below are provided as examples to remind the owner or user that additional safety concerns ~~do~~ exist when firing historical boilers with these alternate fuels. These notes are not meant to be all-inclusive; ~~so~~ each boiler's fuel system should be designed appropriately.
Editorial Part 2, S2.15	TABLES AND FIGURES a) ~~TABLE~~ Table S2.8.1, Minimum Pounds of Steam per H~~h~~our per Square Foot of Heating Surface~~s~~ b) ~~TABLE~~ Table S2.10.2, Sizes for Rivets Based on Plate Thickness c) Table S2.10.3.1, Constants for Calculated MAWP for Cylindrical Components Under External Pressure d~~c~~) ~~TABLE~~ Table S2.10.3.2~~1~~, Maximum Allowable Working Pressure for Cylindrical Components – For Single-Riveted Lap Joint e~~d~~) ~~TABLE~~ Table S2.10.3.3~~2~~, Maximum Allowable Working Pressure for Cylindrical Components – For Double-Riveted Lap Joint f~~e~~) ~~TABLE~~ Table S2.10.3.4~~3~~, Maximum Allowable Working Pressure for Cylindrical Components – For Triple-Riveted Lap Joint g~~f~~) ~~TABLE~~ Table S2.10.3.5~~4~~, Maximum Allowable Working Pressure for Cylindrical Components – For Buttstrap Double- Riveted Lap Joint h~~g~~) Table ~~TABLE~~ S2.10.3.~~5~~6, Maximum Allowable Working Pressure for Cylindrical Components – For Buttstrap Triple-Riveted Lap Joint i~~h~~) Table ~~TABLE~~ S2.10.3.~~6~~7, Maximum Allowable Working Pressure for Cylindrical Components – For Buttstrap Quadruple-Riveted Lap Joint j~~i~~) Table ~~TABLE~~ S2.10.4, Maximum Allowable Working Pressure for Stayed Surfaces k~~j~~) Table ~~TABLE~~ S2.10.4.1-a, Maximum Allowable Working Pressure ~~Based~~ on the Load-~~-~~Carrying Capacity of a Single ~~Riveted~~ Corroded Staybolt

	l) Table S2.10.4.1-b, Maximum Allowable Working Pressure on the Load-Carrying Capacity of a Single Corroded Steel Staybolt m) Table S2.10.6, Efficiencies, Averages for Riveted Joints
Editorial Part 2, Figure S5.2	Delete the following highlighted periods (JUST the periods) 
Editorial Part 2, S6.4.2 c) 5)	**S6.4.2 GENERAL REQUIREMENTS FOR INSPECTORS** **…** c) Inspections for continued service of transport tanks shall be performed by the type of inspector identified below for the specific class of vessel as defined in the applicable Modal Appendices of ASME Section XII and as required by the Competent Authority. Inspectors shall be a Registered Inspector and meet the following additional requirements: … 5) Users may perform continued service inspections including repairs and alterations if the user possesses a valid Owner-User Inspection Organization (OUIO) Certificate of Authorization (NB-371) issued by the National Board of Boiler and Pressure Vessel Inspectors, inspectors have a ~~current and~~ valid NB Commission, and are employed by the OUIO.
Item 25-77 Part 2, S6.13.11.2-b	**TABLE S6.13.11.2-b** MINIMUM THICKNESS FOR SHELLS, ~~IN. (MM)~~MM (IN.)

Cargo tank motor vehicle rated capacity in liters (gallons)	MS	SS/HSLA	AL
More than 0 to at least ~~4,500~~ 17, 000 (0 to ~~17,000~~4,500)	2.54 (0.100)	2.54 (0.100)	3.84 (0.151)

<table>
<tr><td></td><td>
<table>
<tr><td>More than ~~4,500~~17,000 to at least ~~8,000~~30,300 (~~17,000~~4,500 to ~~30,300~~8,000)</td><td>2.92 (0.115)</td><td>2.54 (0.100)</td><td>4.06 (0.160)</td></tr>
<tr><td>More than ~~8,000~~30,300 to at least ~~14,000~~53,000 (~~30,300~~8,000 to ~~53,000~~14,000)</td><td>3.28 (0.129)</td><td>3.28 (0.129)</td><td>4.39 (0.173)</td></tr>
<tr><td>More than ~~14,000~~53,000 (~~53,000~~14,000)</td><td>3.63 (0.143)</td><td>3.63 (0.143)</td><td>4.75 (0.187)</td></tr>
<tr><td colspan="4">Note: The maximum distance between bulkhead, baffles, or ring stiffeners shall not exceed 1,525 mm (60 inches)</td></tr>
</table>
</td></tr>
<tr><td>Editorial Part 2, Table S6.14.6.4</td><td>T1 to T22 For liquid and solid hazardous materials of Classes 3 through 9 that are transported in portable tanks.~~1~~[1]</td></tr>
<tr><td>Item 25-64 Part 2, S6.17 and editorial</td><td>S6.17 DEFINITIONS
These definitions shall be used in conjunction with those of Section 9 of the NBIC. Where conflicts between the two arise, those listed below shall prevail.

Design Certifying Engineer — A person registered with the department in accordance with Subpart F of Part 107 of 49 CFR who has the knowledge and ability to perform stress analysis of pressure vessels and otherwise determine whether a cargo tank design and construction meets the applicable DOT specification. In addition, Design Certifying Engineer means a person who meets, at a minimum, any ~~one~~ of the following:
a) Has an engineering degree and one year of work experience in cargo tank structural or mechanical design;
b) Is currently registered as a professional engineer by the appropriate authority of a state of the United States or a province of Canada; or
c) Has at least three years' experience in performing the duties of a Design Certifying Engineer by September 1, 1991, and was registered with the department by December 31, 1995.

Manufacturer — Any person engaged in the manufacture of a DOT specification cargo tank, cargo tank motor vehicle, or cargo tank equipment that forms part of the cargo tank wall. This term includes attaching a cargo tank to a motor vehicle or to a motor vehicle suspension component that involves welding on a cargo tank wall. A manufacturer ~~must~~ shall register with the department in accordance with Subpart F of Part 107 in Subpart A of 49 CFR.</td></tr>
</table>

	Normal Operating Loading – ~~A cargo tank motor vehicle equipped with two or more cargo tanks fabricated to more than one cargo tank specification.~~ The loading a cargo tank motor vehicle may be expected to experience routinely in operation. **Poisonous Material** – A material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation, or which in the absence of adequate data on human toxicity~~.~~: a) is presumed to be toxic to humans based on laboratory animal testing data for oral, dermal, or inhalation toxicity; or b) is an irritating material, with properties similar to tear gas, which causes extreme irritation, especially in confined spaces. **Registered Inspector (RI)** — A person registered with the department in accordance with Subpart F of Part 107 of 49 CFR who has the knowledge and ability to determine whether a cargo tank conforms with the applicable DOT specification. In addition, Registered Inspector means a person who meets, at a minimum, any ~~one~~ of the following: a) Has an engineering degree and one year of work experience; b) Has an associate degree in engineering and two years of work experience; c) Has a high school diploma or General Equivalency Diploma and three years' work experience; or d) Has at least three years' experience performing the duties of a Registered Inspector by September 1, 1991, and was registered with the DOT by December 31, 1995.
Item 25-79 Part 2, S7.4	**S7.4 EXTERNAL INSPECTION** The pressure vessel shall be inspected for corrosion, distortion, cracking, or other conditions as described in this section. ~~In addition, the following should be reviewed, where applicable:~~ The external inspection shall consist of the following: a) Design/Operation Verify from the nameplate the code of construction, temperature, and pressure ratings to ensure jurisdictional and system compatibility. If the nameplate is lost, illegible, or detached, see NBIC Part 2, 5.2.1. ~~a)~~b) Insulation or Coating

~~If the insulation or coating is in good condition and there is no reason to suspect an unsafe condition behind it, then it is not necessary to remove the insulation or coating in order to inspect the pressure vessel.~~ Removal of the insulation or coating is not required for inspection when it is in good condition and no underlying unsafe condition is suspected. However, ~~it may be advisable to remove a small portion~~selective removal of the insulation or coating may be advisable ~~in order~~ to ~~determine~~ assess ~~its~~ the condition of the insulation or coating and the condition of the pressure vessel surface. For commercially refurbished pressure vessels, see ~~NBIC Part 2,~~ S7.9.

~~b)~~c) Evidence of Leakage

Any evidence ~~leakage~~ of vapor or liquid leakage shall be investigated. Suspected ~~L~~leakage ~~coming~~ from behind insulation or coating~~,~~ or at supports, or ~~evidence~~ indications of ~~past~~ prior leakage, shall be thoroughly ~~investigated~~ examined by removing ~~any~~ insulation as necessary ~~until~~ to identify the source ~~is established~~.

~~c)~~d) Structural Attachments

~~The pressure vessel m~~Mountings should be ~~checked for~~examined to verify adequate allowance for thermal expansion and contraction~~, such as provided by~~ (e.g., slotted bolt holes or unobstructed saddle mountings). Attachments ~~of~~ such as legs, saddles, skirts, or other supports should be ~~examined~~ inspected for distortion ~~or cracks at welds~~and weld cracking.

~~d)~~e) Pressure Vessel Connections

Exterior ~~C~~components that are ~~exterior to the pressure vessel and are~~ accessible without disassembly shall be inspected as described in this paragraph. Manholes, reinforcing plates, nozzles, couplings, ~~or~~ and other connections shall be examined for cracks, deformation, or other defects. ~~Bolts or nuts~~Bolting should be examined for corrosion or ~~defects~~damage. Weep holes in reinforcing plates shall remain open to ~~provide visual evidence of~~indicate leakage ~~as well as to~~and prevent pressure buildup between the pressure vessel and ~~the~~ reinforcing plate. Accessible flange faces should be examined for distortion. Flanges and other connections need not be opened unless conditions indicate internal corrosion~~It is not intended that flanges or other connections be opened unless there is evidence of corrosion to justify opening the connection~~.

~~e)~~f) Fire Damage

Pressure vessels shall be ~~carefully~~ thoroughly inspected for evidence of fire damage. Determining ~~T~~the extent of fire damage ~~determines~~ helps establish

	the appropriate repair method ~~that is necessary~~, if any. (See ~~NBIC Part 2,~~ S7.7.)~~.~~
Item 25-27 Part 2, S7.8 and editorial (S7.8)	**SUPPLEMENT 7** **INSPECTION OF PRESSURE VESSELS IN LIQUEFIED PETROLEUM GAS SERVICES** **S7.8 ACCEPTANCE CRITERIA** a) The acceptance criteria for LPG pressure vessels ~~is~~ are based on successfully passing inspections without showing conditions beyond the limits shown below. b) The limits shown below may be adjusted~~, given that~~if an FFSA has been approved and accepted by the j~~J~~urisdiction. (Refer to Section 4.4.1.) **S7.8.1 CRACKS** Cracks in the pressure boundary (e.g., heads, shells, welds) are unacceptable. When a crack is identified, the pressure vessel shall be removed from service until the crack is repaired by a qualified repair organization, or it shall be ~~or~~ permanently retired from service. (See NBIC Part 3, *Repairs and Alterations*.)~~.~~ **S7.8.2 DENTS** a) Shells The maximum mean dent diameter in shells shall not exceed 5% of the shell diameter, and the maximum depth of the dent shall not exceed 5% of the mean dent diameter. The mean dent diameter is defined as the average of the maximum dent diameter and the minimum dent diameter. If any portion of the dent is closer to a weld than 5% of the shell diameter, the dent shall be treated as a dent in a weld area~~,~~. ~~s~~See S7.8.2 b), below. b) Welds The maximum mean dent diameter on welds (i.e., part of the deformation includes a weld) shall not exceed 10% of the shell diameter. The maximum depth shall not exceed 5% of the mean dent diameter. c) Head The maximum mean dent diameter on heads shall not exceed 10% of the shell diameter. The maximum depth shall not exceed 5% of the mean dent diameter. The use of a template may be required to measure dents on heads. d) When dents ~~are identified~~ which exceed the limits set forth in these paragraphs are identified, the pressure vessel shall be removed from service until the dents are

repaired by a qualified repair organization, or it shall be ~~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 in 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~~using 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 are identified, the pressure vessel shall be removed from service until the bulges are repaired by a qualified repair organization, or it shall be permanently retired from service.

S7.8.4 CUTS OR GOUGES

When a cut or a gouge exceeds 25% of the thickness of the pressure vessel, the pressure vessel shall be removed from service until it is repaired by a qualified repair organization, or it shall be permanently removed from service.

S7.8.5 CORROSION

a) Line and c~~C~~revice c~~C~~orrosion

For line and crevice corrosion, the depth of the corrosion shall not exceed 25% of the original wall thickness.

b) Isolated p~~P~~itting

~~1)~~ Isolated pits may be disregarded provided that:

1)~~a.~~ t~~T~~heir depth is not more than 25% the required thickness of the pressure vessel wall;

2)~~b.~~ t~~T~~he total area of the pits does not exceed 7 ~~sq.~~ in.^{2} (4,500 ~~sq.~~ mm^2) within any 8 in. (200 mm) diameter circle; and

3)~~c.~~ t~~T~~he 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 damaged area may be averaged over a length not exceeding 10 in. (250 mm). The thickness at the thinnest point shall not be less than 75% of the required wall thickness, and the average shall not be less than 90% of the required wall thickness. When general corrosion ~~is identified~~ that exceeds the limits set forth in this paragraph is identified, the pressure vessel shall be removed from service until it is repaired by a qualified "R" ~~Stamp~~ Certificate ~~h~~Holder or permanently removed from service unless an acceptable-~~-~~for-~~-~~service evaluation is performed in accordance with NBIC Part 2, 4.4. d) When general, localized, or pitting corrosion exceeds the specified corrosion/erosion allowance~~,~~ but meets the requirements of S7.8.5 b) and c), consideration should be given to previous inspections. Patterns of corrosion and damage that are expected to occur over the future service life should be used to determine a specific inspection plan. Repairs may be necessary to maintain a safe and satisfactory operating condition.
Item 24-76 Part 2, S7.9	**S7.9 ASME LPG PRESSURE VESSELS WITH A CAPACITY OF LESS THAN 2,000 GALLONS BEING REFURBISHED BY A COMMERCIAL SOURCE** Commercially refurbished pressure vessels are used pressure vessels that are temporarily ~~taken out of~~removed from service for repair and/-or renewal. ~~and~~These vessels are sent to a company ~~which specializes~~specialized in ~~this type of work~~pressure vessel refurbishment. Because of the unknown ~~the~~ history of some of these pressure vessels ~~is unknown~~, ~~special attention~~careful consideration shall be given to inspection and repair before returning any ~~of these~~such pressure vessel~~s~~ back to service. ASME LPG pressure vessels with a capacity of less than 2,000 gal. (7,570 l) may be refurbished subject to the following conditions: a) A complete external inspection shall be completed under the guidelines of this supplement. If any defects ~~are found~~, as defined in S7.8.1 through S7.8.5, are identified, ~~the defect~~they shall be repaired ~~under~~ in accordance with NBIC Part 3, *Repairs and Alterations*~~,~~ by qualified personnel, or the vessel shall be permanently removed from service; b) Pressure vessels of this size that have been previously used in anhydrous ammonia service shall not be converted to LPG service. See NBIC Part 2, S7.8.6; c) The external coating ~~on the outside of the pressure vessel~~ shall be removed down to bare metal so that an inspection can be performed under the guidelines of this supplement; ~~and~~

	d) ~~Verify that there is no internal corrosion i~~If ~~the pressure vessel has had its~~ valves have been removed or if the pressure vessel~~is known to have~~ has been out of service for an extended period, verify that no internal corrosion exists~~.~~; e) Removal and re-attachment of the original manufacturer's nameplate shall ~~only~~ be ~~done~~ completed only in accordance with NBIC Part 2, 5.2.4; and~~.~~ ~~e)~~f) An adhesive label with the following information shall be applied near the service valve of the vessel: 1) Name of the commercial source; 2) Address of the commercial source; 3) Year that the tank was refurbished; and 4) "This ASME LPG pressure vessel was commercially refurbished per NBIC Part 2, S7.9."
Item 24-28 Part 2, S9.3	**S9.3 FACTORS TO CONSIDER** a) Design Consideration~~:~~ 7) Overpressure protection requirements as ~~apllicable~~applicable. b) Material Consideration~~:~~ 1) Chemical and mechanical properties of existing material or any new material to be added or replaced to ensure it has the required strength and toughness to withstand the pressure and temperature effects of the new environment. 2) Effects of erosion or corrosion. 3) Time-dependent effects on service life: c~~C~~reep, fatigue, or both effects combined. 4) Prior to application of postweld heat treatment (PWHT) to a pressure-retaining item when no PWHT had been performed based on the original code of construction, the following shall be met: a. determine that the application of PWHT will not adversely affect the performance of the pressure-retaining item for the intended service conditions; and ~~a.~~b. determine the PWHT holding temperature and holding time.

	c) Environment 1) Physical condition of the pressure-retaining item. 2) Considerations for safe point of discharge and environmental regulation compliance. 3) Regulatory environment: ~~V~~verification of compliance to new or existing jurisdictional rules or regulations. 4) Vessel cleanliness: w~~W~~hen changing lading fluids or contents, one should consider cleaning or decontaminating the vessel as appropriate. e) Repair and Alteration History~~:~~ f) Proposed Rework 2) Repairs and alterations shall be performed in accordance with NBIC Part 3, *Repairs and Alterations*. g) Documentation 3) Review the need for developing or revising an inspection plan to ensure safe operation. Refer to ~~Part 2,~~ Section 1.5.2.1, *Inspection Planning*.
Editorial Part 2, Table S10.7-a	Environmental Damage or Weathering — Ultraviolet or other environmental attack under the exterior coating.~~.~~
Editorial Part 2, Table S10.7-b	Corrosion ……. Any surface damage to structural material identified as corrosion beyond the manufacturer's specification. (See Note 2) Damage to a protective or sacrificial layer ……. The depth of any damage to the protective or sacrificial layer that exceeds the thickness of the protective or sacrificial layer plus 1.3 mm.
Editorial Part 2, S10.10.6	Pressurize vessel to >98% of normal fill pressure and monitor AE during pressurization and for 15 minutes after fill pressure is reached. See Figure S10.10.~~5~~ 6 for a schematic of the pressurization scheme.
Editorial	4) Apply exponential fits by channel for pressure hold time and display both data and fit. The values are determined by the fit to $y = A_e^{Bt} + C$.~~.~~

Part 2, S10.10.7 b) 4)	The B value is the shape factor of the cumulative curves. C is an intercept, and A is a scale factor. The time t shall be equal intervals during the hold with events binned by time interval. Record exponents and goodness of fit (R^2). Plot energy decay curves. One third or one fourth of hold time shall be used for event energy binning (cumulative energy). The formula is $y = A_e^{Bt} + C$. ~~.~~
Editorial Part 2, S11.4.2.1 c) 7)	7) Results are verified by comparison to something (e.g., BP~~V~~VC Section VIII, Division 2, Part 5- Design by Analysis).
Item 21-47 Part 2, new Supplement 15	**PART 2, SUPPLEMENT 15** **Risk of Carbon Monoxide During Boiler Inspections** **S15.1 SCOPE** a) This supplement provides guidelines for recognizing carbon monoxide hazards while inspecting pressure-retaining items. b) It is well documented and internationally recognized that carbon monoxide is highly toxic. Boilers and fired pressure vessels could potentially expose the Inspector and building occupants to carbon monoxide. It is important for the Inspector to verify the following to help prevent the presence of carbon monoxide: 1) NBIC Part 1, 1.6.9: installation of carbon monoxide detectors where required; 2) NBIC Part 2, 2.2.11: review of service and maintenance records; 3) NBIC Part 2, 2.2.10.6 c) and NBIC Part 1, 1.6.6: verification that sufficient combustion air is supplied to the boiler room; and 4) NBIC Part 2, 2.2.5 d): inspecting for combustion air leaks. c) Equipment shall be installed in accordance with the requirements of the manufacturer, and the jurisdiction where required. **S15.2 INSPECTION POINTS THAT SHOULD BE INCLUDED** a) System conditions that may indicate a carbon monoxide hazard outside the combustion chamber include but are not limited to the following: 1) lack of maintenance 2) modifications to combustion systems 3) flue leakage 4) impairment or obstruction of the combustion air intake b) Indications of a condition potentially yielding carbon monoxide outside the combustion chamber include but are not limited to the following: 1) unstable pilot or main flame

	2) yellow flame 3) smoke from the stack 4) discoloration around the burner or casing 5) the presence of soot on any surface 6) flue leakage or blockage 7) obstruction of the combustion air intake 8) negative pressure in the boiler room (e.g., This may manifest in resistance in opening the door, or air rushing in when the door is opened.) 9) lack of maintenance on the burner or boiler 10) condensation in the boiler room **S15.3 SAFE PRACTICES** a) Inspectors should carry a carbon monoxide detector. b) Maintenance activities shall include the burner and associated burner components. c) If flue gas leakage or inadequate combustion air is identified, the owner or user shall engage a qualified person to investigate and implement corrective actions immediately. d) Carbon monoxide detection devices shall be tested in accordance with the manufacturer's instructions to verify proper operation.
Item 24-92, Item 25-28 Part 3, 1.3	1.3 INSPECTOR a) Inspection and certification shall be performed by an Inspector holding a National Board Commission with the National Board "R" Endorsement who is employed by an Authorized Inspection Agency in accordance with NB-263, RCI-1, *Rules for Commissioned Inspectors*. (See NBIC Part 3, Section 9, *Glossary of Terms* for the definition of Authorized Inspection Agency.) b) An Inspector employed by an Owner-User Inspection Organization ~~or a Federal Inspection Agency~~ may authorize and accept work only on pressure-retaining items owned or used by thatthe ~~respective~~ organization. ~~-~~Each accredited Owner-User Inspection Organization's Quality Management System (QMS) shall have the ~~specific~~ approval of the jurisdiction ~~as~~ where required. c) For inspection and certification of repair and replacement activities for nuclear items, the Inspector shall:

1) For Category 1: Hold the National Board “N” ~~E~~endorsement in accordance with RCI-1 and be employed by an Authorized Inspection Agency.

2) For Category 2: Hold the National Board “I” Endorsement in accordance with RCI-1 and be employed by an Authorized Inspection Agency.

3) For Category 3: Hold qualifications required by the r~~R~~egulatory ~~A~~authority. The Inspector shall be employed by an Authorized Inspection Agency or an inspection agency appointed or accepted by the ~~R~~regulatory ~~A~~authority having jurisdiction over the facility.

1.3.1 SUPERVISOR

a) Inspectors shall be supervised by an Inspector holding an active National Board Commission with the National Board “R” Endorsment.

b) Supervisors of Inspectors performing inspection and certification of repair and replacement activities of nuclear items shall:

1) For Category 1: Hold a National Board “NS” Endorsement and be employed by an Authorized Inspection Agency in accordance with RCI-1.

2) For Category 2: Hold a National Board “NSI” Endorsement and be employed by an Authorized Inspection Agency in accordance with RCI-1.

3) For Category 3: Hold qualifications required by the regulatory authority. The Supervisor shall be employed by an Authorized Inspection Agency or an inspection agency appointed or accepted by the regulatory authority having jurisdiction over the facility.

1.3.~~1~~2 AUTHORIZATION

a) The repair organization shall obtain ~~T~~the Inspector’s authorization to perform a repair or alteration ~~shall be obtained by the repair organization~~ prior to initiation of a repair or alteration to a pressure-retaining item. The Inspector shall determine ~~that~~ if the repair or alteration methods are acceptable.
b) Subject to the acceptance of the jurisdiction, the Inspector may approve routine repairs prior to the start of work, provided the Inspector ensures the “R” Certificate Holder has adequately addressed routine repairs in their QMS.

	c) The "NR" Certificate Holder shall obtain the Inspector's authorization prior to initiation of repair and replacement activities to nuclear items. The Inspector shall determine if the repair and replacement methods are acceptable. 1.3.~~2~~3 INSPECTIONS AND CERTIFICATIONS a) Inspections and certification of NBIC Form "R" Reports ~~certifications~~ shall be performed by the same Inspector who authorized the "R" repair or alteration activity or "NR" repair and replacement activity. Where this is not possible or practicable, another Inspector employed by the same Authorized Inspection Agency may perform these duties~~; however, in all cases, duties associated within the same scope of work shall be performed by Inspectors employed by the same Authorized Inspection Agency~~. b) Before signing the appropriate NBIC Form "R" Report, the Inspector shall verify all applicable Inspector duties have been performed as required in RCI-1.
Item 25-51 Part 3, 1.4.2	**1.4.2 NATIONAL BOARD "R" SYMBOL STAMP** a) The "R" Symbol s~~S~~tamp is furnished on loan by the National Board for a nominal fee. b) Provisions may be made for ~~the~~ issuance of ~~the~~ an "R" *Certificate of Authorization* for use of the "R" Symbol ~~S~~stamp ~~for use~~ at various field ~~locations~~sites. c) Additional requirements shall be met in accordance with NB-415, *Accreditation of Repair ~~("R")~~ Organizations*. d) Alternatives to stamping are permitted in accordance with 5.7.5 b).
Editorial Part 3, 1.5.1 f)	f) Organization The QMS shall include an organizational chart which defines and documents the levels of authority, lines of communication, and roles ~~nad~~and ~~responsibilites~~responsibilities associated with the identified functional job titles that can affect the quality of the repair.
Item 25-29 Part 3, 1.5.1 i)	i) The QMS shall describe the method used to ensure that only acceptable materials (including welding ~~material~~consumables) are used for repairs and/or alterations. The QMS shall include a description of how existing material is identified and new material is ordered, verified, and identified. The QMS shall

<table>
<tr><td></td><td>identify the title of the individual(s) responsible for each function and a brief description of how the function is to be performed.</td></tr>
<tr><td>Item 25-51
Part 3, 1.5.1 q)</td><td>1.5.1 OUTLINE OF REQUIREMENTS FOR A QMS FOR QUALIFICATION FOR THE NATIONAL BOARD “R” CERTIFICATE OF AUTHORIZATION

q) Control of the “R” Symbol ~~Stamp~~
1) The QMS shall contain ~~provide adequate~~ controls for the custody of the “R” Symbol stamp and any prestamped nameplates. ~~In addition:~~
~~1~~2) The QMS shall make provisions for Inspector acceptance of the application of the “R” Symbol ~~stamp~~ to the pressure-retaining item or nameplate. See also 5.7.5 b) 3).
~~2~~3) The accepted abbreviation of the “R” Certificate Holder’s name shall be included in the QMS.~~;~~
~~3~~4) If an organization’s request to maintain more than one “R” Symbol stamp is authorized, the use and control of multiple “R” Symbol stamps shall be included in the QMS.~~; and~~
~~4~~5) The QMS shall contain provisions and a timeframe for the “R” Symbol stamp(s) to be returned to the National Board if the organization discontinues its use of the “R” Certificate of Authorization, if it no longer holds an Inspection Agreement with an Authorized Inspection Agency (if applicable), or if the “R” Certificate of Authorization has expired and the organization has not submitted an application to renew their certificate. Additionally, the QMS shall contain provisions for the destruction of nameplates containing the “R” Symbol that are not attached to pressure-retaining items.</td></tr>
<tr><td>Item 25-53
Part 3, Table 1.5.1</td><td>TABLE 1.5.1
<table><tr><th>Form “R” Reports, Records, or Documents</th><th>Instructions</th><th>Minimum Retention Period</th></tr></table></td></tr>
</table>

		a) Form "R" Reports and supporting records and documentation	The organization performing repairs and alterations shall retain a copy of the completed Form "R" Report on file, and all records substantiating the summary of work described in Item 19 of NBIC Part 3, Tables S9.2 and S9.3, for a minimum of 5 years. When the method of repair described in NBIC Part 3, ~~3.3.4.8~~S11.2.2 is used, the record retention period shall as be described in Table 1.5.1 b), below.	5 years
		b) Form "R" Report with Form NB-~~-~~403, *Report of Fitness~~-~~ for ~~-~~Service Assessment* (FFSA) attached	When the method of repair described in NBIC Part 3, ~~3.3.4.8~~ S11.2.2 is used, the record retention period shall be for the duration described on the ~~Fitness- for-Service Assessment (FFSA) f~~Form NB-403 required by the repair method and as described in NBIC Part 2, 4.4. Notes: 1. ~~The "R" Certificate Holder should be aware that s~~Some referenced codes and standards identified in NBIC Part 2, 1.3 describe requirements for permanent record retention throughout the service life of each equipment item. 2. When the "R" Certificate Holder is not the owner or user of the equipment, the record retention period is limited to the FFSA results described on line 8 of the Form NB-403.	5 years or as ~~described~~ recommended on line 8 ~~as reported on~~of the Form NB-403, whichever period is longer.
		c) Continuity records for a welder, welding operator, bonder, or cementing technician	Minimally, continuity records for a welder, welding operator, bonder, or cementing technician within the Certificate Holder's QMS shall be described and established at the time of the applicant's initial certificate review and demonstrated at each triennial certificate review ~~required~~ thereafter.	As applicable to the scope of work identified on the "R" *Certificate of Authorization*, the continuity records are subject to review during each ~~National Board~~ triennial certificate review.

				Continuity records shall be maintained for a minimum of 5 years.

Item 26-02; Item 25-48; Item 25-29; Item 24-83 Part 3, 1.6

1.6 "NR" PROGRAM REQUIREMENTS

1.6.1 SCOPE

a) This ~~s~~Section provides requirements that ~~must~~ shall be met for an organization to obtain a National Board *Certificate of Authorization* to use the "NR" Symbol ~~s~~Stamp for repair/replacement activities to nuclear items constructed in accordance with the requirements of the ASME Code, or other internationally recognized codes or standards, for construction or inservice inspection of nuclear facilities.

b) For administrative requirements to obtain or renew a National Board "NR" *Certificate of Authorization* and the "NR" Symbol ~~S~~stamp, refer to National Board Procedure NB-417, ~~"~~*Accreditation of ~~"NR"~~Nuclear Repair Organizations.*~~"~~.

1.6.2 GENERAL

a) An organization applying for an "NR" *Certificate of Authorization* shall have a written Quality Assurance Program (QAP) that details the specific requirements to be met based on the intended ~~c~~Category of activities selected by that organization as described below and shown in Table 1.6.2. Controls used in the QAP, including electronic capabilities, shall be documented in a Quality Assurance Manual (QAM). Controls required to be included within the QAM shall include who, what, when, where, why, and how, with an understanding that the "how" can be a reference to an implementation procedure or instruction. Quality activities to be described in the QAP are identified in Section 1.6.5. Applicants shall address all requirements in their QAP based on the ~~c~~Category of activity and scope of work to be performed (i.e., organization's capabilities) to which certification is requested.

1) Category 1
   Any ASME Boiler and Pressure Vessel Code (BPVC) Section III certified item or system not under the scope of ASME BPVC Section XI requiring repair/replacement activities, irrespective of physical location and installation status.
2) Category 2
   Any item or system under the scope of ASME BPVC Section XI, Division 1 requiring repair/replacement activities, irrespective of physical location, and based on regulatory or jurisdictional requirements.

3) Category 3
Any item or system, other than those covered by Category 1 or Category 2, requiring repair/replacement activities, irrespective of physical location or installation status.

b) Repair organizations performing repairs of pressure relief devices in nuclear service shall meet the additional requirements of NBIC Part 4, Section 4 and ~~NBIC Part 4,~~ Supplement 6.

TABLE 1.6.2
"NR" QUALITY ASSURANCE PROGRAM (QAP) REQUIREMENTS

Category of Activity	Owner	Organizations other than Owner
Category 1	10 CFR Part 50 Appendix B[1,2] and ASME BPVC Section III, NCA-4000, & ASME NQA-1, Part 1	10 CFR Part 50 Appendix B[1,2] and ASME BPVC Section III, NCA-4000, & ASME NQA-1, Part 1
Category 2	10 CFR Part 50, Appendix B[1,2] or ASME NQA-1[3], Part 1 and ASME BPVC Section XI Division ~~I~~1, IWA-4142	10 CFR Part 50, Appendix B[1,2] supplemented as needed with Owner's QA program; or ASME NQA-1[3], Part 1; or ASME BPVC Section III, NCA-4000
Category 3	ASME NQA-1[3], Part 1, or ~~S~~specify the s~~S~~tandard to which certification is desired	ASME NQA-1[3], Part 1, or ~~S~~specify the ~~S~~standard to which certification is desired
Note 1: Code of Federal Regulations (CFR) – rules and regulations published by the executive departments and agencies of the federal government of the United States.		
Note 2: 10 CFR 50 Appendix B – Title 10 of the Code of Federal Regulations Part 50 Appendix B describes the quality assurance criteria for nuclear plants and fuel reprocessing plants.		
Note 3: The Edition (and Addenda, as applicable) of ASME NQA-1 to be utilized shall be the latest endorsed by the ~~R~~regulatory ~~A~~authority, or as specified in the Owner's QA Program description reviewed and approved by the r~~R~~egulatory a~~A~~uthority.		

1.6.2.1 DEFINITIONS

a) The ~~NBIC~~ terms and definitions in NBIC Part 3, Section 9, shall be supplemented~~,~~ as applicable~~,~~ by the terms and definitions of ASME Section III, ASME BPVC Section XI, Division ~~I~~1, ASME NQA-1, or other standards specified by the ~~R~~regulatory ~~A~~authority.

~~b)~~

~~c)~~b) As used in this s~~S~~ection, ~~T~~the following terms are as defined in ~~the~~ NBIC Part 3, ~~Glossary of Terms~~ Section 9:

1) ~~a)~~ Authorized Inspection Agency
2) ~~b)~~ Authorized Nuclear Inspection Agency
3) ~~c)~~ Jurisdiction
4) ~~d)~~ "NR" Certificate Holder
5) Owner's Requirements

c) As used in this s~~S~~ection, the terms "Inspector" and "Supervisor" refer to the personnel described in NBIC Part 3, 1.3 c) and 1.3.1 b).

~~**TABLE 1.6.2.1**~~

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

~~WA~~	~~ASME Section III, Division 3, Subsection WA, General Requirements~~

~~Note:~~

~~*Edition(s) endorsed by the Regulatory Authority~~

1.6.3 PREREQUISITES FOR ISSUING A NATIONAL BOARD "NR" *CERTIFICATE OF AUTHORIZATION*

Before an organization can obtain a National Board "NR" *Certificate of Authorization*, the organization shall:

a) ~~a)~~ For Category 1 and 2 activities, ~~H~~have and maintain an inspection agreement with an Authorized Nuclear Inspection Agency accepted in accordance with NB-360, "*National Board Acceptance of Authorized Inspection Agencies (AIA) Accredited by the American Society of Mechanical Engineers (ASME)*", with accreditation to perform repair and ~~alteration~~ replacement acceptance inspections.

~~a)~~b) For Category 3 activities, have and maintain an inspection agreement with an Authorized Inspection Agency or an inspection agency appointed or accepted by the r~~R~~egulatory ~~A~~authority having jurisdiction over the facility.

c) Have a written Quality Assurance Program which includes the ~~q~~Quality ~~a~~Assurance ~~m~~Manual and any supporting procedures, instructions, and specifications required to comply with this section. The Quality Assurance Program shall address all controls for the intended ~~c~~Category and scope of activities requested.

~~b)~~d) Have a current ~~e~~Edition of the NBIC.

~~d~~e) Have available ASME BPVC Section XI, Division ~~I~~1, the code of construction, and referenced code sections and standards appropriate for the scope of work to be performed. ASME BPVC Section XI, Division ~~I~~1 and codes of construction (Editions/Addenda) shall meet the requirements of the r~~R~~egulatory a~~A~~uthority and the owner.

1.6.4 OBTAINING OR RENEWING A NATIONAL BOARD "NR" *CERTIFICATE OF AUTHORIZATION*

a) Before an "NR" *Certificate of Authorization* will be issued or renewed, the applicant ~~must~~ shall have ~~the~~ their Quality Assurance Program and ~~the~~ implementation of ~~the program~~such ~~reviewed~~ surveyed and ~~found acceptable~~ accepted by representatives of the National Board, ~~Authorized I~~inspection ~~A~~agency, and~~the~~ ~~J~~jurisdiction/regulatory authority~~, and the Authorized Nuclear Inspection Agency~~ referenced in 1.6.3 a) or b). The ~~J~~jurisdiction ~~will be~~is the National Board Member Jurisdiction in which the applicant is located or the location ~~where~~ in which the Quality Assurance Program is demonstrated~~/~~ and implemented. At the request of the j~~J~~urisdiction, or where there is no National Board Member Jurisdiction,

the National Board representative shall act on behalf of the ~~J~~jurisdiction. The organization shall demonstrate sufficient implementation of ~~the~~ its Quality Assurance Program ~~shall be satisfactorily demonstrated by the organization~~. The ~~D~~demonstration of implementation shall meet the most stringent (classification) code requirements for the scope and category of work to be specified on the *Certificate of Authorization* ~~or as requested by the applicant~~.

b) A further hardware verification implementation may not be necessary ~~I~~if the applicant ~~is~~ holds an ASME "N"-~~-~~type *Certificate of Authorization* ~~holder~~, has satisfactorily demonstrated ~~within the last twelve (12) months the~~ implementation of ~~their~~ its Quality Assurance Program within the past 12 months, and can ~~provide documentation that the organization is capable of implementing~~document the implementation of its Quality Assurance Program as ~~being in compliance~~compliant with this section.~~, a further hardware verification implementation may not be necessary.~~

c) Upon request to the National Board, ~~T~~the ~~Regulatory Authority or J~~jurisdiction/regulatory authority~~, upon request to the National Board,~~ may attend the survey process for an "NR" *Certificate of Authorization* to be issued or renewed.

d) The "NR" *Certificate of Authorization* holder shall be subject to an annual Supervisor audit ~~annually by supervisor the Authorized Nuclear Inspection Agency~~ to ensure compliance with ~~the~~ all aspects of the Quality Assurance Program. The triennial "NR" survey will satisfy this requirement in the year performed.

1.6.5 QUALITY ASSURANCE PROGRAM

a) An applicant or a holder of a National Board "NR" *Certificate of Authorization* ("NR" Certificate Holder) shall have and maintain a written Quality Assurance Program. The Quality Assurance Program shall satisfactorily meet the requirements of this ~~s~~Section, and ~~j~~Jurisdictional and ~~r~~Regulatory requirements as applicable. The Quality Assurance Program may be brief or voluminous, depending on the circumstances. It shall be treated confidentially by the National Board and available for review by the ~~S~~survey ~~t~~Team.

b) Each applicant or "NR" Certificate Holder is responsible for establishing and executing a Quality Assurance Program. The applicant or "NR" Certificate Holder may subcontract activities needed to implement the Quality Assurance Program, as limited by ASME BPVC Section III and ASME BPVC Section XI, Division ~~I~~1, but responsibility for adherence to the Quality Assurance Program remains with the ~~A~~applicant or "NR" Certificate Holder.

c) These rules set forth the requirements for planning, managing, and implementing the organization's Quality Assurance Program to control and ensure quality is performed and maintained during repair/replacement

activities of components, items, parts, and systems for nuclear facilities. These rules ~~are to~~shall be the basis for evaluating such programs prior to the issuance or renewal of the National Board "NR" *Certificate of Authorization*. Rules identified in ~~subsections~~ Section 1.6.6~~, 1.6.7 and 1.6.8 of this section~~ detail the Quality Assurance Program requirements for each ~~c~~Category of activity. These rules are established to meet and follow the requirements specified in ~~NBIC Part 3,~~ Table 1.6.2 ~~of this Section~~.

1.6.6 QUALITY ASSURANCE PROGRAM REQUIREMENTS FOR CATEGORY 1, 2, AND 3 ACTIVITIES

~~**1.6.6.1 SCOPE**~~

~~Owners or o~~Organizations ~~other than owners shall have~~ possessing an "NR" *Certificate of Authorization* shall have a written Quality Assurance Program (QAP) meeting the criteria specified in ~~NBIC Part 3,~~ Table 1.6.2 for Category 1, 2, and/or 3 activities, as applicable to the scope of activities they intend to perform. The ~~following~~ quality program elements in Table 1.6.6 shall be specified and described within the Quality Assurance Manual (QAM), as augmented by the following:~~.~~

a) For Category 2 activities, the "NR" Certificate Holder ~~Owners or organizations other than owners shall have a written Quality Assurance Program meeting one of the criteria specified in Table 1.6.2 of this section. Organizations applying for a Category 2 "NR" *Certificate of Authorization*~~ shall specify in their written ~~Quality Assurance Program~~QAP which program criteria their ~~Quality Assurance Program~~ QAP follows. Owners possessing an "NR" *Certificate of Authorization* ~~-~~shall have a ~~Quality Assurance Program~~ QAP meeting the requirements of either 10 CFR 50, Appendix B, or ASME NQA-1, Part 1, and shall include the additional requirements specified in ASME Section XI Division 1, IWA-4142 when applicable. Organizations other than the owner shall comply with requirements specified in either 10 CFR 50, Appendix B, supplemented as needed with the owner's QAP (if applicable); ASME NQA-1, Part 1; or NCA-4000. Organizations may ~~elect to~~ choose to follow all the rules specified in one of the ~~allowed~~ permitted QAP criteria specified in Table 1.6.2, or they may elect to combine or supplement requirements from other specified QAP~~'~~s. When organizations elect to combine QAP requirements, shared responsibilities for repairs and replacements shall be done in accordance with the customer's specific procedures.~~it shall be clearly specified and understood in the QAM which QAP requirement is being followed for each activity specified in their QAM. The following quality elements shall be specified and described within the QAM.~~

b) For Category 3 activities, the "NR" Certificate Holder ~~Organizations requesting a Category 3 "NR" *Certificate of Authorization*~~ may elect to follow the requirements specified in ASME NQA-1, Part 1, or follow specific ~~Quality Assurance Program~~QAP requirements outlined in other specified standards as required by the owner, ~~R~~regulatory a~~A~~uthority, and/or j~~J~~urisdiction.

Organizations shall specify in the QAM ~~what~~ which QAP requirements are being followed. When standards other than ASME NQA-1 are followed, the organization shall have ~~available~~ a copy of that standard available for review by the ~~NB Survey Team~~National Board survey team and the ~~ANIA~~ inspection agency referenced in 1.6.3 b), as applicable. ~~Each organization shall, as a minimum, include in their written QAM the specified elements listed in Category 1 and/or 2 (1.6.6, 1.6.7) QAP requirements. Additional requirements , as specified within NBIC Part 3, 1.6.8 and 1.6.9 shall be included within the QAP. Also, I~~Limitations or additions to ASME NQA-1, as specified in Table 1.6.6 for Category 1 ~~or 2~~ activities, may also be incorporated and referenced within the QAM.

~~**1.6.6.2 QUALITY PROGRAM ELEMENTS**~~
~~**1.6.7 QUALITY ASSURANCE PROGRAM REQUIREMENTS FOR CATEGORY 2 ACTIVITIES**~~
~~**1.6.7.1 SCOPE**~~
~~**1.6.7.2 QUALITY PROGRAM ELEMENTS**~~
~~**1.6.8 QUALITY ASSURANCE PROGRAM REQUIREMENTS FOR CATEGORY 3 ACTIVITIES**~~
~~**1.6.8.1 SCOPE**~~
~~**1.6.8.2 QUALITY PROGRAM ELEMENTS**~~
~~**1.6.9 INTERFACE WITH THE OWNER'S REPAIR/REPLACEMENT PROGRAM (FOR CATEGORIES 1, 2, AND 3 AS APPLICABLE)**~~

TABLE 1.6.6
QUALITY PROGRAM ELEMENTS FOR CATEGORY 1, 2, AND 3 ACTIVITIES

Quality Program Element	Requirement for Quality Assurance Program (QAP) o~~O~~r Quality Assurance Manual (QAM)	Applicable to Category 1	2	3
1.0 Organization ~~**Statement of Policy and Authority**~~	1.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 1, shall apply in ~~its~~their entirety.	X		
	1.2 – The authority and responsibility for individuals involved in activities affecting quality shall be clearly established and documented throughout the ~~Quality Assurance Program~~QAP, and identified on a functional organizational chart contained within the ~~QA Manual~~QAM.	X	X	X
	1.3 – The QAM shall: a) ~~i~~Identify the titles of individuals who have the authority and responsibility ~~charged with~~for ensuring the ~~quality program~~QAP is implemented as described; b) ~~c~~Confirm their freedom in the organization to identify quality problems and to initiate, recommend, and provide solutions;	X	X	X

	c) ~~i~~Include a statement that if there is a disagreement in the implementation of the ~~quality assurance program~~QAP, the matter is to be referred for resolution to a higher authority and shall be resolved in a manner that will not conflict with code, ~~J~~jurisdiction/~~r~~Regulatory authority, or ~~quality program~~QAP requirements; d) ~~i~~Include a statement of the full support of management; and e) ~~b~~Be dated and signed by a senior management official within the organization.			
2.0 Quality Assurance Program	2.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 2, shall apply, except paragraph 301.	X		
	2.2 – The "NR" Certificate Holder shall make a current controlled copy of the ~~Quality Assurance Manual~~QAM available to the ~~Authorized Nuclear~~ Inspector and ~~Authorized Nuclear Inspector~~ Supervisor.	X	X	X
	2.3 – The "NR" Certificate Holder shall implement and maintain a program for qualification, indoctrination, training, and maintaining proficiency of personnel involved with quality functions.	X	X	X
	2.4 – Specified controls, including responsibilities for personnel, shall be described in the ~~quality assurance program~~QAP.	X	X	X
	2.5 – The "NR" Certificate Holder's repair/replacement plan (see 1.6.7) shall be subject to ~~the~~ acceptance ~~of~~by the owner and the owner's Inspector, and shall be subject to review by the ~~J~~jurisdiction/~~R~~regulatory ~~A~~authority having jurisdiction at the plant site.	X	X	X
	2.6 – The ~~Quality Assurance Program~~QAP as used in this section shall include a written ~~Quality Assurance Manual~~QAM, with supporting procedures and instructions used to meet all the requirements of this Section.	X		X
	2.7 – Qualification of non~~-~~destructive examination personnel shall be as required by the code of construction, or as specified in the ~~owner's~~ Owner's ~~Quality Assurance Program~~Rrequirements.	X	X	
	2.8 – The "NR" Certificate Holder shall be responsible for advising the Authorized Nuclear Inspection Agency of proposed changes to the ~~Quality Assurance Manual~~ QAM and~~to~~ obtaining the Supervisor's acceptance ~~of the Authorized Nuclear Inspector Supervisor~~ before putting such changes into effect.	X	X	

Quality Program Element	Requirement for Quality Assurance Program (QAP) ~~O~~or Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
2.0 Quality Assurance Program *(continued)*	2.9 – The "NR" Certificate Holder shall be responsible for notifying the ~~Authorized Nuclear~~ Inspector of QAM changes, including evidence of acceptance by the ~~Authorized Nuclear Inspector~~ Supervisor.	X	X	
	~~The "NR" Certificate Holder shall address in their QAM the requirements for interfacing with the owner specified in NBIC Part 3, 1.6.9.~~	~~X~~	~~X~~	~~X~~
	2.10 – The ~~Quality Assurance Manual~~QAM need not be in the same format or sequential arrangement as the requirements in these rules, ~~as long as~~provided that all applicable requirements have been covered.	X	X	
	2.11 – The ~~P~~program for qualification, indoctrination, training, and maintaining proficiency of personnel shall include personnel of subcontracted services.	X	X	
	2.12 – Prior to returning an item to service, the owner shall evaluate the suitability of the item subjected to the repair/replacement activity. Corrective actions shall be taken when an item is determined to be deficient or does not satisfy the requirements of this section.		X	
	2.13 – When a repair/replacement activity is split between the owner and an "NR" Certificate Holder, each ~~Quality Assurance Program~~QAP shall comply with this section for their respective activities. The owner shall establish interfaces for ~~assuring~~ ensuring this section is met for the two ~~Quality Assurance Programs~~QAP's.		X	
	2.14 – The ~~quality assurance program~~ QAP shall account for special controls, processes, test equipment, tools, and skills to obtain quality, and for verification of quality by inspections and tests.			X
	2.15 – The status, adequacy, and effectiveness of the QAP shall be regularly reviewed by management. The scope shall be included within the ~~written~~ QAM.			X
3.0 Design Control	3.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 3, shall apply, except p~~P~~aragraph 601.	X		
	3.2 – As applicable to the Category of activity being performed, ~~R~~repair/~~R~~replacement activities of nuclear components shall meet the requirements of ASME Section III, ASME BPVC Section XI, Division ~~I~~1, and/or other applicable standards~~, and the owner's requirements.~~ ~~, and~~ They shall also satisfy the ~~o~~Owner's R~~r~~equirements and be subject to verification by the j~~J~~urisdiction ~~and~~ /r~~R~~egulatory a~~A~~uthorit~~ies~~y having jurisdiction at the plant site.	X	X	X

	3.3 – The "NR" Certificate Holder shall establish measures to ensure applicable requirements of the owner's design specifications, Oowner's Rrequirements, and code of construction requirements are correctly translated into drawings, specifications, procedures, and instructions.	X	X	
	3.4 – All design documents, including revisions, shall be verified by the "NR" Certificate Holder to be correct and adequate in accordance with the oOwner's rRequirements.	X	X	

Quality Program Element	Requirement for Quality Assurance Program (QAP) oOr Quality Assurance Manual (QAM)	Applicable to Category 1	2	3
3.0 Design Control *(continued)*	**3.5 – Repair/replacement plans shall be completed prior to performing any work, inspections, examinations, or testing; however, repair/replacement plans are not required for the design phase of a repair/replacement activity including activities that require design only (except rerating).**	X		
	3.6 – The repair/replacement plan (see NBIC Part 3, Table 1.6.97) shall identify any applicable Code Edition/Addenda and Code Cases, Oowner's rRequirements and the Construction Code Edition/Addenda utilized to perform the work.	X		
	3.7 – Computer programs used for design analysis shall meet the requirements of ASME NQA-1, Part II, Subpart 2.7, unless independently verified with the design analysis for each application.	X		
	3.8 – The repair/replacement plan shall identify expected life of the item when it is less than the intended life as specified in the owner's design specification.	X	X	
	3.9 – The "NR" Certificate Holder shall ensure that specifications, drawings, procedures, and instructions do not conflict with the owner's design specifications. A system to resolve or eliminate such conflicts shall must be described in the Quality Assurance ManualQAM to resolve or eliminate such conflicts. Resolution shall consider the Ddesign Sspecification Rrequirements, as well as, the oOwner's rRequirements, and jJurisdictional and /Rregulatory Aauthority Rrequirements as applicable.	X	X	
	3.10 – The Code Edition and Addenda used for Rrepair/replacement activities, code edition and addenda used shall correspond with the owner's Inservice Inspection Program, unless later cCode eEditions and aAddenda have been accepted by the owner, and the Enforcement and/or the rRegulatory authority having jurisdiction at the plant site.		X	

	3.11 – If a repair/replacement activity reduces the expected life of the item to lower than the intended life ~~as~~ specified in the O~~o~~wner's R~~r~~equirements, the owner shall be advised of the condition.		**X**	
	3.12 – ASME BPVC Section XI, Division ~~I~~1 establishes that the owner is responsible for design in connection with repair/replacement activities.		**X**	
	3.13 – The "NR" Certificate Holder's system shall include provisions to ensure that the appropriate quality standards are specified and included in all quality records.		**X**	
	3.14 – The "NR" Certificate Holder's records shall be reviewed for compliance with the requirements of ASME BPVC Section XI, Division ~~I~~1.		**X**	
	3.15 – ~~Established m~~Measures shall be established to ~~as~~ensure applicable quality standards and regulatory requirements are accurately specified and translated into design documents. Any deviations shall be identified and controlled. Control measures (such as review, approval, release, distribution, and revisions) for suitability of materials, parts, equipment, procedures, instructions, and processes, shall be performed to ensure adherence to specified design basis requirements. Qualifications, responsibilities, and certifications of design personnel shall be clearly defined within the ~~quality assurance program~~QAP.			**X**

Quality Program Element	Requirement for Quality Assurance Program (QAP) o~~O~~r Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
4.0 Procurement Document Control	4.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 4, shall apply.	X		
	4.2 – Procurement documents shall require suppliers to provide a ~~Quality Assurance Program~~QAP consistent with the applicable requirements of ASME BPVC Section III, NCA, and this section.	X		
	4.3 – Documents for procurement of materials, items, and subcontracted services shall include requirements, as ~~to the extent~~ necessary, to ensure compliance with the ~~o~~Owner's ~~r~~Requirements and ~~IWA-4000 of~~ ASME BPVC Section XI, Division ~~I~~1, IWA-4000. To the extent necessary, procurement documents shall require suppliers to maintain a ~~Quality Assurance Program~~QAP consistent with the applicable requirements of the edition and addenda of the code of		X	

	construction to which the items are constructed. Measures shall be established to ensure that all purchased material, items, and services conform to these requirements.			
	4.4 – Documents for procurement of material, equipment, and services shall ensure regulatory requirements, design bases, and ~~other~~ additional quality requirements are included or referenced. Procurement documents shall require contractors ~~or~~ and subcontractors to provide a ~~Quality Assurance Program~~ QAP consistent with the provisions specified herein. The QAP shall clearly describe the ~~C~~controls necessary to ensure that materials, equipment, and services meet specified design criteria. ~~shall be clearly described within the quality assurance program~~QAP.			X
5.0 Instructions, Procedures, and Drawings	5.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 5, shall apply.	X		
	5.2 – All activities affecting quality shall be prescribed by documented instructions, procedures, or drawings.	X	X	X
	5.3 – Instructions, procedures, ~~or~~ and drawings shall describe acceptance criteria to ensure quality activities are accomplished.	X		
	5.4 – Repair/replacement plans and any verification of acceptability (e.g., evaluations) shall be subject to review by ~~j~~Jurisdiction ~~and~~ /r~~R~~egulatory ~~A~~authorit~~ies~~y having jurisdiction at the plant site.		X	
	5.5 – Documented instructions, procedures, and drawings shall be of a type appropriate to the circumstances, and work shall be accomplished in accordance with these instructions, procedures, ~~or~~ and drawings.	X	X	
	5.6 – Instructions, procedures, ~~or~~ and drawings shall include appropriate quantitative and qualitative criteria for determining that activities affecting quality have been satisfactorily accomplished.		X	X
	5.7 – The “NR” Certificate Holder shall maintain a written description of procedures, instructions, ~~or~~ and drawings used by the organization for control of quality and examination requirements detailing the implementation of the ~~Quality Assurance Program~~QAP requirements. Copies of these procedures shall be readily available to the ~~Authorized Nuclear~~ Inspector ~~and Authorized Nuclear Inservice Inspector, as applicable~~.		X	

	Requirement for Quality Assurance Program (QAP)	Applicable to Category

	Quality Program Element	oOr Quality Assurance Manual (QAM)	1	2	3
	6.0 Document Control	6.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 6, shall apply.	X		
		6.2 – The Quality Assurance ProgramQAP shall detail measures to control the preparation, review, issuance, use, approval, and distribution of all documents related to quality as identified in the applicants "NR" Certificate Holder's Quality Assurance ProgramQAP, including changes thereto.	X	X	X
		6.3 – Revisions to the Quality Assurance Program controlled documents related to quality, such as instructions, procedures, and drawings, shall meet the same requirements as the originals, unless the "NR" Certificate Holderapplicant specifies other measures within their programQAP. Measures shall ensure the latest approved documents represent the repair/replacement activities performed.	X		
		6.4 – Quality Assurance ProgramQAP control measures shall ensure that the latest applicable documents, including changes, are reviewed for adequacy, and approved for release by authorized personnel, and distributed for use at the location where the prescribed activity is performed.		X	
		6.5 – The QAP shall describe Rresponsibilities for Quality Assurance Program control of documents affecting quality shall be described within the quality programQAP.			X

7.0 Control of Purchased Material, Items, and Services	7.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 7, shall apply, except: a) Procurement of Authorized Inspection Agency services is not applicable as specified in paragraph 507. b) The decision to perform bid evaluation as described in paragraph 300 is the responsibility of the "NR" Certificate Holder. c) For Certificates of Conformance specified in paragraph 503, changes, waivers, ~~or~~ and deviations, including resolution of non-conformances, ~~must~~ shall meet the requirements of ASME BPVC Section III and this s~~S~~ection. d) The provisions identified in ASME NQA-1, Part 1, Requirement 7, paragraph 700 are not applicable to this ~~s~~Section. e) Documentary evidence for items shall conform to the requirements of ASME BPVC Section III, NCA, and this s~~S~~ection. Materials shall meet the material certification requirements as specified in ASME BPVC Section III, NCA-~~3800~~ 1224 and NCA-1225 or NCA-447~~0~~4, as applicable. Documented evidence for ASME stamped items is satisfied by a Manufacturer's Data Report. Utilization of unqualified source material shall meet the requirements of ASME BPVC Section III, NCA-4255.5. f) The "NR" Certificate Holder may obtain items from an owner, when the required documentation is provided and the ~~owner provides the required documentation and~~ items are identified ~~to~~ as meeting ~~meet~~ Code requirements and the "NR" Certificate Holder's ~~Quality Assurance Program~~QAP. When the owner is an ~~The~~ "NR" Certificate Holder, the "NR" Certificate Holder shall not be required to audit the owner as an approved supplier, provided the items used are exclusively for the owner and ~~the~~ were~~owner~~ procured and controlled ~~the items~~ by the owner under the owner's ~~Quality Assurance Program~~QAP ~~(when the owner is an "NR" Certificate Holder)~~.	X		

Quality Program Element	Requirement for Quality Assurance Program (QAP) ~~O~~or Quality Assurance Manual (QAM)	Applicable to Category 1	2	3
7.0 Control of Purchased Material, Items, and Services *(continued)*	7.2 – The ~~Quality Assurance Program~~QAP shall establish controls to ensure all purchased materials, items, and services conform to the requirements of the owner's design specifications and the code of construction e~~E~~dition/a~~A~~ddenda used to perform the work.	X	X	
	7.3 – Purchase of materials and small products shall meet the requirements specified in ASME BPVC Section XI, Division ~~I~~1, IWA-4142.		X	

7.4 – Purchased material, items, and services shall conform to ASME BPVC Section XI, Division ~~I~~1. These measures shall include identification for material traceability.		X	
7.5 – Provisions shall be identified for source evaluation, and objective evidence shall be provided evidencing quality standards for material examination upon receipt.		X	X
7.6 – Purchased material, items, and services shall conform to the procurement documents.			X
7.7 – Measures shall be established for inspections at the source.			X
7.8 – Effectiveness of quality of suppliers shall be assessed by the "NR" Certificate Holder~~applicant~~ or designee at specified intervals. Documented evidence shall be ~~performed~~ maintained and made available to ~~as~~ensure materials and services conform to procurement documents, quality procedures, and instructions.			X

Quality Program Element	Requirement for Quality Assurance Program (QAP) ~~O~~or Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
8.0 Identification and Control of Items	8.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 8, shall apply.	X		
	8.2 – Controls shall ~~as~~ensure only correct and acceptable items, parts, and components are used or installed when performing repair/replacement activities.	X	X	X
	8.3 – Required Certified Material Test Reports and Certificates of Conformance shall be received, traceable to the items, reviewed to comply with the material specification, and found acceptable.	X	X	X
	8.4 – Welding, brazing, and fusing ~~materials~~ consumables shall be identified and controlled.	X		
	8.5 – The "NR" Certificate Holder shall utilize checklists to identify required characteristics using accepted procedures, compliance with records received, results of examinations and tests performed, and range of values ~~-~~when required. Checklists shall contain spaces for the following: a) Document numbers and revision levels; b) Signature/initial and dates for the "NR" Certificate Holder's Qualified Representative~~,~~ for examinations or tests performed, verified, ~~and/~~or witnessed; ~~a)~~c) Signature/initial and dates for the Inspector, for examinations or tests verified ~~and/~~or witnessed.~~, and spaces for inclusion of document numbers and revision levels, signatures initials / stamps and dates of~~	X		

	~~examinations or tests performed, verified, and/or witnessed by the "NR" Certificate Holder's qualified Representative and Authorized Nuclear Inspector.~~			
	8.6 – Identification for traceability shall be applied using methods and materials that are legible and not detrimental to the component or system involved. Such identification shall be located in areas that will not interfere with the function or quality aspects of the item.		X	
	8.7 – Certified Material Test Reports shall be identified as required by the applicable material specification in ASME BPVC Section II~~,~~ and shall satisfy any additional requirements specified in the original code of construction. The Certified Material Test Report or Certificate of Compliance need not be duplicated for submission with compliance documents when a record of compliance and satisfactory reviews of the Certified Material Test Report and Certificate of Compliance is provided. Quality documents shall provide a record that the Certified Material Test Report and Certificate of Compliance have been received, reviewed, and found acceptable. When the "NR" Certificate Holder authorizes a subcontracted organization to perform examinations and tests in accordance with the original code of construction, the "NR" Certificate Holder shall certify compliance that the material satisfies the original code of construction requirements either on a Certified Material Test Report or Certificate of Compliance ~~that the material satisfies the original code of construction requirements~~.		X	

Quality Program Element	Requirement for Quality Assurance Program (QAP) o~~O~~r Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
9.0 Control of Processes	9.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 9, shall apply.	X		
	9.2 – Process sheets, checklists, travelers, or equivalent documentation shall be prepared, including the document numbers and revisions to which the process conforms (drawings, procedures, instructions, specifications, or other appropriate documents).	X	X	X
	9.3 – Process control documents shall include spaces for signatures, initials, stamps, and dates that activities were performed by the "NR" Certificate Holder's Qualified ~~r~~Representative and the ~~Authorized Nuclear~~ Inspector.	X		X
	9.4 – Measures shall be established to ensure that processes such as welding, nondestructive examination, and heat		X	X

	~~treating~~ treatment are controlled and are accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, and other specified criteria.			
	9.5 – Measures shall be established to ensure that processes are controlled in accordance with the rules of the applicable ~~s~~Section of the ASME ~~Code~~BPVC.		X	
	9.6 – Process control documents shall have space provided for reporting results of completion of specific operations at checkpoints of repair/replacement activities.		X	X
10.0 Examinations, Tests, and Inspections	10.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 10, shall apply~~;~~, ~~except~~however, paragraph 700 for inspections during operations is not required.	X		
	10.2 – A repair/replacement plan shall be described in the ~~Quality Assurance Manual~~QAM that addresses required information to perform the work needed for repair/replacement activities. Spaces shall be included for mandatory hold points. Work shall not proceed beyond designated mandatory hold points without documented consent as appropriate.	X	X	X
	10.3 – Repair/replacement plans shall list any procedures used, including revisions utilized (e.g., welding, brazing, heat treatment, examination, testing)~~,~~ and acceptance criteria used to verify acceptability.	X	X	X
	10.4 – Hold points on repair/replacement plans shall be assigned when witnessing of an activity is required by the "NR" Certificate Holder's Qualified Representative, the ~~Authorized Nuclear~~ Inspector, or the owner's representative~~, if required~~.	X	X	
	10.5 – Repair/replacement plans shall provide a detailed description of repair/replacement activities to be performed.	X	X	

Quality Program Element	Requirement for Quality Assurance Program (QAP) ~~O~~or Quality Assurance Manual (QAM)	Applicable to Category 1	2	3
10.0 Examinations, Tests, and Inspections *(continued)*	10.6 – Repair/replacement plans shall describe any defects and examination methods used to detect the defects, as well as defect removal methods and requirements for identifying reference points.	X		X
	10.7 – Repair/replacement plans shall list any material requirements.	X		X
	10.8 – Repair/replacement plans shall list required documentation and stamping, as well as applicable Code ~~e~~Editions/~~a~~Addenda and Code Cases.	X		

		10.9 – Repair/replacement plans shall include the requirements specified in ASME BPVC Section XI, Division ~~I~~1, IWA-4150.		X	
		10.10 – In-process and final examinations and tests shall be established to ensure conformance with specifications, drawings, instructions, and acceptance criteria contained in applicable design documents. Inspection, test, and examination activities to verify the quality of work shall be performed by persons other than those who performed the activity being examined. Such persons shall not report directly to the immediate supervis~~or~~sion responsible for the work being examined.		X	
		10.11 – Process sheets, travelers, ~~or~~ and checklists shall provide space for recording results.		X	X
		10.12 – Work shall not proceed beyond mandatory hold/inspection points without the consent of the "NR" Certificate Holder's Qualified ~~r~~Representative or the ~~Authorized Nuclear~~ Inspector~~/Authorized Nuclear Inservice Inspector, as applicable~~.	X	X	
		10.13 – Examinations, tests, and inspections shall be performed using trained and qualified personnel. Personnel records for qualification and training shall be available for review.			X
	11.0 **Test Control**	11.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 11, shall apply.	X		
		11.2 – Testing shall be performed in accordance with written test procedures with acceptance criteria clearly defined. Prerequisites for performing each test shall be described~~,~~. This includes ~~including to include~~ calibration, equipment, trained personnel, and environmental conditions ~~shall be described~~.	X	X	X
		11.3 – Provisions for data acquisition shall be described, and test results shall be documented and evaluated to ensure that test requirements have been satisfied.	X	X	
		11.4 – Test results shall be documented and evaluated by qualified personnel.	X		
		11.5 – Testing shall be performed in accordance with the owner's written test procedures, or procedures acceptable to the owner, that incorporate or reference the requirements and acceptance criteria contained in applicable design documents.		X	
		11.6 – Test procedures shall ensure that adequate instrumentation is available and used, and that necessary monitoring is performed.		X	

	11.7 – Test procedures shall consider the condition of test equipment and the item to be tested.		X	
	11.8 – Personnel responsibilities shall be described for performance, acceptance/inspection, and documenting results.			X

Quality Program Element	Requirement for Quality Assurance Program (QAP) ~~O~~or Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
12.0 Control of Measuring and Test Equipment	12.1 – The "NR" Certificate Holder may utilize calibration and test activities performed by subcontractors when surveys and audits are performed. As an alternative to performing a survey and audit for procuring l~~L~~aboratory ~~C~~calibration and t~~T~~est ~~S~~services, the "NR" Certificate Holder ~~as documented in their Quality Program~~ may accept accreditation of an International Calibration and Test Laboratory Services by the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA), provided this alternative method is described in the "NR" Certificate Holder's ~~Quality Program~~QAP and the following requirements are met: a) The "NR" Certificate Holder shall review and document verification that the supplier of calibration or test services was accredited by an accredited body recognized by the ILAC MRA encompassing ISO/IEC-17025:2005 or 2017, "General Requirements for the Competence of Testing and Calibration Laboratories." ~~.~~ b) For procurement of calibration services, the published scope of accreditation for the calibration laboratory covers the needed measurement parameters, ranges, and uncertainties. c) For procurement of testing services, the published scope of accreditation for the test laboratory covers the needed testing services, including test methodology and tolerances/uncertainty. d) The "NR" Certificate Holder's purchase documents shall ~~include~~address the following: 1. Services provided shall be in accordance with the~~ir~~ laboratory's accredited ISO/IEC-17025:2005 or 2017 program and scope of accreditation; 2. As-found calibration data shall be reported in the certificate of calibration when items are found to be out-of-calibration;	X	X	X

	3. Standards used to perform calibration shall be identified in the certificate of calibration; 4. Notification ~~shall be made to the "NR" Certificate Holder~~ of any condition that adversely impacts the laborator~~iesy~~'s ability to maintain the scope of accreditation shall be made to the "NR" Certificate Holder; 5. Any additional technical and/or quality requirements, as necessary, which may include tolerances, accuracies, ranges, and standards; and 6. Service suppliers shall not subcontract services to any other supplier. e) The "NR" Certificate Holder shall, upon receipt inspection, validate that the laboratory documentation certifies ~~that~~the following: 1. Services provided by the laboratory ha~~s~~ve been performed in accordance with their ISO/IEC-17025:2005 or 2017 program and performed within their scope; and 2. Purchase order requirements have been met.			

Quality Program Element	Requirement for Quality Assurance Program (QAP) o~~O~~r Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
13.0 Handling, Storage, and Shipping	13.1 – The provisions identified in~~of~~ ASME NQA-1, Part 1, ~~and~~ Requirement 13, shall apply.	X		
	13.2 – Measures and controls shall be established to maintain quality requirements for handling, storage, and shipping of parts, materials, items, and components.		X	X
	13.3 – Processes or procedures shall be established to prevent damage, deterioration, and ~~or~~ misuse of material, items, ~~or~~and components used and stored.			X
	13.4 – Controls for cleanliness and preservation shall be specified in the ~~quality program~~QAP.			X
14.0 Inspection or Test Status (not to include operation status)	14.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 14, shall apply.	X		
	14.2 – Measures shall be established to indicate inspection and test status of parts, items, ~~or~~and components during the repair/replacement activity.	X	X	X

	14.3 – The system shall include any procedures or instructions necessary to achieve compliance. Procedures shall be provided for the identification of acceptable and unacceptable items and for the control of status indicators. The authority for application and removal of status indicators shall also be specified.	X	X	X	
	14.4 – The ~~Quality Assurance Program~~QAP shall provide adequate control of the "NR" Symbol ~~s~~Stamp. In addition, the ~~Quality Assurance Program~~ QAP shall make provisions for ~~the~~ Inspector acceptance prior to the application of the "NR" Symbol ~~s~~Stamp to the item~~,~~ or attachment of the stamped nameplate.	X	X	X	
	14.5 – The system used shall provide positive identification of the part, item, or component by means of stamps, labels, routing cards, or other acceptable methods.	X	X		
	14.6 – The "NR" Certificate Holder shall provide a nameplate/stamping for repair/replacement activities for each nuclear component unless otherwise specified by the owner's ~~Quality Assurance Program~~QAP (when the owner is an "NR" Certificate Holder). The required information and format shall be as shown in NBIC Part 3, Section 5.	X	X	X	
15.0 Nonconforming Materials or Items	15.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 15, shall apply.	X			
	15.2 – To prevent the inadvertent use of nonconforming materials and items, ~~M~~measures shall be established to control such nonconforming materials ~~or~~ and items ~~that do not conform to requirements to prevent their inadvertent use,~~ including measures to identify and control the proper installation of items and to preclude nonconformance with the requirements of these rules. These measures shall include procedures for identification, documentation, segregation, and disposition. Nonconforming items shall be	X	X	X	

	reviewed for acceptance, rejection, or repair in accordance with documented procedures.			
	15.3 – Repaired or replaced items shall be re-examined in accordance with the applicable procedures.	X	X	X
	15.4 – Ultimate disposition of nonconforming items shall be documented.	X	X	X

Quality Program Element	Requirement for Quality Assurance Program (QAP) ~~O~~or Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
15.0 Nonconforming Materials or Items *(continued)*	15.5 – Segregation of nonconforming materials or items is only needed when practical.	X		X
	15.6 – The responsibility and authority for the disposition of nonconforming items shall be defined.	X	X	
	15.7 – Measures that control further processing of a nonconforming or defective item, pending a decision on its disposition, shall be established and maintained.	X	X	
	15.8 – Altered items shall be re-examined in accordance with the applicable procedures.		X	
16.0 Corrective Action	16.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 16, shall apply.	X		
	16.2 – Measures shall be established to ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and other non-conformances are promptly identified and corrected.	X	X	X
	16.3 – In the case of significant conditions adverse to quality, corrective measures shall also ensure that the cause of these conditions ~~be~~ is determined and corrected to preclude ~~repetition~~reoccurrence. The identification of significant conditions adverse to quality, including their cause, condition, and the corrective action taken, shall be documented and reported to the appropriate levels of management.	X	X	X
	16.4 – Corrective action requirements shall also extend to the performance of subcontractors' corrective action measures.	X	X	X
147.0	147.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 17, shall apply;~~,~~ ~~except~~ however, p~~P~~aragraphs 400, 500, and 600 are not applicable.	X		

Quality Assurance Records	17.2 – Measures shall be established for the "NR" Certificate Holder to maintain those records required for ~~Q~~quality ~~A~~assurance of repair/replacement activities.	~~X~~	X	X
	17.3 – When the "NR" Certificate Holder is the owner, designated records and reports received by the owner shall be filed and maintained in a manner that allows the Inspector access~~to allow access by the Authorized Nuclear Inservice Inspector~~. Suitable protection from deterioration and damage shall be provided by the owner.	X	X	X
	17.4 – All records and reports shall be retained as specified ~~in~~ by the owner~~'s QAP~~ for the lifetime of the component or system.	X	X	X
	17.5 – Records shall be classified, accessible, identifiable, and retrievable.	X		X
	17.6 – Records shall be retained consistent with the O~~o~~wner's R~~r~~equirements for duration, location, and assigned responsibility.	X		

Quality Program Element	Requirement for Quality Assurance Program (QAP) o~~O~~r Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
17.0 Quality Assurance Records *(continued)*	17.7 – Documentation of the repair/replacement activities of nuclear components shall be recorded on the Form NR-1, *Report of Repair/Replacement Activities ~~of Nuclear Components and Systems~~ for Nuclear Facilities~~, Form NR-1,~~* or Form NVR-1, *Report of Repair/Replacement Activities for Nuclear Pressure Relief Devices~~, Form NVR-1~~*, in accordance with the NBIC Part 3, Section 5. The completed forms shall be signed by a representative of the "NR" Certificate Holder and the ~~Authorized Nuclear~~ Inspector when the repair/replacement activity meets the requirements of this section. For repair/replacement activities that involve design changes, Form NR-1, or Form NVR-1, as applicable, shall indicate the organization responsible for the design or design reconciliation in accordance with the ~~o~~Owner's ~~r~~Requirements.	X	X	X
	17.8 – When permitted by the jurisdiction, ~~the owner may use~~ alternative forms containing all the information within ~~the~~ Form NR-1 ~~and~~ or NVR-1 may be used.	X	X	X
	~~Forms NR-1 and NVR-1 as applicable shall be completed by the "NR" Certificate Holder upon completion of all~~	~~X~~		

		~~repair/replacement activities. Completion of forms, registrations and stamping of the "NR" symbol stamp shall meet the requirements of NBIC Part 3, Section 5. A log shall be maintained in accordance with NBIC Part 3, 5.6. When permitted by the jurisdiction, the owner may use alternative forms containing all the information within the Form NR-1 and NVR-1.~~			
		17.9 – The "NR" Certificate Holder shall provide a copy of the signed Form NR-1 or Form NVR-1, as applicable, to the owner, the inspection agency referenced in 1.6.3 a) or b), and the Enforcement ~~, and the~~ and/or Regulatory Authority if required~~, and the Authorized Nuclear Inspection Agency~~. The original Form NR-1 or Form NVR-1, as applicable, shall be registered with the National Board by the "NR" Certificate Holder. A NB registration log shall be maintained by the "NR" Certificate Holder. See NBIC Part 3, Sections 5.5 and 5.6.	X	X	X
		17.10 – Lifetime and non-permanent records shall be as specified in ASME BPVC Section III, NCA-4134, and Tables NCA-4134.17-1 and NCA-4134.17-2.	X		
		17.11 – Radiographs (digital images or film) may be reproduced provided that: a) ~~T~~the process is subject to owner's approval; b) ~~T~~the "NR" Certificate Holder is responsible for the process used, and includes a system for controlling and monitoring ~~the~~ accuracy so ~~that~~ the image will provide the same information as the original; and c) p~~P~~rocedures contain requirements for exposure scanning, focusing, contrast, resolution, and distinguishing film artifacts as applicable for reproduced images.	X		
		17.12 – Records shall be maintained by an index that details the location and individual responsible for maintaining the records.	X	X	
		17.13 – Records shall be accessible to the owner, owner's designee, and the ~~Authorized Nuclear~~ Inspector.	X		
		17.14 – Documentation, reports, and records shall be in accordance with ASME BPVC Section XI, Division ~~I~~1, IWA-6000.		X	
		17.15 – The owner is responsible for designating records to be maintained.		X	
		17.16 – Records shall include records of examination, test data taken before and during repair/replacement activity, and related data such as personnel qualification, procedures, and equipment.		X	X

	17.17 – Procedures, specifications, and drawings used shall be fully identified by pertinent material or item identification numbers, revision numbers, and issue dates.		X	

Quality Program Element	Requirement for Quality Assurance Program (QAP) Or Quality Assurance Manual (QAM)	Applicable to Category 1	2	3
17.0 Quality Assurance Records *(continued)*	17.18 – The "NR" Certificate Holder shall ~~take such steps as may be required to~~ provide records in their care with suitable protection from deterioration and damage ~~for records~~ while in ~~his~~ their care. ~~Also, it is required that t~~The "NR" Certificate Holder shall also have a system for correcti~~on~~ng or amending records that satisfies the O~~o~~wner's ~~r~~Requirements. These records may be ~~either~~ the original or a reproduced, legible copy, and shall be transferred to the owner upon request.		X	
	17.19 – Records to be maintained shall include the following, as applicable: a) Records of material and manufacturing; b) Repairs related to each repair/replacement activity; c) Manufacturer's Data Reports, properly executed, for each replacement component, part, appurtenance, piping system, and piping assembly, when required by the design specification or the owner; d) The required as-constructed drawings certified as to correctness; e) Copies of applicable Certified Material Test Reports and Certificates of Compliance; f) As-built sketch~~(~~es~~)~~ that ~~including~~ include tabulations of materials, repair/replacement procedures, and instructions to achieve compliance with ASME Section XI Division ~~I~~1; g) Nondestructive examination reports, including results of examinations, that ~~shall~~ identify the name and certification level of personnel interpreting the examination results. Final radiographs shall be included where radiography has been performed. Radiographs may be microfilmed or digitally reproduced in accordance with the requirements listed in ASME BPVC Section V, Article 2, Mandatory Appendix VI. The accuracy of the reproduction process shall be verified and monitored for legibility, storage, retrievability, and reproduction quality;		X	

	h) Records of heat treatments certified by the "NR" Certificate Holder.~~that~~ These may be ~~either~~ the heat treatment charts or a summary description of heat treatment time and temperature data ~~certified by the "NR" Certificate Holder~~. Heat treatments performed by the material manufacturer to satisfy requirements of the material specifications may be reported on the Certified Material Test Report; and i) Nonconformance reports ~~shall~~ that satisfy ~~IWA-4000 of~~ ASME BPVC Section XI, Division ~~I~~1, IWA-4000, ~~and~~ which shall be reconciled by the owner prior to certification of the Form NR-1 or NVR-1, as applicable.			
	~~The original of the completed Form NR-1 or Form NVR-1, as applicable, shall be registered with the National Board and, if required, a copy forwarded to the Jurisdiction where the nuclear power plant is located. A log shall be maintained in accordance with NBIC Part 3, 5.6. When permitted by the Jurisdiction, the owner may use alternative forms containing all the information within the Form NR-1 and NVR-1.~~		~~X~~	~~X~~
	17.20 – Records shall be verified and distributed.			X
	17.21 – Records to support evidence of activities affecting quality shall include as applicable: inspections and acceptance criteria/results; types of observations and results; audits; nonconformances; and corrective actions.			X

Quality Program Element	Requirement for Quality Assurance Program (QAP) Or Quality Assurance Manual (QAM)	Applicable to Category		
		1	2	3
18.0 Audits	18.1 – The provisions identified in ASME NQA-1, Part 1, Requirement 18, shall apply.	X		
	18.2 – A comprehensive system of planned and periodic audits of the "NR" Certificate Holder's ~~Quality Assurance Program~~QAP shall be performed. Internal audit frequencies shall be specified in the organization's ~~Quality Assurance Manual~~QAM. Internal audits shall be conducted at least annually (within 12 months) for any ongoing code activity to verify compliance with ~~Quality Assurance Program~~QAP requirements and/or performance criteria, and to determine the effectiveness of the ~~Quality Assurance Program~~QAP. When no code work has been performed, the internal audit need only include those areas of responsibility required to be continually maintained, such	X	X	X

		as training, audits, organizational structure, ~~and Quality Assurance Program~~QAP revisions, etc.			
		18.3 – The QAM shall describe as a minimum the following: a) Audits shall be performed in accordance with written procedures or checklists by qualified audit personnel not having direct responsibility in areas being audited; b) Audit results shall be documented and reviewed by ~~responsible~~ management responsible for adequacy and effectiveness of the QAP; c) Requirements for follow-up actions shall be specified for any deficiencies noted during the audit; d) Audit records and applicable documentation shall be made available to the inspection agency referenced in 1.6.3 a) or b) for review; and e) Audit records shall include as a minimum written procedures, checklists, reports, written replies, and completion of corrective actions.	X	X	X
		18.4 – Frequencies of external audits (e.g., supplier audits) shall be specified in the organization's ~~Quality Assurance Manual~~QAM.	X	X	
		18.5 – External audits (e.g., supplier audits) of organizations with certification/accreditation permitted by ASME may not be required if acceptable to the r~~R~~egulatory a~~A~~uthority.	X		
		18.6 – External audits (e.g., ~~S~~supplier audits) shall be performed on a triennial basis and supplemented by annual evaluations of the s~~S~~upplier's performance to determine if the regular ~~schedule~~ audit frequency schedule shall be maintained or decreased, or if other corrective action is required. A continuous or ongoing evaluation of the s~~S~~upplier's performance may be conducted in lieu of the annual evaluation~~s~~, provided ~~that~~ the results are reviewed ~~in order~~ to determine if corrective action is required. ~~A grace~~An extension period of 90 days may be applied to scheduled audits and annual evaluations of supplier performance. When the ~~grace~~ extension period is used, the next scheduled date for the activity shall be based on the activity schedule date and not on the date the activity was actually performed. If the activity is performed early, the next scheduled date shall be based on the early date the activity was ~~actually~~ performed.		X	
		18.7 – The ~~Quality Assurance Manual~~QAM shall require ~~that~~ audit personnel to be qualified in accordance with imposed regulatory standards~~,~~ or ASME NQA-1.	X		
		18.8 – The ~~Quality Assurance Manual~~QAM shall require ~~that~~ audit personnel to be qualified in accordance with the current requirements of ASME NQA-1.		X	

	18.9 – The ~~Quality Assurance Manual~~QAM shall require ~~that~~ audit personnel to be qualified in accordance with recognized standards, such as ASME NQA-1.			X

Quality Program Element	Requirement for Quality Assurance Program (QAP) Or Quality Assurance Manual (QAM)	Applicable to Category 1	2	3
19.0 Authorized ~~Nuclear~~ Inspect~~or~~ion	19.1 – Measures shall be taken to reference the commissioned rules for the ~~National Board Authorized Nuclear~~ Inspector, in accordance with NB-263, RCI-1, "Rules for Commissioned Inspectors". ~~The Authorized Nuclear Inspector shall hold the "N", "I", and "R" endorsements on his/her Commission.~~ The "NR" Certificate Holder shall ensure ~~that~~ the latest documents, including the ~~Quality Assurance Manual~~QAM, procedures, and instructions, are made available to the ~~Authorized Nuclear~~ Inspector. The "NR" Certificate Holder shall consult the ~~Authorized Nuclear~~ Inspector ~~shall be consulted~~ prior to the issuance of a repair/replacement plan ~~by the "NR" Certificate Holder in order~~so that the ~~Authorized Nuclear~~ Inspector may select any in-process inspection or hold points when performing repair/replacement activities. The "NR" Certificate Holder shall keep the ~~Authorized Nuclear~~ Inspector informed of progress of the repair/replacement activity so that inspections may be performed. The ~~Authorized Nuclear~~ Inspector shall not sign Form NR-1 or Form NVR-1, as applicable, unless satisfied that all work carried out is in accordance with this section. In order to perform their required duties, t~~T~~he ~~Authorized Nuclear~~ Inspector and ~~Authorized Nuclear Inspector~~ Supervisor shall have access to areas where work is being performed, including subcontractors' facilities~~, in order to perform their required duties~~. The ~~ANI~~ Inspector shall be involved in dispositions and verification for non-conformances and corrective actions involving quality or code requirements. ~~Additional requirements regarding Owner Interface are specified in 1.6.9.~~	X	X	X
	19.2 – The "NR" Certificate Holder's QAM shall incorporate the requirements of NBIC Part 3, 1.3.2 and 1.3.3.	X	X	X

20.0 Exhibits	20.1 – Forms and exhibits referenced in the ~~Quality Assurance Manual~~ QAM shall be included as part of the referencing document or as an appendix to the ~~Quality Assurance Manual~~QAM. Forms shall be controlled and identified.	X	X	X
	20.2 – Forms and exhibits referenced in the ~~Quality Assurance Manual~~QAM shall be explained in the text.	X	X	
	20.3 – Forms shall show the latest approved revision, name, and other corresponding references as stated in the ~~Quality Assurance Manual~~QAM.	X	X	

1.6.7 REPAIR/REPLACEMENT PLAN

The “NR” Certificate Holder’s repair/replacement plan shall contain or meet ~~at least~~ the criteria described in Table 1.6.7, as a minimum.

TABLE 1.6.~~9~~7
REPAIR/REPLACEMENT PLAN CRITERIA

	Essential Requirements	Instruction
A	Edition and/or ~~a~~Addenda of ~~c~~Codes	Including codes of construction, ASME ~~c~~Code ~~c~~Cases, o~~r~~ther standards used for the work performed, the NBIC Code edition, and the O~~o~~wner's R~~r~~equirements.
B	Identification of ~~i~~Items	Description of items affected by the repair/replacement activity, including serial numbers, vendor identification, and code classes if applicable.
		Location of installation, if applicable.
C	Performance of the Repair/Replacement ~~a~~Activity	Description of any defects~~,~~ and nondestructive examination methods used to detect the defects.
		Defect removal method, measurement, and area identification/reference points.
		Applicable welding/brazing procedures, heat treatment, nondestructive examination, and tests.
		Final examination criteria to verify acceptability.
		Preservice examination criteria, if applicable.
D	Materials	Original specifications~~,~~ and new material specifications, including heat numbers, code edition/class, and reconciliation requirements, if applicable.
E	Description of Repair/Replacement ~~a~~Activity	Include expected life of the item after completion if different from the original intended life ~~as~~ specified by the design specification. Application of the "NR" ~~code~~ S~~s~~ymbol stamp, if required.
F	Documentation	Generated as required by the ~~q~~Quality ~~a~~Assurance ~~p~~Program QAP and/or the ~~o~~Owner's ~~r~~Requirements.

			Retention and ~~submittal~~ submission in accordance with the ~~qQuality aAssurance pProgram~~QAP and/or the Oowner's Rrequirements.
	G	Evaluations/ Acceptance	Evaluations/acceptance by the jurisdiction~~al~~/regulatory authority, as applicable.
	H	Testing	Post-~~-~~repair/replacement testing criteria.
			Test acceptance criteria to verify acceptability.
			Types (pneumatic, hydrostatic, system leakage, or other).
	I	Design	When applicable, design documents shall be certified by a qualified/certified engineer.
	J	Authorized Inspection ~~Agency~~	~~Authorized Nuclear~~ Inspector review/acceptance. ~~Authorized Nuclear Inservice Inspector review/acceptance.~~
	K	Responsibilities for ~~r~~Review, ~~v~~Verification, and ~~a~~Acceptance	Design, quality, work performed, examination/test, and records.
			Owner acceptance of the repair/replacement plan.
Editorial Part 3, Section 2	Part 3, Section 2 Repairs and Alterations — Welding, Brazing, Fusing, and Heat Treatment		
Item 26-16 Part 3, 2.2.1	**2.2.1 PROCEDURE SPECIFICATIONS** a) A procedure specification is a written document providing direction to the person applying the material joining process. Welding, brazing, and fusing shall be performed in accordance with procedure specifications for welding (WPS), brazing (BPS), and fusing (FPS) qualified in accordance with the original code of construction or the construction standard or code selected. When this is not possible or practicable, the procedure specification may be qualified in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section IX. b) Welding procedures may be simultaneously qualified by more than one organization under the rules of ASME BPVC Section IX, QG-106.4. The "R" Certificate Holder's ~~written~~ Quality Management System (QMS) shall include requirements for addressing the rules of ASME BPVC Section IX, QG-106.4. c) The "R" Certificate Holder is responsible for the selection and control of weld consumables and the welding process. Weld consumables shall be selected to provide deposited weld metal of chemical composition and mechanical properties suitable for joining the materials and for the anticipated service conditions.		

	d) The procedure sample requirements for box headers found in the ~~O~~original c~~C~~ode of c~~C~~onstruction are not applicable to repair or alteration activities.
Item 26-16 Part 3, 2.2.3	**2.2.3 PERFORMANCE QUALIFICATION** a) The "R" Certificate Holder shall qualify the performance of personnel for each process they will use for repairs and alterations of pressure-retaining items. Such qualification shall be in accordance with the requirements of the original code of construction, the construction standard, code selected, or ASME BPVC Section IX. Use of a Standard Welding Procedure Specification (SWPS) shown in NBIC Part 3, 2.3 is permitted for performance qualification testing. b) Provided that the welder/welding operator is qualified to weld without backing and is otherwise qualified for the materials, thickness, and positions required, the performance sample requirements for box headers found in the ~~O~~original ~~C~~ode of c~~C~~onstruction are not applicable to repair or alteration activities.
Item 25-22 Part 3, 2.5.1	**2.5.1 PREHEATING** a) Preheating may be employed ~~during use of a process~~ to assist in completion of the joint. The need for and ~~the~~ temperature of preheat are dependent on ~~a number of~~many factors, ~~such as~~including chemical analysis, degree of restraint of the items being joined, material thickness, and mechanical properties. The procedure specification for the material being joined shall specify the preheat temperature requirements. ~~b) See minimum temperatures for preheating given in NBIC Part 3, Table 2.5.1 as a general guide. It is cautioned that the preheating temperatures listed may not be the same as those of the original code of construction and do not necessarily ensure satisfactory completion of the joint. Requirements for individual materials within the P-Number listing may have preheating requirements more or less restrictive than this general guide. When reference is made in this section to materials by the ASME designation, P-Number and Group Number, the suggestions of this section apply to the applicable materials of the original code of construction, either ASME or other, which conform by chemical compo-sition and mechanical properties to ASME materials having the ASME P-Number and Group Number designations.~~ b. Minimum temperatures for preheating and maximum temperatures for interpass shall be in accordance with the original code of construction or as provided in alternative welding methods in 2.5.3. **~~TABLE 2.5.1~~** ~~Thicknesses referenced are nominal at the weld for the parts to be joined.~~

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

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Part 3, 2.5.2

2.5.2 POSTWELD HEAT TREATMENT (PWHT)

a) Postweld heat treatment (PWHT) shall be performed as required by the original code of construction, the construction standard or code selected in accordance with a written procedure. The procedure shall contain the parameters for postweld heat treatmentPWHT. Efforts should be made to avoid detrimental thermal gradients during PWHT, as they may lead to the generation of additional residual stresses or distortion.

b) Postweld heat treatmentPWHT shall should be performed by heating either the entire item or a circumferential band around the item. When heating a circumferential band, the heat treatment procedure shall specify locations and widths of the temperature bands, (i.e., the soak band (SB) width, the

heated band (HB) ~~width~~, and the gradient control band (GCB)). Figure 2.5.2-a shows these bands. ~~width~~Additionally, the number, location, ~~of thermocouples~~ and method of attachment of thermocouples, ~~in addition to~~ the ~~heating rate,~~ PWHT temperature holding time, ~~temperature~~ and heating and cooling rates shall be specified. ~~Figures 2.5.2-a and 2.5.2-b show these bands.~~ If the original ~~C~~construction standard or code does not give ~~detailed or~~ specific details, AWS D10.10, *Recommended Practices for Local Heating of Welds in Piping and Tubing* may be referred to for further information.

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

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

d) Heating and Cooling rates

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

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

~~and radially from the edge of the nozzle wall, or attachment weld or repair area equally by a minimum distance as defined by the thickness of the shell, t or 2 in. (50 mm), whichever is less. See Figure 2.5.2-b.~~

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

e) Heat Bands (see Figure 2.5.2-a)

1) Soak Band (SB) ~~—~~

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

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

i. The shell thickness for a full penetration weld.

ii. The groove weld depth of a partial penetration repair weld.

iii. For a fillet weld, the throat thickness of the weld.

iv. If a fillet weld is used in combination with a groove weld, the nominal thickness for PWHT shall be the depth of the groove weld.

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

For nozzles and attachments with a nominal diameter greater than 4 in. (100 mm), the SB should extend along the shell across the nozzle junction and along the neck a minimum of 2*t* or 2 in. (50 mm) ~~past~~beyond the toe

of the weld, whichever is the less, where t is the nozzle or attachment wall thickness.

2) Heating Band (HB)

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

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

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

The temperature differential within the GCB measured at the outside edge of the SB and the temperature measured at the outside edge of the HB shall not exceed one-half (½) of the peak--soak PWHT temperature.

3) Temperature Gradient Control Band (GCB)

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

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

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

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

	~~5) The term t, as used above to determine SB, HB and GCB shall be the nominal thickness of either a full penetration weld, or the groove weld depth of a partial penetration repair weld. If a fillet weld is used in combination with a groove weld, the nominal thickness for PWHT shall be the depth of the groove weld.~~ f) When PWHT is performed on pressure components that contain riveted joints, consideration should be given to the maximum temperature to which the riveted joint should be exposed ~~to,~~so as to avoid any detrimental effects to the integrity of the joint. ~~**FIGURE 2.5.2-b**~~ ~~LOCAL POSTWELD HEAT TREATMENT TEMPERATURE CONTROL BANDS NOZZLE WELD OR ATTACHMENT TANGENTIAL DIRECTION HEATING BANDS~~
Item 25-04 Part 3, 2.5.3 b) and editorial (2.5.3)	**2.5.3 ALTERNATIVE WELDING METHODS WITHOUT POSTWELD HEAT TREATMENT** a) Under certain conditions, postweld heat treatment, in accordance with the original code of construction, may be inadvisable or impractical. In such instances, the following alternative methods may be used. b) Evaluation for use of alternative weld methods ~~Competent technical advice should be obtained from the manufacturer of the pressure-retaining item or from another qualified source, such advice being especially necessary if the alternative is to be used in highly stressed areas, if service conditions are conducive to stress corrosion cracking, if materials are subject to hydrogen embrittlement, or are operating at temperatures in the creep range, or if the alternative is being considered for "on-stream" repairs or "hot tapping" on piping systems.~~For repair of pressure parts subject to one or more of the following conditions, competent technical advice should be obtained from the manufacturer of the pressure-retaining item or from another qualified source: 1) Items identified as special services per the original code of construction where PWHT was not exempted for new construction; 2) Repairs in highly stressed areas where the stress concentration cannot be reduced by weld repair alone; 3) Parts subject to high-cycle operation or fatigue service;

4) Where any one of the following service conditions are conducive to:

a. stress corrosion cracking

b. hydrogen embrittlement

c. creep damage

5) The alternative welding method is being considered for inservice repairs (i.e., on-stream repairs or "hot tapping" on piping systems).

Selection of the welding method used, concerning the adequacy of the weld in the as-welded condition at operating and pressure test conditions, shall be based on the ~~rules~~ requirements of the original code of construction together with the ~~above-mentioned~~ competent technical advice noted in 2.5.3 b)~~concerning the adequacy of the weld in the as-welded condition at operating and pressure test conditions~~.

c) In this section, ~~W~~when reference to materials is made ~~in this section to materials~~ by the ASME designation, P-Number, and Group Number, the requirements of this section apply to the applicable materials of the original code of construction~~, either~~ (ASME or other~~,~~) ~~which conform by~~whose chemical composition and mechanical properties conform to the ASME P-Number and Group Number designations.

d) The detailed welding methods listed in the following subsections may be used as an alternative to ~~postweld heat treatment (~~PWHT~~)~~.

1) NBIC Part 3, 2.5.3.1 describes Welding Method 1~~ is a method~~ in which the welding procedure requires an ~~elevation of the~~elevated preheat temperature.

2) ~~-~~In contrast, ~~NBIC Part 3,~~ 2.5.3.2 through 2.5.3.4~~5~~, ~~are~~describe Welding Methods 2 through 4~~ methods~~ in which the welding procedure requires the use of a temper ~~-~~bead welding technique. ~~Welding Method 6 as described in 2.5.3.6 requires use of a controlled fill technique.~~

3) Welding Method 5, described i~~t~~n 2.5.3.5, is a method in which the welding procedure used for joining dissimilar materials requires either an ~~elevation of the~~elevated preheat temperature or a temper ~~-~~bead welding technique, depending on the chemical composition of the base metal that is joined to an austenitic steel. Temper ~~-~~bead welding procedure nomenclature is defined in ASME BPVC Section IX~~ of the *ASME Boiler and Pressure Vessel Code*~~. Typically, this technique minimizes heat input of the initial beads, thus limiting heat beyond the weld heat-affected zone (HAZ) of the base metal. Heat input shall be increased for successive beads in accordance with the ~~rules~~ requirements of ASME BPVC Section IX, QW-290 for temper bead welding~~ in ASME Section IX~~. The Welding Procedure Specifications and Welder Performance Qualifications shall, in all cases, be in accordance with the requirements of the

	latest eEdition of ASME BPVC Section IX ~~of the *ASME Boiler and Pressure Vessel Code*~~. 4) Welding Method 6, described in 2.5.3.6, requires use of a controlled fill technique. e) Nondestructive eExamination of wWelds Prior to welding, the area prepared for welding shall be examined using either the Magnetic Particle (MT) or the Liquid Penetrant (PT) examination method to determine that no defects exist. After the finished weld has reached ambient temperature, and~~,~~ when required by the specific welding method, the surface temper bead reinforcement layer has been removed substantially flush with the surface of the base metal, the weld shall be examined again by either of the above methods to determine that no defects exist. This shall be done using acceptance standards acceptable to the Inspector or original code of construction. In addition, welds greater than 3/8 in. (10 mm) deep or welds in a pressure-~~-~~retaining item that were originally required to be volumetrically examined by the ~~rules~~ requirements of the original code of construction, shall be examined in accordance with ~~paragraph~~ NBIC Part 3, 4.2. ~~f) Methods that may be used as alternatives to postweld heat treatment are described in the following subsections.~~
Item 25-29 Part 3, 2.5.3.1 e) 1) and 2)	e) 1) Provided the carbon equivalent of the base ~~material~~ metal to be welded is determined to be 0.40 or less. e) 2) The ~~electrodes and filler metals~~weld consumables are classified ~~by the filler metal specification~~ with a diffusible hydrogen designator of H4 or lower.
Item 25-53 Part 3, 2.5.3.2 d) 4); Item 25-29 Part 3, 2.5.3.2 i), k), and l); And editorial (2.5.3.2)	**2.5.3.2 WELDING METHOD 2** When using this method, the following is required: a) This method shall be used when the applicable rules of the original code of construction required notch toughness testing. ~~or~~ Or it shall be used when the applicable rules of the original code of construction did not require notch toughness testing, provided the adequacy of the notch toughness of the weld, including the heat-affected zone, in the as-welded condition at operating and pressure test conditions, is verified; b) The materials shall be limited to carbon and low-~~-~~alloy steels permitted for welded construction by the applicable rules of the original code of construction, including those materials conforming to any of the following ASME P-No. designations: P-No. 1, Groups 1, 2, and 3; P-No. 3, Groups 1, 2, and 3; P-No. 4; P-No. 5A; P-No. 9A; P-No. 10A; P-No. 10B; P-No. 10C; P-No. 11A; or P-No. 11B; c) The welding shall be limited to the sShielded mMetal- aArc wWelding (SMAW), gGas mMetal -aArc wWelding (GMAW), fFlux cCored -aArc wWelding (FCAW), and gGas

	tTungsten -Aarc wWelding (GTAW) processes; d) The ~~Welding Procedures Specifications~~WPS shall be qualified in accordance with the temper bead procedure qualification requirements in ASME BPVC Section IX, QW-290 ~~of ASME Section IX,~~ and shall include the following additional requirements: 1) For P-No. 1, Groups 1, 2, and 3 and P-No. 3, Groups 1, 2, and 3, the minimum preheat temperature shall be 350°F (177°C), and the maximum interpass temperature shall be 450°F (232°C). 2) For P-No. 9A, P-No. 10A, P-No. 10B, P-No. 10C, P-No. 11A, or P-No. 11B, the minimum preheat and interpass temperature requirements shall be in accordance with the guidelines in NBIC Part 3, 2.5.1. 3) For P-No. 4 and P-No. 5A materials, the technique and minimum preheat~~,~~ and interpass temperatures~~, and technique~~ shall be in accordance with NBIC Part 3, 2.5.3.4. The repair depth for temper bead repairs to pressure--retaining items of P-No. 4 and P-No. 5A materials is limited to welds not penetrating through full thickness. 4) Full thickness temper bead weld repairs are permitted to pressure--retaining items of P-No. 4 and P-No. 5A materials under the following conditions: a. For ASME BPVC Section VIII, Division 2 pressure vessels, where application of PWHT on in-service vessels has been demonstrated to cause harm to vessel material. b. For tube-to-header welds in steam service. Full thickness weld repairs referenced above shall be completed ~~per~~ in accordance with NBIC Part 3, ~~3.3.5~~S11.2.3 with the following additional requirements: ~~a.~~c. The full thickness repair weld shall be verified as being the full penetration. ~~b.~~d. Volumetric examination of the full thickness weld shall be performed. e) The test material for the welding procedure qualification shall be of the same material specification (including specification type, grade, and class~~,~~ and condition of heat treatment) as the material being repaired. ~~In the event that~~If the notch toughness of the material to be repaired is unknown, evidence from tests of that material or from another acceptable source (see NBIC Part 3, 2.5.3) may be used for the base metal notch toughness when qualifying the WPS as required in NBIC Part 3, 2.5.3.2 h). ~~In the event that~~If 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 CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15; elements are expressed in ~~W~~weight p~~P~~ercent a~~A~~mounts), 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 ASME BPVC Section IX; for pressure--retaining items repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME BPVC Section IX temper bead procedure qualification, provided the pressure--retaining item operates in steam service above 900°F (482°C); g) When qualifying the WPS, ~~T~~the organization ~~making~~ performing the repair shall ~~include, when qualifying its WPS,~~conduct sufficient ~~tests~~ testing to ~~determine~~ verify 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~~ for the minimum operating and pressure test temperatures, ~~(~~including start-up and shutdown~~)~~ conditions. If ~~for reasons of corrosion resistance, special~~specific hardness limits are necessary due to corrosion resistance, 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. Exemptions from impact testing described in the original code of construction are not applicable; i) For the welding processes in NBIC Part 3, 2.5.3.2 c), use of austenitic or ferritic filler metals is permitted. For ferritic filler metals, use only ~~electrodes and filler metals~~those that are classified by the ~~filler metal~~weld consumable specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes. When shielding gases are used with a process, the gas shall exhibit a dew point that is below -60°F (-50°C). Surfaces ~~on which welding will be done~~prepared for welding shall ~~be maintained in~~maintain 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 processes, after completion of welding and without allowing the weld~~ment~~ to cool below the minimum preheat temperature, the temperature of the weld~~ment~~ shall be raised to a minimum 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~~weld consumable manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018-H4); and l) After the finished repair weld has cooled to ambient temperature, the surface temper reinforcing layer shall be removed substantially flush with the surface of the base ~~material~~metal.
Item 26-07 Part 3, 2.5.3.3 b)	~~b) The materials shall be limited to any P-No. 1 or P-No. 3 material as permitted for welded construction by the applicable rules of the original code of construction;~~
Item 25-29 Part 3, 2.5.3.3 d)	d) The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base ~~material~~ metal specification of the repair. ~~In the event that~~If the original ~~material~~ base metal specification is obsolete, the test material used should

	conform to the nominal composition and carbon equivalent (IIW Formula CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15; elements are expressed in ~~W~~weight ~~P~~percent a~~A~~mounts)~~, as~~ of the ~~material~~ base metal being repaired, but in no case shall the material be lower in strength; e) If ~~for reasons of corrosion resistance, special~~specific hardness limits are necessary due to corrosion resistance, such limits shall be included when qualifying the WPS. For pressure-~~-~~retaining items repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME BPVC Section IX temper bead procedure qualification, provided the pressure-~~-~~retaining item operates in steam service above 900°F (482°C); f) The qualification thickness for the test plates and repair groove depths shall be in accordance with ASME BPVC Section IX; and g) The WPS shall be qualified in accordance with the temper bead procedure qualification requirements in QW-290 of ASME BPVC Section IX, and shall include the following additional requirements: … 3) After completion of welding using SMAW and without allowing the weldment to cool below the minimum preheat temperature, the temperature of the weldment shall be raised to ~~a temperature of~~at least 450°F (232°C) ~~minimum~~ for a minimum ~~period~~ of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the filler metal manufacturer with a diffusible-hydrogen designator of H4 (e.g., E7018-H4); and
Item 25-29 Part 3, 2.5.3.3 g) and editorial	g) The WPS shall be qualified in accordance with the temper bead procedure qualification requirements in QW-290 of ASME Section IX, and shall include the following additional requirements: 1) The minimum preheat temperature for welding shall be 350°F (177°C) and the maximum interpass temperature shall be 450°F (232°C); 2) For the welding processes in NBIC Part 3, 2.5.3.3 c), use of austenitic or ferritic filler metal is permitted. For ferritic weld~~filler~~ metals, use only electrodes or filler metals that are classified by the ~~filler metal~~weld consumable specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes; 3) After completion of welding using SMAW and without allowing the weld~~ment~~ to cool below the minimum preheat temperature, the temperature of the

	weld~~ment~~ shall be raised to a temperature of 450°F (232°C) minimum for a minimum period of two hours. This hydrogen bake-out treatment may be omitted, provided the electrode used is classified by the ~~filler metal~~weld consumable manufacturer with a diffusible- hydrogen designator of H4 (e.g., E7018-H4); and 4) After the finished repair weld has cooled to ambient temperature, the final temper bead reinforcement layer shall be removed substantially flush with the surface of the base ~~material~~metal.
Item 25-83, Item 25-53, Item 25-29, Item 26-07 Part 3, 2.5.3.4 a), b), g) and h) and editorial (2.5.3.4)	**2.5.3.4 WELDING METHOD 4** When using this method, the following is required: a) This method is limited to repair welds in pressure-retaining items for which the applicable rules of the original code of construction did not require notch toughness testing. The repair depth for temper bead repairs to pressure-retaining items shall not penetrate the full thickness of the material, except as permitted below. 1) ASME BPVC Section VIII, Division 2 pressure vessels, where application of PWHT on inservice vessels has been demonstrated to be detrimental to the vessel's material; or 2) ~~Tube-to-header welds~~Pressure--retaining items in steam service. b) Full thickness weld repairs, as permitted in 2.5.3.4 a) 1) and 2), above, shall be completed in accordance with NBIC Part 3, ~~3.3.5~~S11.2.3~~,~~ and the following additional requirements: 1) The full thickness repair shall be verified as being full penetration. 2) Volumetric examination of the full thickness weld shall be performed. c) The materials shall be limited to P-No. 3, P-No. 4, Groups 1 and 2~~,~~ and P-No. 5A steels as permitted for welded construction by the applicable rules of the original code of construction; d) The welding shall be limited to the SMAW, FCAW, GMAW, or GTAW processes using low-hydrogen ~~electrodes and filler metals~~ weld consumables classified by the ~~filler metal~~ specification with a diffusible-hydrogen designator of H8 or lower, and suitably controlled by maintenance procedures to avoid contamination by hydrogen-~~-~~producing sources. The surface of the metal prepared for welding shall be free of contaminants; e) The test material for the welding procedure qualification shall be of the same P-No. and Group No. as the base ~~material~~ metal specification of the repair. ~~In the event that~~If the original ~~material~~ base metal specification is obsolete, the test material used should conform as closely as possible to the original material used for construction based on ~~to~~ the nominal composition and carbon equivalent (IIW Formula CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15; elements are expressed in ~~W~~weight ~~Percent~~ percent ~~A~~amounts)~~, as~~ of

	the base metal~~material~~ being repaired, but in no case shall the material be lower in strength; f) If ~~for reasons of corrosion resistance, special~~specific hardness limits are necessary due to corrosion resistance, such limits shall be included when qualifying the WPS; g) The qualification thickness for the test plates and repair groove depths shall be in accordance with ASME BPVC Section IX. ~~For pressure-retaining items repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME Section IX temper bead procedure qualification provided the pressure-retaining item operates in steam service above 900°F (482°C);~~ h) The ~~welding procedures (~~WPS~~)~~ shall be qualified in accordance with the temper bead procedure qualification requirements in ~~QW-290 of~~ ASME BPVC Section IX, QW-290 and shall include the following additional requirements. For pressure-retaining items repaired using this temper bead method, the hardness testing and carbon equivalency requirements in QW-290 may be waived, provided the pressure-retaining item operates in steam service above 900°F (482°C);~~:~~ 1) The minimum preheat temperature for welding shall be 350°F (177°C) for P-No. 3 material, 300°F (150°C) for P-No. 4 material, and 400°F (200 °C) for P-No. 5A material. The preheat temperature shall be checked to ensure that 4 in. (102 mm) of the material or four times the material thickness (whichever is greater) on each side of the groove (or full thickness of joint for a groove weld) is maintained at the minimum temperature during welding. The interpass temperature shall not exceed 800°F (430°C). When the weld does not penetrate through the full thickness of the material, the minimum preheat temperature and maximum interpass temperature ~~need only~~shall be maintained for 4 in. (102 mm) or four times the depth of the repair weld (whichever is greater) on each side of the joint; 2) For the welding processes in NBIC Part 3, 2.5.3.4 c), use of austenitic or ferritic filler metal is permitted. For ferritic filler metals, use only ~~electrodes or filler metals~~those that are classified by the ~~filler metal~~weld consumable specification with a diffusible-hydrogen designator of H8 or lower for the FCAW and SMAW processes. B2L or B3L consumables are permitted; 3) After the weld has been deposited flush with the base metal, a surface temper reinforcing weld layer shall be applied; 4) For welds made by the SMAW and FCAW processes, after completion of welding and without allowing the weld~~ment~~ to cool below the minimum preheat temperature, the temperature of the weld~~ment~~ shall be raised to a minimum 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~~weld consumable manufacturer

	with a diffusible-hydrogen designator of H4 (e.g., E7018-~~-~~H4); and 5) After the finished repair weld has cooled to ambient temperature, the surface temper reinforcing weld layer shall be removed substantially flush with the surface of the base metal (and for a fillet weld, to the required size and suitable contour of the toes).
Item 25-29 Part 3, 2.5.3.5 c) and editorial	b) The materials shall be limited to ASME P-No. 1, Groups 1, 2, and 3, P-No. 3, Groups 1, 2, and 3, P-No. 4, P-No. 5A, P-No. 9A, P-No. 10A, P-No. 10B, P-No. 10C, P-No. 11A, and P-No. 11B joined to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45, as permitted for welded construction by the applicable rules of the original code of construction; c) The welding shall be limited to the SMAW, FCAW, GMAW, and machine or automatic GTAW processes. The ~~filler metal~~weld consumable used for joining the dissimilar materials shall be either an A-No. 8 weld metal in ASME BPVC Section IX, Table QW-442 or n~~N~~ickel-~~Chrome c~~~~C~~hromium alloy classification ~~(~~of F-No. 43~~)~~ in ASME BPVC Section IX, QW-432. When selecting a ~~filler metal~~weld consumable for dissimilar metal weld joints, determine if the weld joint will be exposed to elevated temperature service. Weld metals with chemistry matching A-No. 8 (per ASME BPVC Section IX, Table QW-442) ~~filler metals~~ exposed to service temperatures greater than 800°F (427°C) will exhibit reduced creep life along the fusion zone of the ferritic material due to carbon diffusion. Instead, a low-~~-~~hydrogen~~,~~ n~~N~~ickel-c~~C~~hromium alloy classification ~~filler metal~~weld consumable shall be used for dissimilar weld joints exposed to service temperatures at or above 800°F (427°C); d) The WPS shall be qualified in accordance with the temper bead rules of ASME BPVC Section IX, QW-290~~ in ASME Section IX~~. For pressure-~~-~~retaining items fabricated to ASME BPVC Section I and repaired using this temper bead method, hardness testing and carbon equivalency requirements may be waived for ASME BPVC Section IX temper bead procedure qualification, provided the pressure-~~-~~retaining item operates in steam service above 900°F (482°C); e) If the original code of construction did not require notch toughness testing, qualification of ~~welding procedures (~~WPS~~)~~s for joining ASME P-No. 1~~,~~ or P-No. 3 ferritic materials to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45 materials shall be in accordance with the requirements in either NBIC Part 3, 2.5.3.1, Welding Method 1 or ~~in NBIC Part 3,~~ 2.5.3.3, Welding Method 3; f) If the original code of construction did not require notch toughness testing, qualification of ~~welding procedures (~~WPS~~)~~s for joining ASME P-No. 4 or~~,~~ P-No. 5A ferritic materials to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45 materials shall be in accordance with the requirements in NBIC Part 3, 2.5.3.4, Welding Method 4; and

	g) If the original code of construction required notch toughness testing, qualification of ~~welding procedures (~~WPS~~)~~s for joining ferritic materials to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45 materials shall be in accordance with the requirements in NBIC Part 3, 2.5.3.2, Welding Method 2.
Item 25-85, Item 25-29 Part 3, 2.5.3.6 c) and editorial (2.5.3.6)	**2.5.3.6 WELDING METHOD 6** This welding method provides requirements for welding ~~only Grade 91~~creep strength enhanced ferritic steel (CSEF) tube material ASME P-No. 15E, Group 1 or P-No. 5B, Group 1 within the steam boiler setting. When using this welding method, the following applies: a) This method is limited to butt welds, weld build-up repairs, or attachment welds to NPS 5 (DN 125) or less in diameter and ~~½~~ 0.5 in. (13 mm) or less in wall thickness for which the applicable rules of the original code of construction did not require notch toughness testing; b) Application shall be limited to only boiler tube repairs at a location internal to the boiler setting; c) Upon the completion of weld repair, the repair area shall be kept above the dew point temperature so that condensation does not form on the repair surface before the boiler is returned to service, or a moisture-barrier coating shall be applied to the surface. 1) The material shall be limited to P-No. 15E, Group 1 or P-No. 5B, Group 1~~, Grade 91, creep strength enhanced ferritic steel (CSEF)~~. 2) The welding shall be limited to the SMAW and GTAW processes, using suitably controlled maintenance procedures to avoid contamination by hydrogen-producing sources. The surface of the metal shall be kept dry and free of contaminants. 3) The welding procedure qualification test coupon shall be P-No. 15-E, Group 1 or P-No. 5B, Group 1~~, Grade 91~~. 4) Qualification thickness limits of base metal and weld deposit thickness shall be in accordance with ASME BPVC Section IX, QW-451. 5) The ~~Welding Procedure Specification (~~WPS~~)~~ shall be qualified in accordance with the requirements of ASME BPVC Section IX. No postweld heat treatment shall be applied to the test coupon. Additionally, the WPS shall include the following requirements: a. The minimum preheat for the GTAW process shall be 200°F (100°C). The minimum preheat for the SMAW process shall be

	300°F (150°C). The preheat temperature shall be checked to ensure the minimum preheat temperature is maintained during welding and until welding is completed. The maximum interpass temperature shall be 550°F (290°C); b. When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW ~~-~~process is specified, any limits in ~~filler~~ weld consumable diameter size ~~is to~~shall be shown on the WPS; c. Regardless of the welding process (SMAW or GTAW), only the use of stringer beads shall be permitted; d. The ~~filler metal~~weld consumable shall be limited to a~~n austenitic,~~ nickel-base ~~filler metal to those~~type assigned to F-N~~n~~umber 43 in ASME BPVC Section IX, QW-432 and limited to the following ~~consumables~~classifications: A or SFA-5.14 ERNiCr-3 ~~(e.g., Filler Metal 82)~~, A or SFA 5.11 ENiCrFe-3 ~~(e.g., INCONEL Welding Electrode 182)~~, ENiCrFe-2 ~~(e.g., INCOWELD A), UNS N08087~~, or ENiCRFE-4; e. A martensitic, iron-base ~~filler metal~~weld consumable ~~to those~~ assigned to F-N~~n~~umber 4 or F-N~~n~~umber 6 in ASME BPVC Section IX, QW-432 and limited to the following ~~consumables~~classifications: A or SFA-5.5 E8015-B8, E8018-B8, or A or SFA-5.28 ER80S-B8; and f. For weld build~~-~~up repairs due to wastage, the ~~filler metal~~weld consumable shall be limited to those assigned to F-N~~n~~umber 43 in ASME BPVC Section IX, QW-432.
Item 25-29 Part 3, 2.5.3.7 i) and editorial	**2.5.3.7 WELDING METHOD 7** When using this welding method, the following applies: a) This welding method may be used when the applicable rules of the original code of construction or the construction standard or code selected permit joining dissimilar materials. b) The materials shall be limited to ASME P-No. 15E, Group 1 joined to either P-No. 5A ~~or,~~ P-No. 8, P-No. 42, P-No. 43, or P-No. 45, as permitted for welded construction by the applicable rules of the original code of construction. …. f) Upon the completion of weld repair, the repair area shall be kept above the dew point temperature so that condensation does not form on the repair surface before the boiler is returned to service, or a moisture-barrier coating shall be applied to the surface.

	g) Qualification thickness limits of base metal and weld deposit thickness shall be in accordance with ASME BPVC Section IX, QW-451. h) The welding procedure qualification test coupon shall be ASME P-No. 15 E, Group 1, joined to either P-No. 5A, P-No. 8, P-No. 42, P-No. 43, or P-No. 45. i) The ~~Welding Procedure Specification (~~WPS~~)~~ shall be qualified in accordance with the requirements of ASME BPVC Section IX. No postweld heat treatment shall be applied to the test coupon. Additionally, the WPS shall include the following requirements: 1) The minimum preheat for the GTAW process shall be 200°F (93°C). The minimum preheat for the SMAW process shall be 300°F (149°C). The maximum interpass temperature shall be 550°F (288°C). The preheat temperature shall be checked to ensure the minimum preheat temperature is maintained during welding and until welding is completed. 2) When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW~~-~~ process is specified, any limits in ~~filler size is~~weld consumable diameter are to be shown on the WPS. 3) Regardless of the welding process, only the use of stringer beads shall be permitted. 4) For the joining of ASME P-No. 15E, Group 1 to P-No. 5A, the ~~filler metal~~weld consumable shall be limited to a martensitic, iron-base filler metal ~~to~~ of those assigned to F-No. 4 or F-No. 6 in ASME BPVC Section IX, QW-432 and limited to the following ~~consumables~~classifications: A or SFA-5.5 E8015-B8, E8018-B8, or A or SFA-5.28 ER80S-B8. 5) For the joining of ASME P-No. 15E, Group 1 to P-No. 8, P-No. 42, P-No. 43, or P-No. 45, the filler metal shall be limited to a~~n austenitic,~~ nickel-base ~~filler metal to those~~ weld consumable assigned to F-No. 43 in ASME BPVC Section IX, QW-432 and limited to the following ~~consumables~~classifications: A or SFA-5.14 ERNiCr-3, A or SFA-5.11 ENiCrFe-3, ENi-CrFe-2, or ~~UNS N08087~~ENiCrFe-4.
Item 25-26 Part 3, 3.2.2 d)	**3.2.2 REPLACEMENT PARTS** d) When the original code of construction is other than ASME Code, replacement parts subject to internal or external pressure, fabricated by welding, shall be manufactured by an organization certified as required by the original code of construction. The item shall be inspected and stamped as required by the original code of construction. Certification to the original code of construction, as

	required by the original code of construction or equivalent, shall be supplied with the item. 1) When ~~this is not~~the above requirements are not possible~~ or practicable~~, the organization fabricating the part shall have a National Board "R" Certificate of Authorization; replacement parts shall be documented on Form R-3 and the "R" Symbol Stamp applied as described in NBIC Part 3, Section 5 paragraphs 5.2.3 and 5.7.4 b) respectively.
Item 23-39 Part 3, 3.3.1	3.3.1 DEFECT REPAIRS Prior to repairing a defect in a welded joint or base metal, it is important to investigate its cause, extent, and likelihood of reoccurrence. A condition assessment may be part of this process and may be conducted by the owner or user, equipment manufacturer, repair organization, or another technically competent source. For repairs involving complex defects, a more comprehensive condition assessment method may be required, including an engineering evaluation performed by a competent technical source. Guidance for performing condition assessments is available in NBIC Part 2, Section 4.4. For repair methods that do not fully remove the defect, refer to NBIC Part 3, S11.2.2.~~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.~~
Item 26-18 Part 3, 3.3.2 e)	**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 if acceptable to the jurisdiction and Inspector. Routine repairs are not permitted for ASME BPVC Section VIII, Division 2 or Division 3 vessels. 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 QMS shall describe the process for identifying, controlling, and implementing routine repairs. Routine repairs shall be documented on the NB-66, Form R-1, *Report of Repair* with this statement in the "Remarks" section: "Routine Repair."~~;~~ d) Alternative welding methods without postweld heat treatment as described in NBIC Part 3, 2.5.3 shall not be used for routine repairs. e) The following repairs may be considered ~~as~~ routine repairs and shall be limited to these categories:

	1) Welded repairs or replacements of valves, fittings, tubes, or pipes NPS 5 (DN 125) in diameter and smaller, or sections thereof, where the original code of construction does not require ~~neither~~ postweld heat treatment ~~nor~~ or NDE other than visual ~~is required by the original code of construction~~. This includes ~~their~~ attachments such as clips, lugs, skirts, etc., but does not include nozzles to pressure-retaining items; 2) The addition or repair of non-load-~~-~~bearing attachments to pressure-retaining items where postweld heat treatment is not required; 3) Weld buildup of wasted areas in heads, shells, flanges, and fittings not exceeding an area of 100 in.2 (64,520 mm2) or a thickness of 25% of nominal wall thickness or 1/2 in. (13 mm), whichever is less; 4) Corrosion-resistant ~~resistance~~ weld overlay not exceeding 100 in.2 (64,520 mm2); 5) Seal welding a mechanical connection for leak tightness where the pressure-retaining capability is not dependent on the weld for strength and requires no postweld heat treatment due to its design; and 6) Plugging of heat exchanger tubes ~~¾~~ 0.75 in. (19 mm) outside diameter and smaller when explosion welding is used as the method of plugging tubes. 7) Repairing dimple jacket welds in high-~~-~~alloy or non-ferrous materials when performed by the original equipment manufacturer of the vessel or a repair organization that has conducted proof testing in accordance with the original code of construction ~~the repair organization is either the original equipment manufacturer of the vessel or a repair organization that has conducted proof testing in accordance with the original code of construction~~.
Item 25-29, Item 26-03, Item 26-18 Part 3, 3.3.3 a) and j)	**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~~metal; … c) Corrosion-~~-~~resistant strip lining, or weld overlay; … h) Replacement of pressure-retaining parts identical to those existing on the pressure-retaining item and described on the original Manufacturer's Data Report (MDR). For example:

	j) The addition of a nozzle (or opening) where reinforcement is required is considered ~~to be~~ a repair, provided all ~~of~~ the following are satisfied: 1) The nozzle is identical to one in the original design (including orientation, e.g., radial, hillside, or angled relative to the longitudinal axis). 2) The nozzle is located in a similar part of the vessel. 3) The spacing between the nozzle and any adjacent nozzles is no closer than three times the average finished opening diameter of the nozzle and the adjacent nozzle, measured from the nozzles' centerlines. 4) Material within the nozzle's limits of reinforcement, measured parallel to the vessel wall, as defined in the applicable code of construction, is available in its entirety for reinforcement. 5) The nozzle is not restricted by any service requirements.~~;~~ q) Subject to the administrative procedures of the ~~j~~jurisdiction and approval of the Inspector, the replacement of a riveted section or part by welding; r) The repair or replacement of a pressure part with a code-accepted material that has a nominal composition and strength that is equivalent to the original material~~,~~ and ~~is~~ suitable for the intended service; s) Replacement of a pressure-retaining part with a material of different nominal composition and, equal to or greater in allowable stress from that used in the original design, provided the replacement material satisfies the material and design requirements of the original code of construction ~~under which the pressure-retaining part was built~~. The minimum required thickness shall be at least equal to the thickness stated on the original ~~*Manufacturer's Data Report*~~MDR*;* t) The replacement of a pressure-~~-~~relieving device (PRD) attached by welding, provided the replacement device's relieving capacity is equal to or greater than the PRD capacity required by the original code of construction; or u) Repairs to plate heat exchangers (PHE) are limited to the following: 1) Welding on any pressure part~~,~~ (i.e., not limited to a flange, nozzle, or endplate); 2) In-~~-~~kind replacement of endplates~~,~~ or welded nozzles; 3) Replacement of any failed connection or frame bolting**,** representing the replacement parts described in Part 3, 3.2.2- a), with no change of material or grade as described on the ~~Manufacturer's Data Report (~~MDR~~)~~ or Original Equipment Manufacturer's (OEM) drawing; 4) The addition or repair of load-~~-~~bearing attachments (e.g., welded supports or lifting lugs) to the endplates; and

	5) Replacement of parts bearing certification or manufacturer's stamping with no-change in material ~~allowed~~ permitted as described on the MDR or verifiable OEM drawing. **3.4.4 EXAMPLES OF ALTERATIONS** c) The addition of new nozzles or openings in a boiler or pressure vessel, except those classified as repairs (e.g., 3.3.3 i) or j));
Item 25-53; Item 25-29; Item 26-34 Part 3, 3.3.4.1, 3.3.4.2 a), and 3.3.4.2 d) and editorial (3.3.4.2)	**3.3.4.1 SCOPE** Except as provided in NBIC Part 3, ~~3.3.4.8~~S11.2.2, a repair of a defect in a welded joint or base ~~material~~ metal shall not be made until the defect has been removed. A suitable nondestructive examination (NDE) method, such as magnetic particle (MT) or liquid penetrant (PT), may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld, such as a double buttweld or single buttweld with or without backing. Where circumstances indicate that the defect is likely to reoccur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, ~~by~~ the j~~J~~urisdiction. **3.3.4.2 DEFECT REPAIRS** a) Cracks Except as provided in NBIC Part 3, ~~3.3.4.8~~S11.2.2, a repair of a crack in a welded joint or base ~~material~~ metal shall not be made until the defect has been removed. A suitable ~~nondestructive examination~~NDE method, such as MT or PT, may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld, such as a double buttweld or single buttweld with or without backing, as ~~allowed~~ permitted by the original code of construction. b) Unstayed Boiler Furnace Cracks Cracks at the knuckle or at the turn of the flange of the furnace opening require immediate replacement of the affected area or specific approval of repairs by the ~~J~~jurisdiction. (See NBIC Part 3, Figure 3.3.4.2-a.)~~.~~ c) Rivet or Staybolt Hole Cracks Cracks radiating from rivet or staybolt holes may be repaired if the plate is not ~~seriously~~ severely damaged. If the plate is ~~seriously~~ severely damaged, it shall be replaced. For suggested methods of repair, see NBIC Part 3, Figure 3.3.4.2-b. d) Minor Defects

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

e) Defective Bolting

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

f) Bulges

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

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

g) Blisters

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

Item 26-34 Part 3, 3.3.4.6 a) 3)	**3.3.4.6 PATCHES** a) Flush Patches 1) Examples of welded flush patches are shown in NBIC Part 3, Figure 3.3.4.6-a. 2) Defects should be evaluated in accordance with 3.3.1 and 3.3.4.1. 3) Before installing a flush patch, defective material shall be removed. ~~until sound material is reached.~~ The area adjacent to the flush patch opening shall be measured to ensure it is at or above the required minimum thickness as per the original code of construction. b) Tube Patches In some situations it is necessary to weld a flush patch on a tube, such as when replacing tube sections ~~and~~ where accessibility around the complete circumference of the tube is restricted, or when it is necessary to repair a small bulge. This is referred to as a window patch. Suggested methods for window patches are shown in NBIC Part 3, Figure 3.3.4.6-b. **Figure 3.3.4.6-b** 3) The gas tungsten -arc welding process should be used for the ~~inital~~initial pass on the inside of the tube and for the ~~inital~~initial pass joining the patch to the tube.
Item 25-60 Part 3, 3.4.1 d) and editorial (3.4.1)	**3.4.1 RE-RATING** Except as provided for yankee dryers in Supplement 5, the NBIC does not provide rules for de-rating boilers or pressure vessels; however, when the maximum allowable working pressure (MAWP) or maximum allowable working temperature (MAWT) of a boiler or pressure vessel is reduced, the jurisdiction where the object is installed, if applicable, shall be contacted to determine if specific procedures should be followed. Re-rating of a pressure-retaining item by increasing the ~~maximum allowable working pressure~~MAWP (internal or external) or ~~temperature~~MAWT, or decreasing the minimum design metal temperature below that for which notch toughness testing is required by the original code of construction, shall be done only after the following requirements have been met to the satisfaction of the jurisdiction at the location of the installation: a) Revised calculations verifying the new service conditions shall be prepared in accordance with the “R” Certificate Holder’s QMS. Establishing a higher joint efficiency to re-rate a pressure-retaining item is not permitted. b) All re-ratings shall be established in accordance with the requirements of the construction standard to which the pressure-retaining item was built.

	c) Current inspection records ~~verify~~ confirm that the pressure-retaining item is satisfactory for the proposed service conditions. d) The pressure-retaining item has been pressure tested~~,~~ as required~~,~~ for the new service conditions. Any insulation, coatings, or coverings that may inhibit or compromise a meaningful pressure test shall be removed~~,~~ to the extent identified by the Inspector. The pressure test may be waived if the original test pressure~~, test~~ as recorded on the Manufacturer's Data Report, is at least equal to the calculated test pressure required to verify the integrity of the pressure-retaining item for the new conditions. If the pressure test is waived, it shall be documented on the NB-229, Form R-2, *Report of Alteration* with this statement in the "Remarks" section: "Pressure test waived in accordance with NBIC Part 3, 3.4.1 d)."~~.~~ e) In lieu of pressure testing, alternative methods may be used to ensure the structural integrity of the re-rated pressure-retaining item. The alternative methods shall be documented and are subject to review and approval by the jurisdiction.
Item 24-28 Part 3, 3.4.4 k)	k) Performing ~~postweld heat treatment~~PWHT where none was originally performed on the pressure-retaining item. (See NBIC Part 2, S9.3 b) 4).)
Item 23-77; Item 25-29 Part 3, 4.2	**4.2 NONDESTRUCTIVE EXAMINATION** a) All nondestructive examination (NDE) requirements, except for NDE personnel qualification requirements, shall be in accordance with the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Where this is not possible or practicable, or where there is insufficient information available to determine the original NDE requirements, alternative NDE methods that provide meaningful results to verify the integrity of the repair or alteration may be used~~,~~. ~~if~~ The alternative NDE methods shall be acceptable to the Inspector, and where required, jurisdiction where the pressure-retaining item is installed, ~~may be used, provided that~~and all other requirements of this section ~~are~~ shall be met. ~~a)~~ 1) When volumetric NDE is required by the original code of construction~~For welds that were subject to volumetric NDE during construction~~, repairs may be made to the base ~~material~~ metal and welded joints without volumetric examination under the following conditions: ~~1.~~a. The repair depth does not exceed the lesser of 1/8 in. (3 mm) or 25% of the nominal base ~~material~~ metal thickness; ~~2.~~b. The aggregate repair length is no longer than 6 in. (150 mm); and

	~~3.~~c. The repair cavity and each layer of deposited weld metal, including the final weld surface, have been examined by magnetic particle (MT) or liquid penetrant (PT). ~~b) a)~~ 2) When volumetric NDE is required by the original code of construction and volumetric examination ~~but~~ is not possible or practicable, progressive PT or MT examination ~~as described in paragraph 4.2 b) 1), below,~~ may be used in lieu of volumetric examination, provided all the following conditions are met:~~.~~ ~~This alternative NDE method is subject to the acceptance of the Inspector, owner, and when required, jurisdiction where the pressure-retaining item is installed, provided all other requirements of this section are met.~~ ~~1)~~ a. The Inspector, owner, and where required, the jurisdiction where the pressure-retaining item is installed, have accepted the use of this alternative NDE method. b. Progressive PT or MT examination shall be performed on each layer of the weld to be examined, including the final weld. c. Before MT or PT is performed, the surface of each layer of weld shall be properly prepared for examination, except that ~~. The~~ the final weld may be examined with or without grinding. d. The NDE report shall include the number of layers examined. e. This alternative NDE method shall be documented in the "Remarks" section of the applicable Form "R" Report. b~~c~~) NDE personnel utilizing volumetric examination methods shall be qualified and certified in accordance with the requirements of the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). When this is not possible or practicable, NDE personnel may be qualified and certified in accordance with their employer's written practice. ASNT's *Recommended Practice* ASNT SNT-TC-1A, ~~*Recommended Practice Nondestructive Testing*~~ *Personnel Qualification and Certification in Nondestructive Testing* (2006 edition) or ANSI/ASNT CP-189, *Standard for Qualification and Certification of Nondestructive Testing Personnel* (2006 edition)~~,~~ shall be used as a guideline for employers to establish their written practice. Provisions for training, experience, qualification, and certification of NDE personnel shall be described in the "R" Certificate Holder's ~~written~~ Quality Management System (QMS) Manual. c~~d~~) NDE personnel utilizing NDE examination methods other than volumetric, such as visual examination (VT), PT, or MT, shall be qualified and certified in accordance with the requirements of the original code of construction, standard, or specification selected for the repair or alteration of the pressure-retaining item (see NBIC Part 3, 1.2). Alternatively, NDE personnel may be qualified and certified in accordance with a written program established by the employer of the personnel being certified, which shall be based on the following minimum requirements: ...

	4) For PT and MT examination methods, a visual acuity examination performed annually, with correction if necessary to enable reading of Jaeger Type No. 2 Standard Chart at a distance of not less than 12 in. (300 mm), that is capable of distinguishing and differentiating contrast between colors used to determine optical capability of NDE personnel to perform the required examinations; 5) Upon completion of 4.2 c) 1) and 2), above, the NDE personnel shall be given a written examination and performance examination by the employer to determine if the NDE personnel are qualified to perform the required examinations and interpretation of results. 6) Certified NDE personnel whose work has not included performance of a specific examination method for a period of ~~1yr~~ one year or more shall be recertified by successfully completing the examinations of 4.2 c) 3) and 4). ~~and also passing the visual examination of 3).~~ 7) Substantial changes in procedures or equipment shall require recertification of NDE personnel. 8) All documentation concerning the training, qualification, examination, and certification of NDE personnel in this program shall be described in the "R" Certificate Holder's ~~written quality system~~ QMS Manual. As an alternative to the requirements of 4.2 d) 1) through 5) above, the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (~~ASME BPV Code~~BPVC), Section V, Article 1, T-120(e) or T-120(f) may be used for the qualification of NDE personnel. Personnel qualified to the American Welding Society (AWS)'s QC1 may be used for the visual examination of welds, provided they meet the annual visual acuity examination requirement of 4.2 d) 3) and the Jaeger J1 visual acuity requirement of ASME BPVC ~~Code~~, Section V, Article 9.
Item 23-77 Part 3, 4.4	**4.4 EXAMINATION AND TEST FOR REPAIRS AND ALTERATIONS** The following requirements shall apply to all repairs and alterations to pressure-retaining items: a) The integrity of repairs~~, alterations,~~ and replacement parts used in repairs ~~and alterations~~ shall be verified by examination or test, in accordance with 4.4.1. b) The integrity of alterations and replacement parts used in alterations shall be verified by examination or test, in accordance with 4.4.2. ~~b)~~ c) Examination or ~~T~~testing methods used shall be suitable for providing meaningful results to verify the integrity of the repair or alteration. Any impediment that compromises or limits a test method, such as insulation, coatings, oxidation, or coverings ~~that may inhibit or compromise a meaningful test method~~ , shall be removed~~,~~ to the extent ~~identified by~~ acceptable to the Inspector. ~~c)~~ d) The "R" Certificate Holder is responsible for all activities relating to examinations and tests of repairs and alterations.

	~~d)~~ e) Examinations and tests to be used shall be subject to the acceptance of the Inspector, and where required, the jurisdiction.
Item 25-44 Part 3, 4.4.1	4.4.1 TEST OR EXAMINATION METHODS APPLICABLE TO REPAIRS a) Liquid Pressure Test b) Pneumatic Test A pneumatic test may be conducted. Concurrence of the owner shall be obtained in addition to that of the Inspector and Jurisdiction where required. The test pressure shall be the minimum required to verify leak tightness integrity of the repair, but shall not exceed the maximum pneumatic test pressure of the original code of construction. Precautionary requirements of the original code of construction shall be followed.~~;~~ ~~c) Initial Service Leak Test~~ ~~When an initial service leak test is permitted by the original code of construction, such testing may also be used to verify the leak tightness integrity of repairs;~~ ~~d)~~ c)Vacuum Test A vacuum test may be conducted. Vacuum test methods used shall be suitable to verify the leak tightness integrity of the repair.~~;~~ ~~e)~~ d)Nondestructive Examination (NDE) NDE may be conducted. NDE methods used shall be suitable for providing meaningful results to verify the integrity of the repair. Exclusive use of visual examination (VT) is only permitted with the following considerations:
Item 25-50 Part 3, 5.2.2 f)	**5.2.2 PREPARATION OF NB-229, FORM R-2, *REPORT OF ALTERATION*** b) “R” Certificate Holders whose scope is “Design Only” may perform code calculations for re-rating and alterations as permitted in NBIC Part 3 but

4) and editorial (5.2.2)	are prohibited from performing physical work (construction work) to the pressure-retaining item, except for the application of the "R" Symbol stamp and performing NDE and/or final pressure testing, as applicable, provided the controls are included in their Quality Management System (QMS). "R" Certificate Holders who perform these activities in the field shall have the scope for field activities included on their "R" *Certificate of Authorization*. f) The following, as applicable, shall be attached to and become a part of the completed Form R-2: 1) For pressure-retaining items built to a code of construction other than ASME, the manufacturer's reports (i.e., reports required by the original code of construction)~~,~~ when available. 4) Form NB-403, *Report of Fitness-for-Service Assessment*
Item 25-26 Part 3, new 5.5	***Editorial note: subsequent sections will need to be renumbered**** **5.5 DISTRIBUTION OF FORM R-3** a) Legible copies of completed Form R-3, together with attachments, shall be distributed to the owner or user and Jurisdiction, if required, and shall be provided to the Inspector and the inservice Authorized Inspection Agency of the pressure retaining item upon request. b) Distribution of Form R-3 and attachments shall be the responsibility of the organization manufacturing the part.
Item 24-95 Part 3, 5.5 a) and editorial (5.5)	5.5 REGISTRATION OF FORMS — GENERAL Some jurisdictions may require registration of repairs and alterations with the National Board. a) When registration of the forms is required, the Certificate Holder ~~performing a repair or alteration~~ shall submit the completed NBIC-compliant form~~, meeting the requirements of the NBIC,~~ to the National Board no more than 30 days following certification. b) When registration of the forms is not required, the Certificate Holder may register the completed NBIC-compliant form~~, meeting the requirements of the NBIC,~~ with the National Board.

	~~c) The "R" or "NR" Certificate Holder should be aware that some Jurisdictions may require registration of repairs and alterations with the National Board.~~ 5.5.1 REGISTRATION FOR REPAIRS A Form R-1 may be registered with the National Board, as noted in ~~NBIC Part 3,~~ 5.5.
Item 25-26 Part 3, 5.7.4	**5.7.4 STAMPING REQUIREMENTS FOR PARTS** a) For replacement parts subject to internal or external pressure fabricated by welding, stamping shall be as required per paragraph 3.2.2 c) or d). b) For parts fabricated in accordance with 3.2.2 d) 1), the organization who fabricated the part having a National Board "R" Certificate of Authorization, shall stamp the part or attach a nameplate (see Figure 5.7.5-d) in a conspicuous location on the part. The stamping shall include: a. The Certificate Holders name. b. The Manufacturers National Board 'R' Certificate Number c. The "R" symbol stamp. d. The M.A.W.P. at temperature. e. The manufacturers serial number. f. The year built. ~~Stamping or nameplate shall be applied in a conspicuous location on the part.~~
Item 24-17 Part 3, 5.7.5	5.7.5 Specific Requirements For Stamping and Nameplates a) Required data shall be in characters of at least 5/32 in. (4 mm) high, except that characters for pressure relief valve repair nameplates may be smaller. Markings may be produced by casting, etching, embossing, debossing, stamping, ~~or~~ engraving, or laser. Any marking by laser is permitted only on stainless steel and aluminum. No coating that obscures the marking shall be allowed. The selected method shall not result in any harmful contamination, or sharp discontinuities to the pressure-retaining item. See NBIC Part 3, Figures 5.7.5–a through 5.7.5-e. b) The National Board Code Symbols ("R", ~~"VR",~~ and "NR") ~~are to be stamped; do not emboss.~~ shall be made by direct application of the National Board Code Symbol Stamp. As an alternative:

	1) The Code Symbol may be made by casting, embossing, engraving, etching, dot peening, laser, or any other process that will leave a legible and permanent image. 2) The applied Code Symbol shall be the same shape and configuration as the National Board Code Symbol Stamp. 3) The process controls for the custody and method of marking shall be described in the Quality Management System.
Item 24-82 Part 3, S1.1.4	S1.1.4 FORMULA AND CALCULATIONS FOR STEAM LOCOMOTIVE BOILERS a) Most steam locomotive boilers were manufactured in the first half of the ~~20th~~ twentieth century or before. The calculations, formulas, and shop practices used then are now distant history and ~~quite~~ difficult to obtain. The original rules for riveted construction were last published by the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) ~~in~~ Section I ~~Code~~, 1971 Edition. Currently, ASME BPVC~~,~~ Section I, Part PR and Part PL~~,~~ govern riveted construction and steam locomotive boiler construction~~,~~ and ~~these Parts~~ may be referenced for repairs and alterations if appropriate for the boiler under repair/alteration. ~~b) This supplement herein, is based in part on the ASME Code, Section III, 1952 Edition, which was the last published edition of the Steam Locomotive Code. The railroad industry has attempted to collect the old formula and some shop practices. These have been published by The Engineering Standards Committee for Steam Locomotives, Inc. (ESC) as Compendium, Volume 1, Compilation of Calculations, which may be obtained from the Strasburg Rail Road, P.O. Box 96, Strasburg, PA 17579 (717) 687-7421.~~ b) This supplement is based in part on the ASME BPVC Section III, 1952 Edition; ASME BPVC Section I, Part PL; and established railroad standards. c) When the original code of construction is unknown or unavailable, the current edition of ASME BPVC Section I may be referenced for most locomotive calculations. The original codes of construction may not contain some necessary calculations, in which case the current edition of ASME BPVC Section I, or the nearest applicable code which postdates the construction, may be used to augment the original code of construction. d) Allowable stress values for materials are provided or referenced by ASME BPVC Section I, all editions. Care shall be taken to ensure the design margin used by a specific edition of the code is the same as that of the original code of construction, or the same as required by the jurisdiction in which the boiler will

	operate. When in doubt, divide ASME BPVC's listed ultimate tensile strength for the material used by the required design margin.
Item 24-106 Part 3, S1.2.2 b) and g)	**S1.2.2 THREADED STAYBOLTS** b) All staybolts shorter than 8 in. (200 mm) in length shall have telltale holes. Staybolt telltale holes in existing staybolts shall be 3/16 in. (5 mm) to 7/32 in. (5.5 mm) in diameter and at least 1-1/4 in. (3 2 mm) deep in the outer end. When staybolts shorter than 8 in. (200 mm) ~~or less~~ in length are replaced, they shall be replaced with staybolts that have a telltale hole 3/16 in. (5 mm) to 7/32 in. (5.5 mm) in diameter their entire length, or with ones that have a 3/16 in. (5 mm) to 7/32 in. (5.5 mm) diameter hole in each end, drilled a minimum of 1-1/4 in. (32 mm) deep. On reduced body staybolts, shorter than 8 in. (200 mm) in length, the telltale hole shall extend beyond the fillet and into the reduced section of the staybolt. ~~Ball socket-type flexible staybolts may have telltale holes that extend from the threaded end of the bolt into the bolt head for a distance of onethird the spherical bolt head diameter.~~ g) Ball socket-type flexible staybolts may have telltale holes that extend from the threaded end of the bolt into the bolt head for a distance of one third the spherical bolt head diameter. Ball socket-type flexible staybolts shall not be braced for driving the staybolt by inserting a spacer under the cap.
Item 24-77 Part 3, S1.2.3 i) and k)	**S1.2.3 BALL SOCKET-TYPE FLEXIBLE STAYBOLTS, SLEEVES, AND CAPS** i) Substitution of one type of flexible staybolt sleeve by another type shall be considered a repair, provided it does not affect the pressure retaining capability in accordance with Part 3, 3.4.4. j) Where necessary for boiler expansion, ball socket-type flexible staybolts shall be positioned in such a manner as to not interfere with boiler expansion. Where individual bolts are replaced, care should be taken to ensure that the stress load of the new bolt is compatible to the loading on adjacent bolts. **Note:** Some locomotive boiler designs positioned the bolts by backing the bolt head away from the sleeve socket bottom a certain amount.

	k) When the installation of a flexible staybolt and/or sleeve affects the pressure retaining capability, in accordance with Part 3, 3.4.4, the change shall be considered an alteration.
Item 25-29 Part 3, S1.2.10 a)	a) Except as provided in NBIC Part 3, 3.4.4.8, a repair of a defect in a welded joint or base ~~material~~ metal shall not be made until the defect is removed. A suitable nondestructive examination (NDE) method such as magnetic particle (MT) or liquid penetrant (PT) may be necessary to ensure complete removal of the defect. If the defect penetrates the full thickness of the material, the repair shall be made with a full penetration weld, such as a double buttweld or a single buttweld with or without backing. Where circumstances indicate that the defect is likely to reoccur, consideration should be given to removing the defective area and installing a flush patch or taking other corrective measures acceptable to the Inspector, and when required, ~~by~~ the j~~J~~urisdiction. …. e) All welded repairs to boiler barrel unstayed areas shall be radiographically examined in accordance with ASME ~~Code~~BPVC~~,~~ Section I when the size of the repaired area is greater than the maximum size of an unreinforced opening as calculated in accordance with the latest edition of ASME ~~Code~~BPVC~~,~~ Section I. f) Riveted patches may be any shape or size, provided the lowest patch efficiency is equal to or greater than the lowest equivalent seam efficiency of the boiler course to which it is applied. ~~Ref:~~ Reference ASME ~~Code~~BPVC~~,~~ Section I. g) The ~~factor of safety~~safety factor of all riveted patches shall not be less than four for locomotives operating under Federal Railroad Administration (FRA) regulations.
Item 25-13 Part 3, Table S2.7.1 and editorial (S2.7.1)	**S2.7.1 MATERIAL LIST FOR HISTORICAL BOILERS REPAIRS** Table S2.7.1 is intended as a basic guideline only, ~~and~~ cover~~s~~ing just the basic carbon steel and some alloy steel material specifications. Other alloy materials may be available for these applications if necessary. **Note:** See American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section II for Other Acceptable Section I Materials. TABLE S2.7.1 MATERIALS LIST FOR HISTORIC BOILERS Application: Boiler ~~T~~tubes ~~&~~ and ~~F~~flues Specification: SA-178 Grade A, SA-192, SA-210

Boiler ~~& and F~~ffirebox	Plate SA-285 Grade C, SA-515, SA-516
Staybolts ~~& and p~~Patch ~~B~~bolts	SA-675, SA-36, ASTM A-31
Boiler b~~B~~races	SA-675, SA-36
Rivets	SA-675, SA-31, SA-36[1]
Forged ~~P~~pparts ~~& and F~~ffittings	SA-105, SA-217
Hollow c~~C~~ylindrical ~~P~~ppressure ~~R~~rretaining ~~P~~pparts	SA-105 Forgings SA-675 Bar Stock
Pipe ~~F~~fflanges	SA-181, SA-105
Flange b~~B~~olts, s~~S~~tuds, ~~& and N~~nuts	SA-193-B7, SA-194-2H
Bronze c~~C~~astings ~~& and w~~W~~ashout P~~plugs	SB-61, SB-62, SB-148
Boiler studs for component attachment	SA-675 Grade 70, SA-36

[1] SA-36 rivets shall comply with the requirements ASME BPVC Section I, PG-14.

Editorial Change Part 3, S2.12

S2.12 DOCUMENTATION

Organizations performing repairs to historic boilers shall document the repair or alteration on Form R-1 or R-2, as applicable. Job records shall be retained in accordance with NBIC Part 3, 1.5.1 ut). Additionally, documentation detailing repairs or alterations shall be retained by the owner in permanent boiler records such as an operator ~~log book~~logbook.

Item 25-53; Item 25-29 Part 3, S2.13 and editorial

S2.13 REPAIR METHODS

a) Before performing any welding activity, consideration shall be given to ensure the weldability of historical boiler materials. Materials used for patches shall be made from material that is ~~at least~~ equal or superior in quality and strength to the original material.

b) Before ~~a repair is made to~~repairing a defect in a welded joint or base metal, one should take care ~~should be taken~~ to investigate its cause and ~~to~~ determine its extent and likelihood of reoccurrence.

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

d) Welded repairs at or near riveted seams requiring preheating or postweld heat treatment shall be care~~-~~fully made to prevent loosening in the riveted seams, especially when localized heating is used. Where necessary to control thermal expansion or to gain access for welding, rivets at the defective section, and to each side of it, may be removed. ~~Reuse of rivets is prohibited~~Rivets shall not be reused.

Editorial Change Part 3, Table S2.13.7

TABLE S2.13.7

MAXIMUM ALLOWABLE WORKING PRESSURES FOR STEEL TUBES OR FLUES FOR FIRETUBE BOILERS FOR DIFFERENT DIAMETERS AND GAGES OF TUBES CONFORMING TO THE REQUIREMENTS OF SPEC. SA-178, SA-192, SA-209, OR SA 210

Outside diameter of tube, inches D	Minimum gage, Birmingham Wire Gage (BWG), inches									
	13 t = 0.095	12 t = 0.10~~59~~	11 t = 0.120	10 t = 0.134	9 t = 0.148	8 t = 0.165	7 t = 0.180	6 t = 0.203	5 t = 0.220	4 t = 0.238
1	470	~~690~~630	—	—	—	—	—	—	—	—
1-1/2	320	~~460~~420	570	720	860	—	—	—	—	—
1-3/4	270	~~400~~360	490	620	740	890	—	—	—	—
2	240	~~350~~320	430	540	650	780	900	—	—	—
2-1/4	210	~~310~~280	380	480	580	690	800	960	—	—
2-1/2	190	~~280~~250	350	430	520	620	720	860	970	1,080
3	160	~~230~~210	290	360	430	520	600	720	810	900
3-1/4	—	~~210~~200	270	330	400	480	550	660	740	830
3-1/2	—	~~200~~180	250	310	370	450	510	620	690	770
4	—	~~180~~160	220	270	330	390	450	540	610	680
4-1/2	—	~~160~~—	190	240	290	350	400	480	540	600
5	—	—	180	220	260	310	360	430	490	540
5-3/8	—	—	160	200	240	290	340	400	450	500
5-1/2	—	—	—	200	240	290	330	390	440	490
6	—	—	—	180	220	260	300	360	410	450

P = {(t–0.065)/D} x 15550 where P = maximum allowable working pressure, pounds per square inch,
t = minimum wall thickness, inches,
D = outside diameter of tubes, inches.

For pressures below those given in the table, the gage thickness shall be not less than the minimum given in the table.
Calculated values of pressure have been rounded to the next higher unit of 10 psi.

Item 26-34 Part 3, S2.13.9.3 c) and

S2.13.9.3 WELDED FLUSH PATCHES IN UNSTAYED AREAS

a) Welded repairs to boiler unstayed areas shall have volumetric NDE performed in accordance with the approved code of construction or ASME BPVC Section I, when the size of the repaired area is greater than 3 in. (75 mm) in diameter. The completed

editorial (S2.13.9.3)	repair ~~must~~ shall be stress relieved. Alternative m~~M~~ethods without p~~P~~ostweld h~~H~~eat t~~T~~reatment identified in NBIC Part 3, 2.5.3 may be used. b) The weld around a flush patch shall be a full penetration weld and the accessible surfaces shall be ground flush. Examples of flush welded patches are shown in ~~Figure~~ NBIC Part 3, Figure S2.13.9.3. c) Before installing a flush patch, the defective material should be removed. ~~until sound material is reached.~~ d) The patch should be rolled or pressed to the proper shape or curvature. The edges of the patch should align with the original material without overlap. Patches shall fit flush on the waterside of the sheet. If the patch includes an existing riveted seam, the patch shall be riveted at that seam. Changing a riveted seam to a welded seam is considered an alteration. Patches may be of any shape or size. If the patch is square or rectangular, an adequate radius~~,~~ of at least three times the material thickness should be provided at the corners. Square corners shall be avoided. e) Material thickness of patches shall be at least equal to, but not greater than, 1/8 in. (3 mm) thicker than the original construction thickness.
Item 26-04 Part 3, S3.1	**S3.1 SCOPE** This supplement provides requirements and guidelines for repairs to graphite pressure equipment requiring the use of certified impervious graphite, with or without certified cement. An important factor in establishing the desired material properties of impervious graphite is the manufacturing process. There are two types of certified impervious graphite: impregnated graphite and compound graphite. If the manufacturing processes, such as resin impregnation or compound material production, are not controlled, then it is not possible to maintain consistent material properties. ~~This supplement provides requirements and guidelines for repairs to graphite pressure equipment requiring the use of certified impregnated graphite and cement. The determining factor in establishing the desired material properties is the resin impregnation cycle. If the resin impregnation cycle is not controlled, it is not possible to meet the minimum design values.~~ a) The letter "G" shall be included on the "R" *Certificate of Authorization* for those organizations authorized to perform repairs/alterations of graphite pressure equipment except as permitted by NBIC Part 3, S3.5.4 f).
Item 24-67; Item 26-04 Part 3, S3.2 c), d), and deletion of j)-r) and Table S3.2	**S3.2 REPAIRS** The requirements provided in ~~this supplement~~NBIC Part 3 shall apply, insofar as they are applicable to graphite pressure equipment. Graphite specific requirements include: **…** c) The materials used in making repairs or alterations shall conform to the requirements of the original code of construction except as provided in NBIC Part 3, S3.5.1 e)~~2 j)~~. The "R" Certificate Holder is responsible for verifying identification of existing materials from original data, drawings, or unit records and identification of the materials to be installed. Where material strength

properties are used in supporting calculations, replacement part materials used for repairs shall meet or exceed the original strength values.

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

d) When ASME is the original code of construction, replacement parts subject to internal or external pressure, which require shop inspection by an Authorized Inspector, shall be fabricated by an organization having an appropriate ASME *Certificate of Authorization*. The item shall be inspected and stamped as required by the applicable section of the ASME Code. A completed ASME *Manufacturer's Partial Data Report* shall be supplied by the manufacturer. Further, all ~~impregnated~~ impervious graphite material subject to internal or external pressure shall be fabricated by an organization having the appropriate ASME *Certificate of Authorization*. The ~~impregnated~~ impervious graphite material shall be inspected and stamped as required by the applicable section of the ASME Code. A completed ASME *Manufacturer's Partial Data Report* with supplementary U1B shall be supplied by the ~~impregnated~~ impervious graphite material manufacturer.

…

~~j) Graphite parts that have previously been in service in one pressure vessel should not be used in a second vessel without prior approval of the owner. Consideration should be given to the service condition of the previous process and possible contamination of the subsequent process.~~
~~k) Blind cracks and delaminations shall not be repaired by cement injection only.~~
~~l) Cracks and porosity in tubes shall not be repaired. Cracked and porous sections may be removed so that the remainder of the tube may be used. Individual tube sections shall not be less than 24 in. (610 mm) in length, and the number of segments in a tube shall not exceed the quantity listed in NBIC Part 3, Table S3.2.~~
~~m) Cracks and porosity in graphite plates used in plate and frame exchangers shall not be repaired.~~
~~n) Cementing procedure specifications shall be qualified by the repair organization. The specifications shall be qualified as required by the code of construction. Cementing procedure qualification shall be verified by the Inspector.~~
~~o) Cementing technicians shall be qualified by the repair organization. The technicians shall be qualified as required by the code of construction. A cementing technician is any individual who is responsible for proper joint preparation, cleaning parts to be joined, mixing cement, applying cement, securing the joint during the curing process, and controlling the curing process.~~
~~p) All records shall be made available to the Inspector.~~
~~q) Completed repairs shall be subjected to a pressure test. The test pressure shall not be less than operating pressure or more than maximum allowable working pressure. The test pressure shall be maintained for 30 minutes minimum.~~
~~r) Reimpregnation may be used to reduce porosity in an existing graphite component, which will improve the existing graphite component's performance and expected life. Reimpregnation of~~

	~~graphite shall not be considered a means to restore original strength, nor shall it be considered a means to restore the original depth of impregnation.~~ **~~TABLE S3.2~~** ~~PERMITTED QUANTITY OF TUBE SEGMENTS~~ ~~Total Tube Length, ft. (m)~~ | ~~Number of Tube Segments~~ | ~~Number of Joints~~ ~~6 (1.8)~~ | ~~1~~ | ~~0~~ ~~9 (2.7)~~ | ~~2~~ | ~~1~~ ~~12 (3.7)~~ | ~~3~~ | ~~2~~ ~~14 (4.3)~~ | ~~3~~ | ~~2~~ ~~16 (4.9)~~ | ~~4~~ | ~~3~~ ~~18 (5.5)~~ | ~~4~~ | ~~3~~ ~~20 (6.1)~~ | ~~4~~ | ~~3~~ ~~22 (6.7)~~ | ~~4~~ | ~~3~~ ~~24 (7.3)~~ | ~~5~~ | ~~4~~ ~~27 (8.2)~~ | ~~5~~ | ~~4~~
Item 24-86; Item 26-04 Part 3, S3.3	S3.3 ROUTINE REPAIRS a) The following repairs ~~shall~~ may be considered routine and shall comply with NBIC Part 3, 3.3.2 a), b), and c). 1) ~~Machining —~~ Minor machining of pressure-retaining items for cleaning or joint preparation, not to exceed 1/32 in. (0.8 mm) of existing material thickness.~~routine repair shall not include the machining of pressure-retaining parts with the exception of minor machining, not to exceed 1/32 in. (0.8 mm) of material thickness, for cleaning and joint preparation.~~ 2) Repair of g~~G~~asket ~~S~~surfaces a. Re-machining ~~of gasket surfaces~~, re-serrating, or flattening of gasket surfaces is permitted if the design thickness is maintained. b. Gasket surface damage repair by cement only is permitted, provided the repair depth does not exceed 3/16 in. (5 mm). 3) Replacing ~~i~~individual ~~T~~tubes — drilling out and replacing damaged tubes with new or repaired tubes ~~or repaired tubes~~. The quantity of tubes replaced, along with the location in the tube bundle, shall be recorded. (See NBIC Part 3, S3.5.4.5)~~Only certified materials shall be used for this repair.~~ 4) Repairing damaged tubes ~~-~~ — replacing cracked or porous portions

	of individual tubes with new tube segments. (See NBIC Part 3, S3.6) 5) Plugging tubes or block holes -— plugging individual tubes or block holes to eliminate leaks or fluid transfer. The quantity of tubes or block holes plugged, along with the location in the part, shall be recorded. (See NBIC Part 3, S3.5.4.3) 4)6)Nozzle rReplacement — complete or partial replacement of nozzles by removing all or a length of the existing nozzle and cementing a new piece in place. This is applicable for nozzles with inside diameters not exceeding 106 in.ches (254152 mm). 5) Plugging Tubes or Block Holes — plugging individual tubes or block holes using accepted procedures. 6)7)Surface Rrepair — surface repair by installation ofr inlay material shall not exceed a total of 64 in.^{3} (1049 cm^3) or ten percent of the volume of the part, whichever is less. Surface repair does not include plug stitching. (See NBIC Part 3, S3.5.4.6) 8) Plate replacement - replacing individual graphite plates with new plates in a plate heat exchanger. 7)9)Replacement or aAddition of nNon-lLoad-bBearing aAttachments to pPressure-rRetaining iItems — for attachment of non-load bearing attachments to pressure-retaining items, the cementing procedure specification shall be qualified for the pressure part and cement to be used as a minimum. 8) Replacing graphite plate(s) with new plate(s) in a plate and frame exchanger. b) Complete records of these routine repairs shall be kept for review by the Inspector. The records shall include the number of tubes replaced or plugged and their location within the tube bundle.
Item 24-67; Item 26-04 Part 3, S3.4	**S3.4 ALTERATIONS** a) a) The requirements provided in this section shall apply, insofar as they are applicable to the materials discussed herein. Completed alterations shall be subjected to a pressure test that is no less than operating pressure and no more than maximum allowable working pressure. The test pressure shall be maintained for a minimum of 30 minutes. subjected to a pressure test not less than that required by the code of construction. The test pressure shall be maintained for a minimum of 30 minutes. The pressure shall be reduced to MAWP and maintained for inspection. b) All re-ratings shall be pressure tested in accordance with the original code of construction. The test pressure shall be maintained for a minimum of 30 minutes prior to inspection by the Inspector. Where the test pressure exceeds the MAWP of the item, the test pressure shall be

	reduced to the MAWP for inspection. Hold-time shall be as necessary to conduct the inspection. c~~b~~) Alteration of the spring design (e.g., change in stiffness or the initial compression) of a graphite shell-and-tube heat exchanger shall be done only after revised calculations have been prepared in accordance with the "R" Certificate Holder's Quality ~~Control~~ Management System and accepted by the Inspector. When the standard governing the original construction is any edition of the ASME Code, the calculations shall comply with Section VIII, Div. 1 2019 Edition or later. d~~c~~) The nameplate shall be applied in accordance with Section 5 of this part. The letter "G" shall be applied to the nameplate under the "R" stamp when graphite alterations are made. The alternate procedure defined in 5.10 may be used in lieu of the stamping and nameplate attachment requirements of NBIC Part 3, Section 5. e) Legible copies of the completed Form R-2, together with attachments, shall be distributed to the owner or user, the Inspector, the Jurisdiction if required, and the Authorized Inspection Agency responsible for inservice inspection. Form R-2 shall be registered with the National Board. Distribution of Form R-2 and attachments shall be the responsibility of the organization performing the repair. ~~d) Organizations performing alterations under an "R" stamp program shall register such alterations with the National Board.~~
Item 26-04 Part 3, S3.5.1, S3.5.2, S3.5.3	**S3.5.1 INTRODUCTION** a) This section is intended to provide suggested process and technique details for repairs. This section should be used as a guide by the repair organization in developing specific repair procedures. b) Damage to domes (heads), tubesheets, or nozzles is invariably a sign of improper installation, operation, or maintenance. Because such damage is random in nature, each case must be analyzed separately to determine the appropriate repair procedure, and the economics of repair versus replacement. c) All damage shall be examined and evaluated to determine the cause. Identification and elimination of the cause is helpful to prevent a recurrence. d) Most ~~i~~impervious graphite is a machinable material. Parts ~~can~~ may be modified or repaired in the field, or in a repair shop. e) Graphite parts that have previously been in service in one pressure vessel shall not be used in another vessel without prior approval of

	the Owner. Consideration should be given to the service condition of the previous process and possible contamination of the subsequent process. ~~c)~~f) A hydrophilic solvent, such as acetone or isopropyl alcohol, washed on the surface of the damaged part is useful in identifying the full extent of the cracks. The hydrophilic solvent will quickly evaporate from the surface, leaving the cracks damp and clearly visible. ~~d)~~g) Machining operations may be handled with high-speed steel tools. Extensive machining requires tungsten carbide or diamond tooling. No cooling or flushing fluid is required, nor should either be used. ~~e)~~h) Cleanliness is important. Dusty, dirty, and chemically contaminated surfaces prevent proper cement adhesion. Poor cement adhesion will result in a low strength joint or a joint which leaks. All surfaces should be neutralized to a pH of 7. Graphite parts should be cleaned and washed with acetone to remove all moisture. i) Cementing procedure specifications shall be qualified by the repair organization as required by the code of construction. Cementing procedure qualification shall be verified by the Inspector. j) Cementing technicians shall be qualified by the repair organization as required by the code of construction. A cementing technician is any individual who is responsible for proper joint preparation, cleaning parts to be joined, mixing cement, applying cement, securing the joint during the curing process, and controlling the curing process. k) Reimpregnation may be used on impregnated graphite materials to reduce porosity in an existing graphite component, which will improve the performance and expected life of the component. Reimpregnation of graphite shall not be considered a means to restore original strength or depth of impregnation, nor shall it be performed on compound materials. l) Blind cracks and delaminations shall not be repaired by cement injection only. m) Cracks and porosity in tubes shall not be repaired. Cracked and porous sections may be removed so that the remainder of the tube may be used. (See NBIC Part 3, S3.5.7) n) Cracks and porosity in graphite plates used in plate heat exchangers shall not be repaired. o) Completed repairs shall be subjected to a pressure test. The test pressure shall not be less than operating pressure or more than maximum allowable working pressure. The test pressure shall be maintained for a minimum of 30 minutes. p) All records shall be made available to the Inspector.

~~f) All damage shall be examined and should be evaluated to determine the cause. Identification and elimination of the cause is essential in helping to prevent a recurrence.~~

~~g) A hydrophilic solvent wash on the surface of the damaged part is useful in identifying the full extent of the cracks. The hydrophilic solvent will quickly evaporate from the surface, leaving the cracks damp and clearly visible.~~

FIGURE S3.5.1-b
TYPICAL TUBE REPLACEMENT USING SLEEVE AND INSERT AT TUBESHEET JOINT

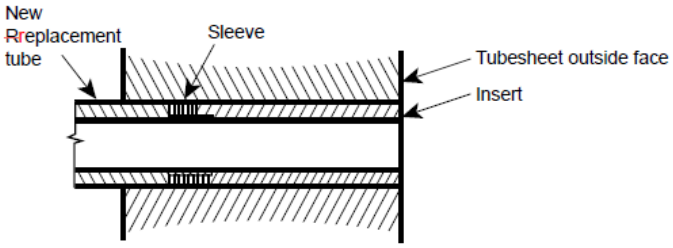
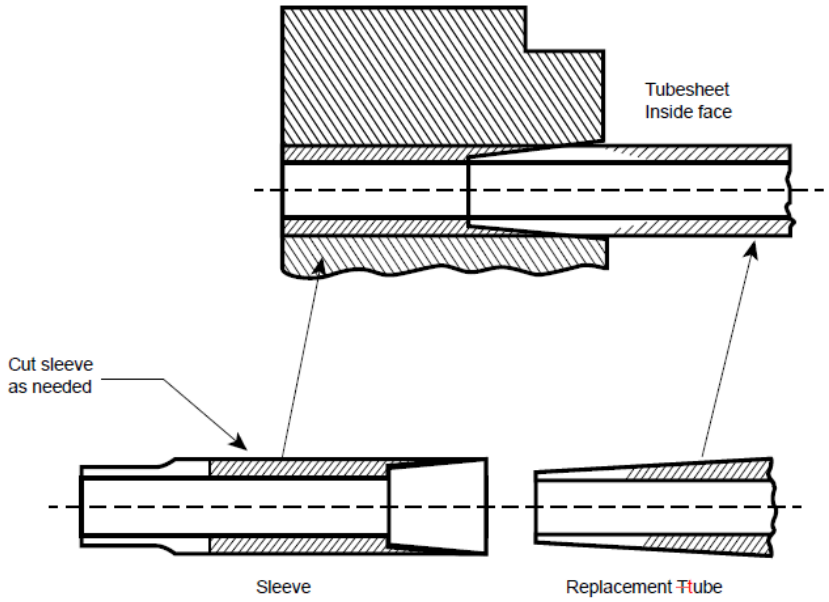


FIGURE S3.5.1-c
TYPICAL TUBE REPLACEMENT USING SLEEVE AT TUBESHEET JOINT



S3.5.2 TYPICAL GRAPHITE CEMENT JOINTS

FIGURE S3.5.2-a
TUBE TO TUBESHEET JOINTS

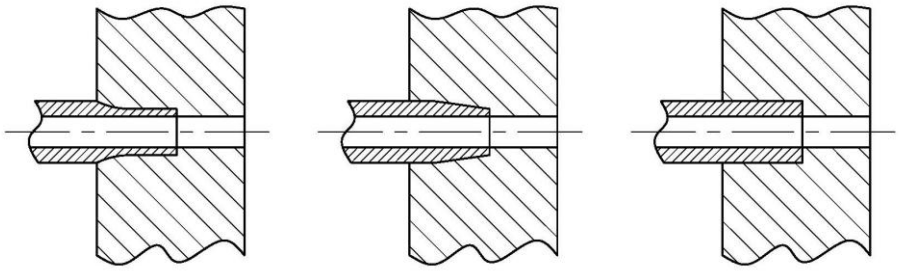


FIGURE S3.5.2-b
TUBE TO TUBE JOINTS

FIGURE S3.5.2-b
CYLINDER SEAM JOINT

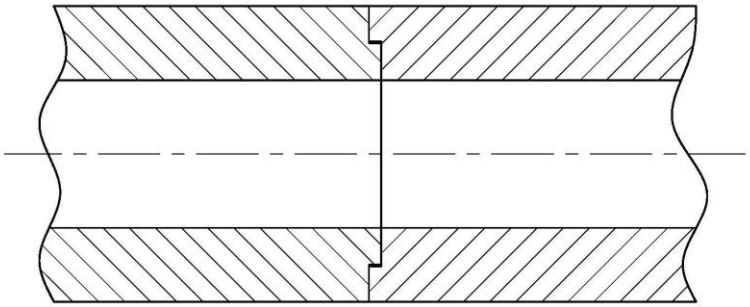
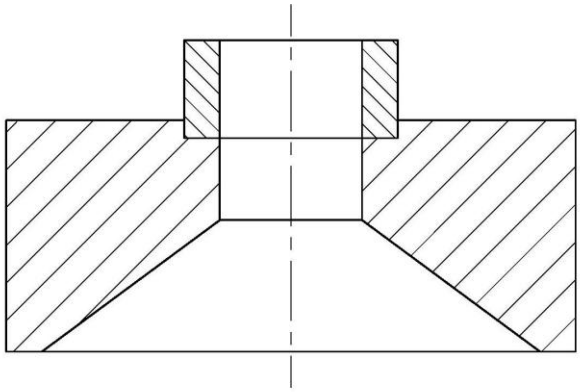
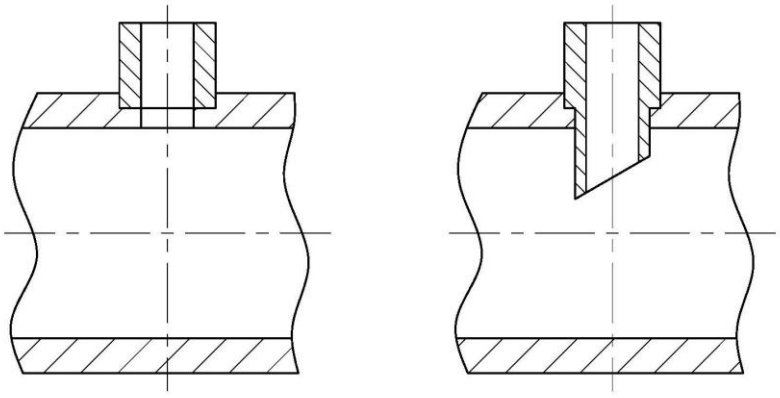


FIGURE S3.5.2-c
NOZZLE JOINTS





~~FIGURE S3.5.1-a~~

~~TYPICAL TUBE-TUBESHEET JOINTS~~

~~FIGURE S3.5.1-b~~

~~TYPICAL TUBE REPLACEMENT USING SLEEVE AND INSERT AT TUBESHEET JOINT~~

~~FIGURE S3.5.1-c~~

~~TYPICAL TUBE REPLACEMENT USING SLEEVE AT TUBESHEET JOINT~~

~~FIGURE S3.5.1-d~~

~~TYPICAL TUBE-TUBE JOINT~~

~~FIGURE S3.5.1-e~~

~~TYPICAL EDGE REPAIR MATERIAL INLAY~~

~~FIGURE S3.5.1-f~~

~~TYPICAL NOZZLE CONNECTION~~

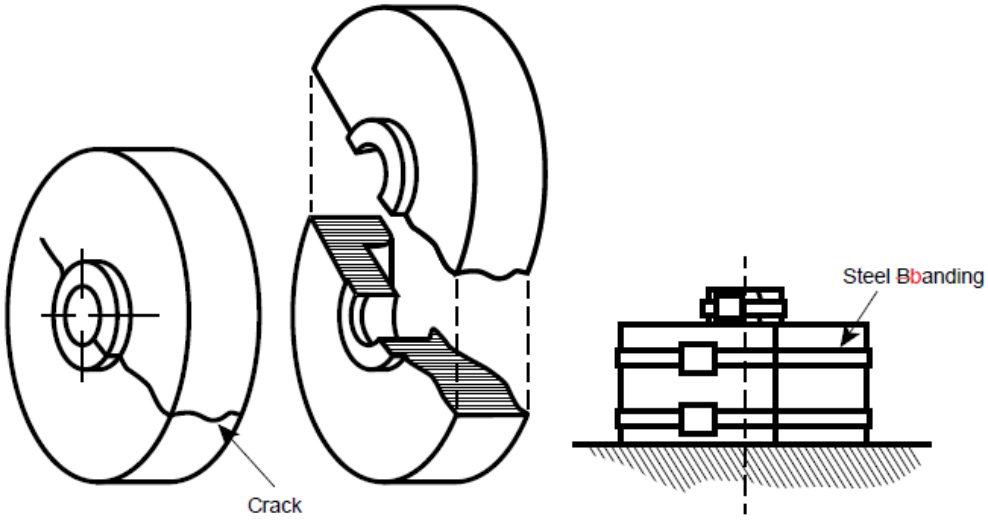
S3.5.3~~2~~ TYPICAL GRAPHITE FRACTURES

S3.5.3~~2~~.1 MAJOR FRACTURE

~~An extensive~~ A major fracture, such as shown in NBIC Part 3, Figure S3.5.3~~2~~.1, is best repaired by completing the break and re-cementing the two pieces. Temporary steel banding around the circumference is a method of clamping the repair until the cement is cured.

FIGURE S3.5.3~~2~~.1

EXAMPLE OF ~~EXTENSIVE~~ MAJOR FRACTURE AND REPAIR



S3.5.3~~2~~.2 INTERMEDIATE FRACTURE

If the break is too minor to warrant completing the fracture, a pie-shaped cut may be made and the segment re-cemented in place. (See NBIC Part 3, Figure S3.5.3~~2~~.2)

FIGURE S3.5.3~~2~~.2

EXAMPLE OF INTERMEDIATE FRACTURE REPAIR

S3.5.3~~2~~.3 MINOR FRACTURES AND DAMAGE

	Minor fractures, cracks, gouges, or surface erosion may be repaired using methods provided in this supplement. ~~For minor fractures, such as those shown in NBIC Part 3, Figure S3.5.2.3, plug stitching can be used. The crack is removed by drilling and plugging a continuous chain of overlapping holes along the length and depth of fracture.~~ ~~**FIGURE S3.5.2.3**~~ ~~**EXAMPLES OF MINOR FRACTURE REPAIR**~~
Item 25-62; Item 26-04 Part 3, S3.5.4	**S3.5.~~2~~.4 ~~FINISHING THE REPAIR~~GRAPHITE REPAIR PROCEDURES** ~~a) The parts should be held in place to prevent movement while curing the cemented joint to achieve a proper repair. The repair firm shall take care to ensure that the cement joint thickness is within the range recommended by the cement manufacturer. Care spent in precisely aligning the parts while clamping will avoid many finishing and machining operations later. Particular attention should be given to gasket and other bearing surfaces.~~ ~~b) Gasket and bearing surfaces may have to be machined, filed, or sanded before the job is completed. Gasket serrations must be clean and continuous. Serrations can be easily re-cut into graphite and any repair plugs that cross the gasket surface.~~ **S3.5.4.1~~3~~ GRAPHITE REPAIR BY PLUG STITCHING** a) Plug stitching is a form of repair by material inlaying. In this case, the inlays are small cylindrical impervious graphite plugs. The crack or fracture is removed by drilling and plugging a continuous series of overlapping holes along its length and depth. b) Most plug stitching is done with 7/8 in. (22 mm) diameter plugs. The plugs are laid out along the fracture line on a pitch of 5/8 in. (16 mm) centers. The overlap of plug material is 1/4 in. (6 mm) along the fracture line. A number of plug sizes are available and are used in repair, and the amount of overlapping is proportional to their diameters. **FIGURE S3.5.4.1~~3~~** **S3.5.~~43~~.1.~~11~~ PLUG STITCHING PROCEDURE (SEE NBIC PART 3, FIGURE S3.5.4.1~~3~~)** **…** k)) Cure the graphite cement according to the cement manufacturer's ~~instructions~~specification. …

~~**S3.5.3.2 FIGURES - TYPICAL PLUG STITCHING PROCEDURE**~~

~~**Step one: Lay out hole centers.**~~

~~**Step two: Drilling pilot holes.**~~

~~**Step three: Drilling the first set of holes.**~~

~~**Step four: Cementing and curing the first set of plugs.**~~

~~**Step five: Drilling the second set of holes.**~~

~~**Step six: Plug stitching repair completed.**~~

S3.5.4.2 PLUGGING OF LEAKING OR DAMAGED TUBES OR BLOCK HOLES

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

…

f) As an alternative to S3.5.4.2 e) any "R" Certificate Holder, with or without the Graphite ("G") Designator included on their "R" Certificate of Authorization, may install graphite plugs for a single repair operation, provided the "R" Certificate Holder ~~obtains the concurrence of the Inspector and~~ utilizes a ~~tube~~ plugging qualification kit provided by an ASME Certificate Holder authorized to use the "G" Designator. The kit shall include the following items:

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

1~~2~~) The qualified cementing procedure of the ASME Certificate Holder authorized to use the "G" Designator, and a step-by-step procedural checklist that shall be followed explicitly. The cementing procedure shall address the entire ~~tube~~ plugging process including materials, ~~-~~plug configuration, ~~tube~~ hole cleaning and preparation, mixing and application of the cement, application of the plugs, securing the plugs during the curing process, controlling the curing process, and leak testing, thereby meeting the requirements of S3.3.

~~3~~2) Additional materials and the cementing procedure shall be provided and used to prepare a demonstration plug joint prior to performing the repair being performed. This demonstration plug joint shall be tested by a twist (torsional) test designed to demonstrate acceptable application and curing of the cement (Figure S3.5.4.2). The test procedure shall include acceptance criteria, which may be based on a principle of breakage of part of the test piece. A successful twist test, in conjunction with the

completed procedural checklist, shall serve as a valid cement technician certification for a single repair operation. The twist test shall be witnessed by the Inspector. The “R” Certificate Holder shall review the material certifications, including verification that the shelf life of the cement has not been exceeded. They shall also ensure that the certified cement technician has completed the qualification demonstration, and has access to the cementing procedure and checklist. Prior to accepting the repair plan, the Inspector shall review and verify that the qualified cementing procedure has been completed and that the other elements of the certified kit have been provided by the ASME Certificate Holder authorized to use the “G” Designator, have been administered and completed prior to his acceptance. The “R” Certificate Holder shall note the installation of cemented graphite plugs in accordance with S3.5.4.2 in the "Description of Work" section of Form R-1. The “G” Designator shall not be applied to the vessel when this alternative repair is performed. The “R” Certificate Holder shall identify and document the location of the plugs on the Form R-1.

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

i) Once the plugging is completed and before the cement cures, the plugs may need to be held in place as newly cemented plugs exhibit a tendency to dislodge from the holes prior to final curing of the cement.

j) Curing time is dependent upon the cement manufacturer’s ~~instructions~~ specification and is considered complete when the cement is hardened to the point that ~~it cannot be indented with pressure~~ force from a standard screwdriver or other similar instrument is unable to indent the cement.

k) After the cement is completely cured, the ~~plugged, cemented~~repaired area(s) on the tubesheet/block surface may be dressed with sandpaper or other suitable abrasive.

l) ~~Repaired tubes or block holes –~~The repair shall be tested in accordance with NBIC Part 3, using a method acceptable to the Inspector, with a written procedure as approved by the manufacturer’s internal Quality Management System, to ensure leaks have been repaired.

m) The scope of the work completed shall be described and reported on a Form R-1. When the work is performed in accordance with S3.5.4.2 f), the “R” Certificate Holder shall note in the “Remarks” section of Form R-1: “Repaired in accordance with NBIC Part 3, S3.5.4.2 f).”

FIGURE S3.5.4.2

DEMONSTRATION PLUG JOINT TWIST TEST

S3.5.4.3~~5~~ TUBE REPLACEMENT

Tube replacement should be performed with the unit preferably in the horizontal position. Avoid replacing adjacent tubes simultaneously because the replacement areas may overlap or reduce the ligament between holes and possibly damage the tubesheet. The general steps used in horizontal tube replacement follow below.

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

b) Tube replacement shall be performed by qualified cementing technicians, using qualified cementing procedures, in accordance with the requirements of the ASME ~~Boiler and Pressure Vessel~~BPV Code, Section VIII, Division 1, Part UIG~~ 79 and UIG-80~~.

c) Determine the thickness of each tubesheet and inside distance between the tubesheets to obtain tube and sleeve length.

d) Access each tubesheet face, clearly identify and mark each tube hole on each tubesheet of the tubes to be replaced.

e) Prepare/clean the existing tube hole in preparation for extracting the damaged tube. Some holes may contain plugs which require removal. A boring tool slightly larger than the outside diameter of the tube being replaced is required.

f) Drill/bore out the tube hole in each tubesheet to release the tube from the tubesheet. Exercise caution when centering and align cutting to the common axis of the tube.

g) The damaged tube should disengage and become loose. Using guides, remove the damaged tube. Ensure that no debris is trapped in the space where the tube was removed (Fig. S3.5.4.3~~5~~-a).

h) Replacement tubes shall have a sleeve at each end, cemented into the bored holes to replace the material that was removed from the tubesheet to access the damaged tube (Fig. S3.5.4.3-b and S3.5.4.3-c).~~tube shall have sleeves at the ends cemented in the bored holes to replace the material in the tubesheet that was bored out to access the damaged tube (Fig. S3.5.5-b and S3.5.5-c).~~

   1) Dry-fit a new tube and sleeve.

   2) The sleeve length may vary.

   3) Prior to applying cement, prepare and clean all surfaces to be cemented.

i) Cement the ID of the prepared bore in the floating tubesheet

and the tube end OD at the fixed tubesheet. (Fig. S3.5.~~5~~4.3-b).

j) Insert the tube through the fixed tubesheet and through the floating tubesheet cemented bore so that it protrudes. Cement the ID of the fixed tubesheet bore as shown in (Fig. S3.5.4.3~~5~~-c). The use of alignment dowels can assist/guide in tube handling.

k) Cement the OD of the tube end protruding from the floating tubesheet. Cement the ID of the mating sleeve end, fit it to the cemented tube end and push the assembly part-way into the floating tubesheet. Cement the remainder of the OD of the floating tube end sleeve. Push this cemented assembly the rest of the way into the floating tubesheet (Fig S3.5.4.3~~5~~-c).

l) Cement the ID and OD of the sleeve for the fixed tubesheet and insert it until it mates with the tube end inside. Push together cemented tube/sleeve assemblies. (Fig S3.5.4.3~~5~~-d). Clean/wipe away any excess cement.

m) Apply ~~slight pressure~~ an appropriate force on the sleeves to seat the joints. Remove excess cement.

n) Maintain ~~pressure~~ the force and cure both ends of the cemented assembly according to the cement manufacturer's ~~instructions~~specification.

o) Sleeves may be trimmed after curing.

p) Replaced tubes shall be tested in accordance with this code per a written procedure acceptable to the Inspector.

q) The scope of work completed shall be described and reported on a Form R-1.

FIGURE S3.5.4.3~~5~~-a

CLEANED AND PREPARED TUBESHEETS

FIGURE S3.5.4.3~~5~~-b

STARTING TUBE REPLACEMENT

FIGURE S3.5.4.3~~5~~-c

SLEEVE CEMENTING

FIGURE S3.5.4.3~~5~~-d

COMPLETED TUBE REPLACEMENT

S3.5.4.4 REPAIR OF CRACKED OR DAMAGED TUBES

Cracks, porosity, or other damage in tubes shall not be repaired; however, a damaged portion of an individual tube may be removed and replaced with new tube segment.

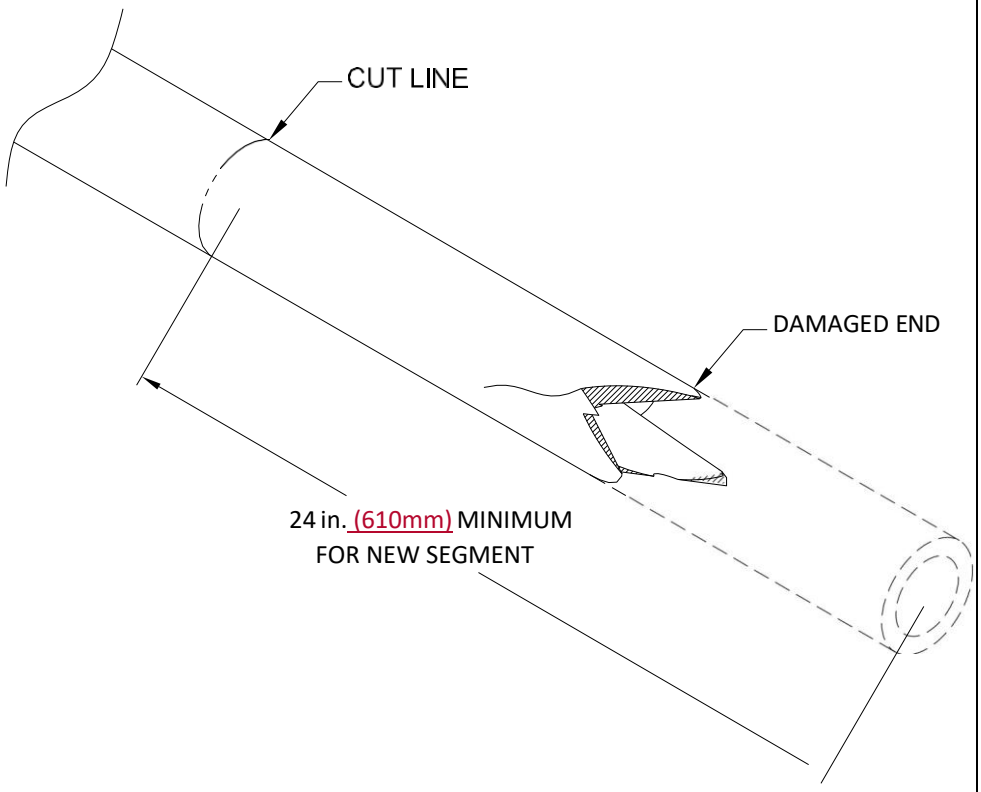
a) Individual tube segments shall not be less than 24 in. (610 mm) in length.
b) The number of segments in a repaired tube shall not exceed the quantity shown in Table S3.5.4.4.
c) Tube repair shall be performed by qualified cementing technicians, using qualified cementing procedures, in accordance with the requirements of ASME BPV Code, Section VIII Division 1, Part UIG.
d) Tube segment ends shall be cleaned and prepared for cementing per the manufacturer's specification for a tube to tube joint.
e) Cement shall be applied to the joint surfaces on each segment and the segments joined with an appropriate force applied on each tube end. See Figure S3.5.4.4.
f) Maintain the force on both ends and cure the cemented assembly according to the cement manufacturer's specification.
g) Repaired tubes shall be tested in accordance with this code per a written procedure acceptable to the Inspector.
h) The scope of work completed shall be described and reported on Form R-1

TABLE S3.5.4.4

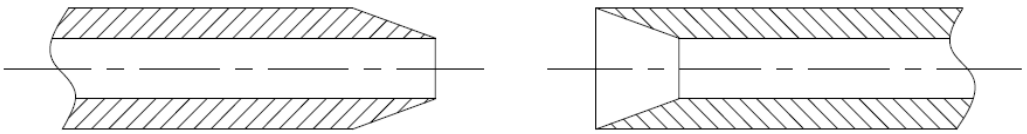
PERMITTED QUANTITY OF TUBE SEGMENTS

Total Tube Length, ft. (m)	Number of Tube Segments	Number of Joints
6 (1.8)	1	0
9 (2.7)	2	1
12 (3.7)	3	2
14 (4.3)	3	2
16 (4.9)	4	3
18 (5.5)	4	3
20 (6.1)	4	3
22 (6.7)	4	3
24 (7.3)	5	4
27 (8.2)	5	4

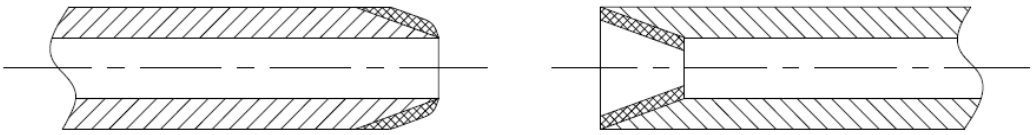
FIGURE S3.5.4.4 TUBE REPAIR

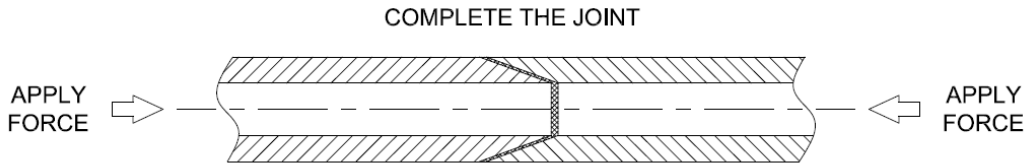


CLEAN AND PREPARE TUBE ENDS



APPLY CEMENT TO BOTH SURFACES





(25) S3.5.4.5~~6~~ REPAIR OF CROSS-DRILLED BLOCKS

Cross-drilled blocks are solid impervious graphite forms, drilled through in offset (non-intersecting) perpendicular patterns to isolate two different operating fluids.

a) Cross-drilled blocks can experience failure in a cross ligament, due to ~~a~~ cracks or erosion, that leads to fluid transfer between the opposing chambers. The general steps used to repair a cross-drilled block that is transferring fluid follow below.

1) Isolate one chamber sufficiently to perform a pressure test.

2) Test the isolated chamber.

3) Check the opposing chamber for affected holes.

4) Identify and mark any leaking holes.

5) Plug all leaking holes per S3.5.4.2.

b) During visual inspection of a cross-drilled block, same chamber ligament cracking can be identified. To prevent crack propagation, the affected area can be repaired by material inlaying, or the affected holes can be plugged per S3.5.4.2.

c) Surface erosion may be repaired by material inlaying. (See NBIC Part 3, S3.5.4.6)

d) Damage to gasket surfaces may be repaired per S3.3 a) 2) or by material inlaying. (See NBIC Part 3, S3.5.4.6)

e) When a modular multi-block type of cross-drilled block is confirmed to be transferring fluid, is showing visible ligament cracking, or has visible surface erosion damage, it shall be tested as required in S3.5.4.5~~6~~ a). Segments determined to be free of damage may be re-used after cutting away the damaged segment(s). The portion of the block that was removed shall be replaced.

SUPPL. 3

FIGURE S3.5.4.5-a~~6~~

~~REPAIR OF~~TYPICAL CROSS-DRILLED BLOCKS

FIGURE S3.5.4.5~~6~~-b~~d~~

REPAIR OF MODULAR MULTI-BLOCK TYPE CROSS-DRILLED BLOCK ~~(DAMAGED GASKET SURFACE)~~

S3.5.4.6 REPAIR BY MATERIAL INLAY

Surface damage, such as cracks, gouges, or erosion can be repaired by removing the damaged area and replacing it with new material.

a) Material inlay repair shall be performed by qualified cementing technicians using qualified cementing procedures in accordance with the requirements of ASME BPV Code, Section VIII Division 1, Part UIG.

b) The damaged area shall be inspected thoroughly to determine the extent of the damage and the size of the area to be removed.

c) The damaged area shall be removed completely so that an inlay piece of a simple shape (cylindrical, rectangular, or wedge shaped) can be used. The size and shape of the area removed shall be appropriate to allow proper cement joint clearance per the manufacturer's specification.

d) The surfaces on the part, as well as the inlay, shall be clean, dry, and prepared for cementing per the manufacturer's specification. If the surfaces are smooth, they should be slightly roughened for better cement adhesion.

e) Cement shall be applied to the joint surfaces on each part, and the parts joined with an appropriate force applied to the inlay.

~~a)~~f) Maintain the force and cure the cemented assembly according to the cement manufacturer's specification.

~~b)~~g) After the cement has cured, the finished part may be sanded, filed, or machined to match the existing geometry and ensure flush surfaces, as required. Extra attention should be given to gasket and bearing surfaces. Gasket serrations must be clean and continuous.

h) Repaired parts shall be tested in accordance with this code per a written procedure acceptable to the Inspector.

i) The scope of work completed shall be described and reported on Form R-1.

FIGURE S3.5.4.6-a

IDENTIFY EXTENT OF DAMAGE

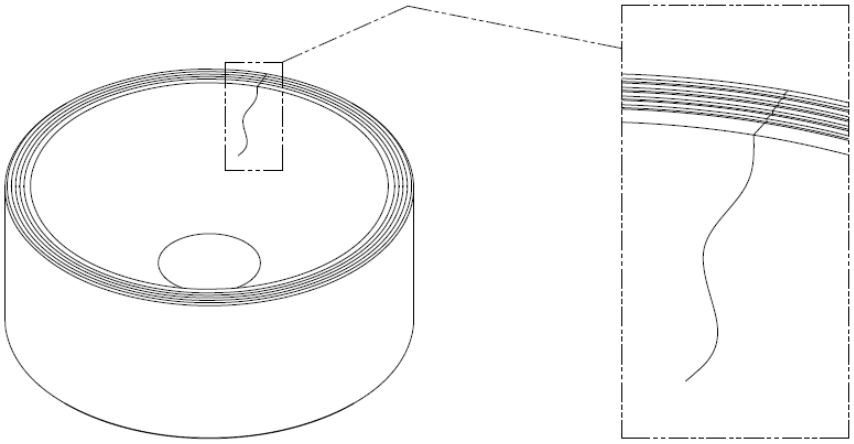


FIGURE S3.5.4.6-b
REMOVE DAMAGED MATERIAL

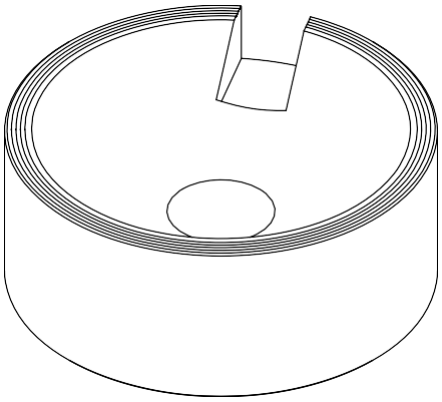


FIGURE S3.5.4.6-
c APPLICATION
OF CEMENT

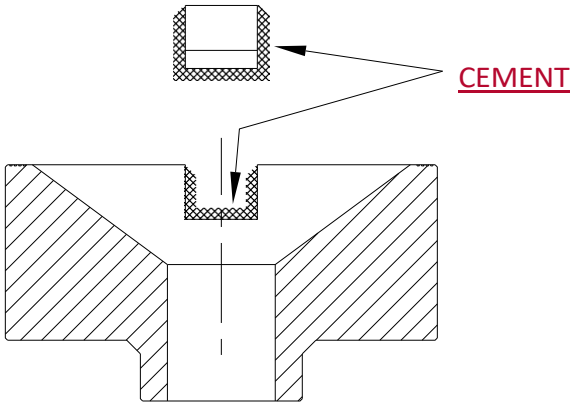


FIGURE S3.5.4.6-d FINISHING THE JOINT

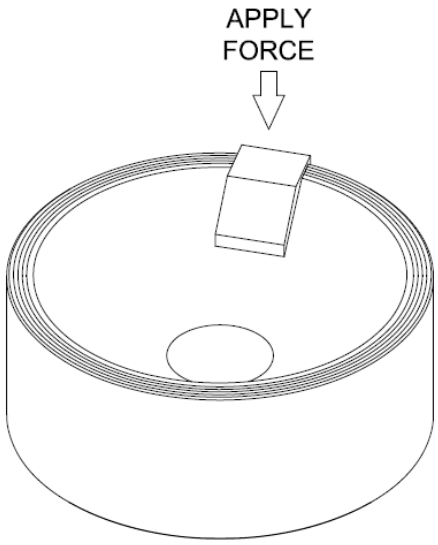
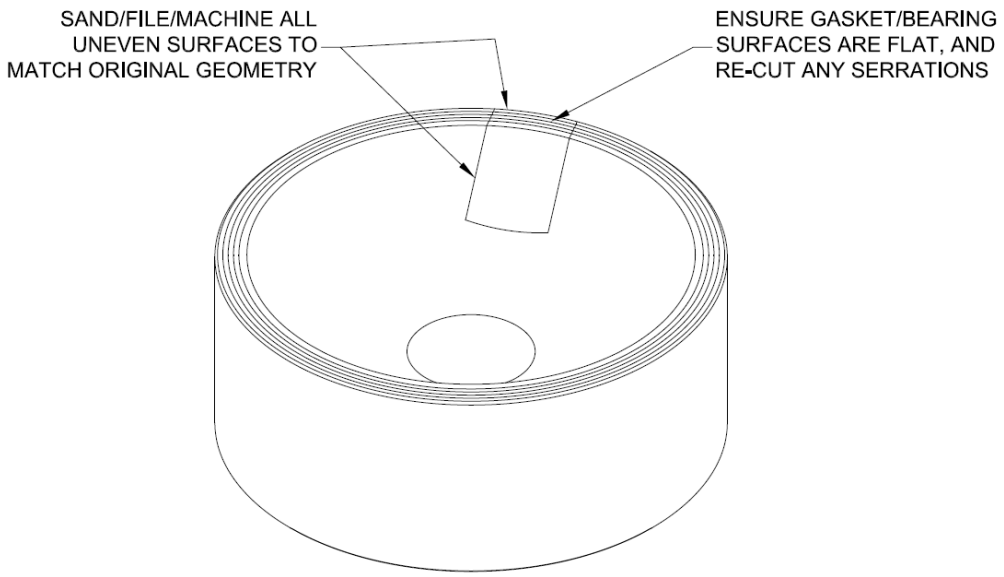


FIGURE S3.5.4.6-e
FINAL CLEAN-UP



S3.5.4.7 NOZZLE REPLACEMENT

Nozzles with cracks, gouges, or other damage can be replaced, partially or completely, by removing all, or part, of the damaged nozzle material and replacing it. Care should be taken to ensure all of the damaged material is removed to prevent recurrence.

a) Nozzle replacement shall be performed by qualified cementing technicians, using qualified cementing procedures, in accordance with the requirements of ASME BPV Code, Section VIII Division 1, Part UIG.

b) Nozzles shall be inspected and evaluated to determine the extent of the damage, and the level of repair required, from partial to complete replacement.

c) The damaged nozzle, or nozzle portion, shall be removed completely. A counterbore or boss may be required per the manufacturer's specification for the joint design.

d) The remaining joint surface of the existing part, as well as the replacement nozzle or nozzle portion, shall be cleaned and prepared for cementing per the manufacturer's specification.

e) Cement shall be applied to all joint surfaces on each part, and the parts assembled with an appropriate force on the face of the nozzle.

f) Maintain the force on the face of the nozzle and cure the cemented assembly according to the cement manufacturer's specification.

g) Repaired or replaced nozzles shall be tested in accordance with this code per a written procedure acceptable to the Inspector.

h) The scope of work completed shall be described and reported on Form R-1.

FIGURE S3.5.4.7-a

IDENTIFY EXTENT OF DAMAGE

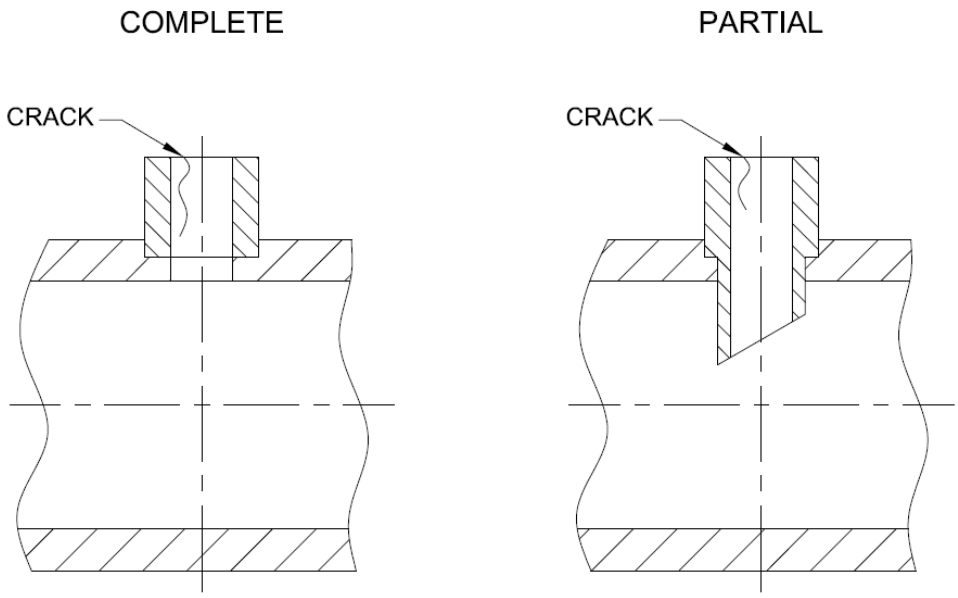


FIGURE S3.5.4.7-b

REMOVE DAMAGED MATERIAL

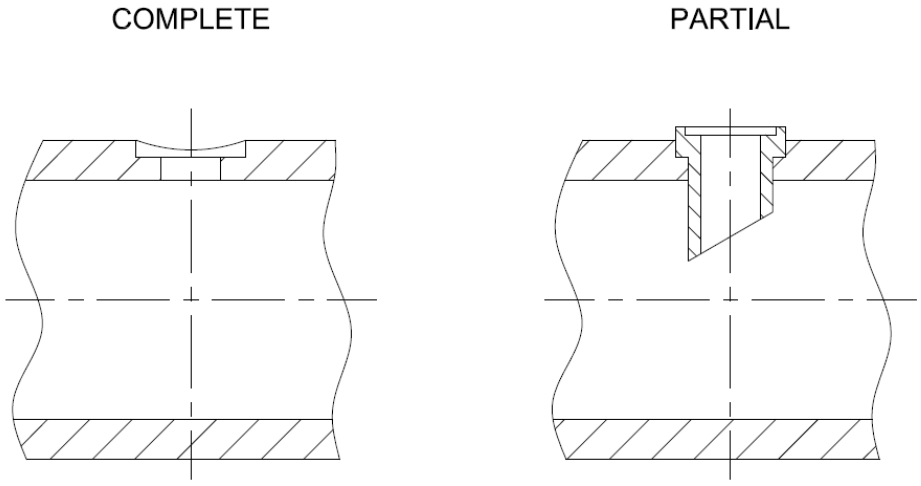


FIGURE S3.5.4.7-c

APPLICATION OF CEMENT

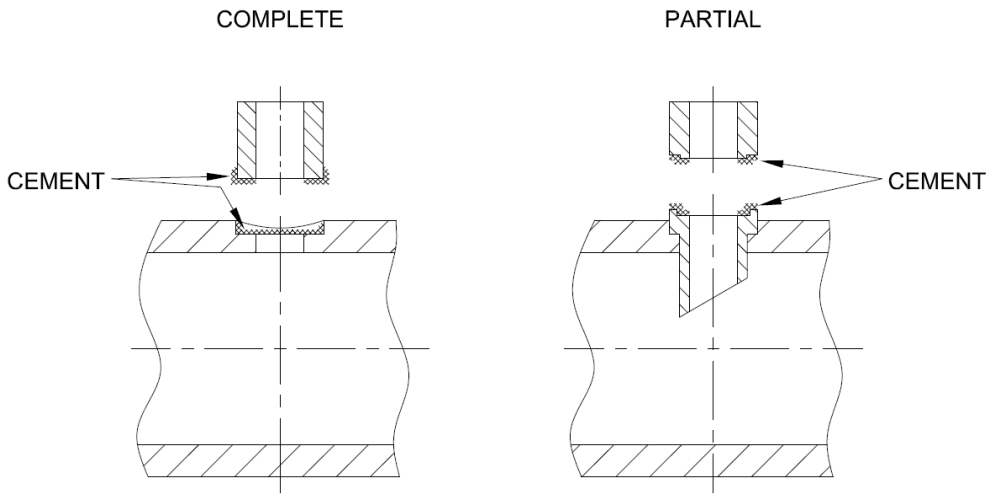
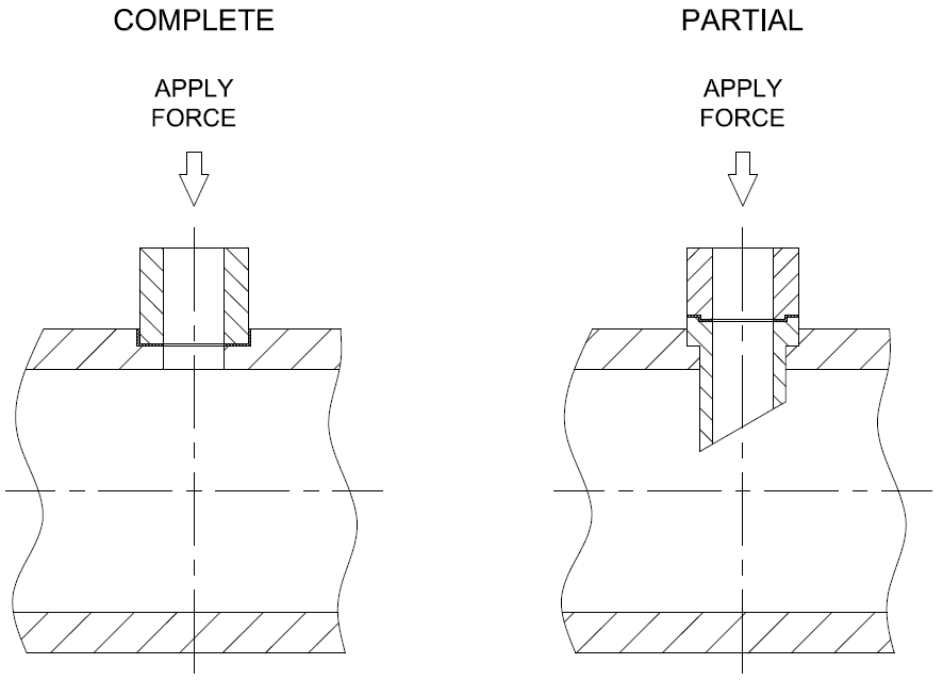


FIGURE
S3.5.4.7-d
FINISHING
THE JOINT



S3.5.4.8 FINISHING CEMENTED REPAIRS

a) The parts should be held in place to prevent movement while curing the cemented joint to achieve a proper repair. The “R” Certificate Holder shall take care to ensure that the cement joint thickness is within the range recommended by the cement manufacturer. Effort invested in

precisely aligning the parts while clamping will avoid many finishing and machining operations later. Particular attention should be given to gasket and other bearing surfaces.

b) Gasket and bearing surfaces may have to be machined, filed, or sanded before the job is completed. Gasket serrations must be clean and continuous. Serrations can be easily re-cut into graphite and any repair plugs or cement that cross the gasket surface.

S3.6~~5.7~~ REIMPREGNATION OF IMPREGNATED GRAPHITE PARTS (TUBESHEETS, HEADS, AND BLOCKS)

a) As a function of time, temperature, and chemical exposure, the resin used to impregnate graphite may shrink and/or degrade. As such, it is possible for voids to develop in impregnated graphite that has been in chemical service for a period of time. The resin loss can vary from slight to almost complete loss of impregnation. There is no practical way to determine the amount of resin remaining in the pores. However a pressure test will determine if the graphite has continuous porosity.

b) Reimpregnation of an impregnated graphite component may be used to reduce porosity in the component which in turn will improve the performance and expected life of the component. A written re-impregnation procedure acceptable to the Inspector is required. The reimpregnation procedure shall include as a minimum:~~of a graphite component may be used to reduce porosity in an existing graphite component, which in turn will improve the performance and expected life of the existing graphite components. A written re-impregnation procedure acceptable to the Inspector is required. The reimpregnation procedure shall include as a minimum:~~

1) Decontamination and drying of the graphite component;

2) Subjecting the component to a vacuum;

3) Impregnation material;

~~3)~~4) Introducing ~~resin~~ impregnation material under pressure;

~~4)~~5) Curing the ~~resin~~ impregnation material at a specified temperature and time; and

~~5)~~6) Leak test.

S3.6.1~~5.7.1~~ CONTROL OF IMPREGNATION MATERIAL

a) Impregnation material shall be the same as that specified in the

	Reimpregnation Procedure. Each impregnation material shall be traceable by the name of its manufacturer and the trade name or number of that manufacturer. b) The impregnation material manufacturer shall supply the Certificate Holder with a Certificate of Analysis for each material. It shall include the following: 1) Impregnation material identification; 2) Batch number(s); 3) Date of manufacture; 4) Shelf life; 5) Viscosity per ASTM D 2393; and 6) Specific gravity. c) Prior to reimpregnation, and at subsequent intervals not to exceed 14 days, the Certificate Holder shall test each batch of impregnation material to assure that the characteristics of the material have not changed from values specified in the Reimpregnation Procedure. The values obtained for viscosity and specific gravity for the impregnation material shall be within the limits specified by the manufacturer and as listed in the Reimpregnation Procedure. The test values shall be made available to the Inspector.
Item 25-29 Part 3, S5.6.3 e)	Cast iron shell surface imperfections may be repaired with smooth, driven plugs as described in ASME BPVC Section VIII, Division ~~.~~ 1, UCI-78, with the following additional requirements: a) Maximum plug length (depth) shall be limited to 20% of shell effective thickness, and plug diameter shall not exceed the plug length (depth); b) Total surface area of plugs shall not exceed 4 ~~sq.~~ in.^{2} in an 8 in. diameter circle (2580 ~~sq.~~ mm^2 in a 200 mm diameter circle); c) Average number of shell plugs shall not exceed ~~1~~ one plug per 1 ~~sq.~~ ft^2 ~~.~~ (~~1~~ one plug per 0.1 ~~sq.~~ m^2) of the surface; … e) The plug material shall conform in all respects to the material specification of the base ~~material~~metal;
Item 25-75 Part 3, S5.7.2 b)	**S5.7.2 ALTERATION TYPES** b) Alteration plans to yankee dryers shall be accepted by the ~~Inspector~~Authorized Inspection Agency/Owner-User Inspection Organization whose inspector will

	make the acceptance inspection and sign the Form R-2, and when required, by the Jurisdiction, prior to the start of work.
Item 25-29 and Editorial Part 3, S6.11 b) and c)	b) For hydrogen control when low-alloy steel ~~filler metals~~weld consumables are used, the ~~filler metal~~ classification shall include an H4 supplemental diffusible hydrogen designator (maximum 4 ml [H_2]/100 g deposited metal) for each of the following welding processes: 1) ~~electrodes for~~ shielded~~-~~ metal arc welding (SMAW) conforming to SFA-5.5; 2) ~~electrodes and fluxes for~~ submerged arc welding (SAW) conforming to SFA-5.26; 3) ~~electrodes and rods for~~ gas~~-~~ shielded metal arc welding (GMAW) conforming to SFA-5.28; 4) ~~electrodes for~~ flux ~~-~~cored arc welding (FCAW) conforming to SFA 5.29. c) Practices used for controlling storage and exposure of ~~filler metals~~weld consumables shall be those developed by the "R" Certificate Holder or those recommended by the ~~filler metal~~weld consumable manufacturer.
Item 25-53 Part 3, S7.4	***S7.4 REQUIREMENTS FOR REPAIRS AND ALTERATIONS*** a) Refer to NBIC Part 3, Section 3 for all applicable post-construction activities pertaining to requirements for repairs and alterations. Excluded is ~~NBIC Part 3, 3.3.4.8~~S11.2.2, *Repair of Pressure-Retaining Items Without Complete Removal of Defects*. b) Radiographic or ultrasonic examinations are ~~considered to be~~ suitable alternative nondestructive examination methods to ensure complete removal of ~~the~~ a defect, as described in ~~NBIC Part 3,~~ 3.3.4.1.
Item 24-93 Part 3, S8	SUPPLEMENT 8 WELD AND POST-REPAIR INSPECTION OF CREEP STRENGTH ENHANCED FERRITIC STEEL PRESSURE-RETAINING ITEMS ~~EQUIPMENT~~
Item 25-85, Item 26-31 Part 3, S8.1 a) and editorial (S8.1)	a) The technical information provided in this supplement pertains to weld repair and post-repair inspection of creep strength enhanced ferritic steel (CSEF) pressure-retaining items. ~~The present~~This guidance covers P-No. 15E, Group 1 or P-No. 5B, Group 1~~, Grade 91~~ and dissimilar welds made to either~~this~~ material (e.g., P-No. 4, P-No. 5A, ~~or~~ P-No. 8, P-No. 42, P-No. 43, or P-No. 45). This s~~S~~upplement provides guidance for ~~full penetration and partial penetration~~ weld repairs not ~~covered under~~specified in Welding Method 6 (NBIC Part 3, 2.5.3.6) or Welding Method 7 (NBIC Part 3, 2.5.3.7). b) ~~Creep strength enhanced ferritic (~~CSEF~~)~~ alloys are a collection of ferritic steels whose creep strength is enhanced by the creation of a precise condition of micro-structure, specifically martensite or bainite, which is stabilized during tempering by controlled precipitation of temper-resistant carbides, carbo-nitrides, or other stable or meta-stable phases. Careful consideration shall be

	given to pressure-retaining items that are fabricated from CSEF steels. These materials may exhibit fracture toughness and/or fatigue behavior when subjected to low temperatures~~.,~~ ~~a~~And when subjected to high temperatures, they may exhibit creep and/or creep-fatigue behavior ~~when subjected to high temperatures~~. These materials and components can be degraded if welding procedures are not adhered to or if postweld heat treatment (PWHT) is improperly applied. Experienced inspection personnel should oversee weld repairs of this nature for strict compliance with all welding procedure and repair requirements. c) Post-~~-~~construction access and in-~~-~~service operation may not allow the practicable application of PWHT following original construction fabrication requirements and repair weld joint design. This supplement provides guidelines for weld repair options and post-~~-~~repair inspection using a well-engineered approach for CSEF steels. The user is cautioned to seek technical guidance for welding and selection of heat ~~treating~~ treatment requirements. d) Prior to using ~~this~~ these guidelines, an engineering evaluation shall be performed to determine the scope of the repair and impact to safety prior to returning the pressure-retaining item to service for a specified period ~~of time~~, based on acceptance by the Inspector, and when required, the j~~J~~urisdiction. The organization performing the engineering evaluation shall have demonstrated experience with Grade 91 CSEF steels.
Item 25-29 Part 3, S8.2.1 b) and c) and Table S8.2.1	a) 9Cr-1Mo-VNbN Filler Metal (i.e., matching to Grade 91) + Controlled Fill + Low PWHT (Minimum temperature is 1250°F, 675°C). Acceptable filler materials are referenced in Table S8.2.1. The minimum time and maximum heat treatment temperature shall be in accordance with the original code of construction. For reference, where the Ni+Mn content of the filler metal is not known, the maximum PWHT temperature shall be 1425°F (775°C). This maximum shall be enforced to avoid over-tempering or exceeding the absolute maximum PWHT temperature. PWHT hold times at temperature shall be as follows: 1) Minimum holding time at PWHT temperature is specified as 1 hour per 1.0 inch (25 mm) of thickness, 30-~~-~~minute minimum provided the component < 0.5 inches (12.5 mm) in thickness; and … b) 9Cr-1Mo Filler Metal + Controlled Fill and No PWHT. Acceptable ~~filler materials~~weld consumables are detailed in Table S8.2.1.

c) Ni-ckel--base Filler Metal + Controlled Fill and No PWHT. Acceptable nickel--base weld consumables include selected ~~ASME F-~~F-No. 43 types per ASME BPVC Section IX, QW-432 ~~filler metals~~ as detailed in Table S8.2.1.

TABLE S8.2.1

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

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

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

Item 25-29 Part 3, S8.2.2 a) and b)

a) For repairs ~~in~~ of P-No. 15E, Group 1, Grade 91, CSEF steel ~~joined~~ welded to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45, as permitted for welded construction by the applicable rules of the original code of construction, the filler metal shall be limited to an austenitic, nickel-base ~~filler metal~~weld consumable having a designation F-No. 43 per ASME BPVC Section IX, QW-432 and limited to the following weld consumable classifications: A or SFA-5.14 ERNiCr-3, ~~or~~ or ERNiCrFe-4, A or SFA-5.11 ENiCrFe-3, ENiCrFe-2, or~~ERNiCrFe-4,~~ ENiCrFe-4, A or SFA 5.34 ENiCr3Tx-y, ENiCrFe2Tx-y, or ENiCrFe3Tx-y. This weld repair option does not require PWHT.

b) For repairs in P-No. 15E, Group 1, Grade 91, CSEF steel joined to P-No. 4, Group 1, or P-No. 5A, Group 1, the filler metal shall be limited to:

1) A martensitic, iron-base ~~filler metal~~weld consumable having a designation F-No. 4 or F-No. 6 per ASME BPVC Section IX, QW-432 and limited to the following ~~consumables~~weld consumable classifications: A or SFA-5.4 E8015-B8, E8018-B8, or A or SFA-5.28 ER80S-B8. This weld repair option does not require PWHT; or

2) A martensitic, iron-base ~~filler metal~~weld consumable having a designation F-No. 4 or F-No. 6 per ASME BPVC Section IX, QW-432 and limited to the following weld consumable classifications: A or SFA-5.5 E9015-B91, E9016-B91, E9018-B91, A or SFA

	5.29 E91T1-B91, or A or SFA-5.28 ER90S-B91. This weld repair option requires PWHT at a minimum temperature of 1250°F (675°C).
Item 25-29 Part 3, S8.3 e)	**S8.3 APPLICATION OF CONTROLLED FILL WELDING PROCEDURE** a) The minimum preheat for the repair procedure shall be 300 oF (150 oC). The preheat temperature shall be checked to ensure the minimum preheat temperature is maintained during all welding and until welding is completed. The maximum interpass temperature shall be 550 oF (290 oC). At the completion of welding, a post-weld hydrogen bake-out is ~~not~~ neither required nor prohibited. b) To control heat input, the weld repair shall be performed using a "controlled fill" technique. In this technique, the first layer in contact with the repair groove can be identical or smaller in diameter than the fill passes. c) Figures S8.3-a through S8.3-d illustrate the deposition of weld passes using the controlled fill technique for full- or partial--penetration weld repairs. This supplement is not restricted to the repair of girth welds. d) The fill passes should be deposited working from the bevel of the excavation towards the center of the excavation with a minimum overlap of 25% and ideally 50%. As a general rule ~~of thumb~~, if the welder aims for the toe of the previously deposited weld bead, an overlap of at least 40% will be achieved. e) When the SMAW process is specified, the weld beads deposited onto the base ~~material~~ metal shall not exceed a~~n electrode~~ weld consumable diameter of 1/8 in. (3.2 mm). The remaining fill passes shall not exceed an electrode diameter of 5/32 in. (4.0 mm). When the GTAW process is specified, any limits for ~~filler metal~~weld consumable size shall be reflected in the ~~qualified~~ procedure qualification record (PQR) and WPS.
Item 25-85 Part 3, S8.4 a) and editorial (S8.4)	a) The welding procedure qualification test coupon shall be ASME P-No. 15 E, Group 1 or P-No. 5B, Group 1 ~~, Grade 91~~ joined to itself, P-No. 4, P-No. 5A, P-No. 8, P-No. 42, P-No. 43, or P-No. 45. b) Qualification thickness for the test plates and repair groove depths shall be in accordance with ASME Boiler and Pressure Vessel Code (BPVC) Section IX. c) The Welding Procedure Specification ~~(WPS)~~ shall be qualified in accordance with the requirements of ASME BPVC Section IX. d) For qualification of weld repair procedures using 9Cr-1Mo filler metal and in the as-welded condition, the requirements for the bend test shall be performed using a bend radius which achieves a minimum of 14% elongation in the outer fibers.
Item 21-53 Part 3, S8.5	**S8.5 POST--REPAIR INSPECTION** ~~a) After the completion of weld repairs to CSEF steels, post inspection requirements shall be developed and implemented based on acceptance from the Inspector, and if applicable, the Jurisdiction.~~

	~~b) Post-repair inspection intervals and methods of examination shall be implemented to ensure safe operation and margin to locate and monitor defect growth in the weld repair area. The selected non-destructive examination method shall provide meaningful results and shall follow NBIC Part 3, Section 4.~~ ~~c) Post repair inspection shall be on-going until the component reaches end of life or is replaced. The Owner/User may revise the re-inspection interval based on inspection results from previous inspections.~~ a) A post-repair inspection plan shall be developed by the owner or user prior to the completion of the weld repairs to ensure continued safe operation of the pressure-retaining item.~~,~~ b) The post-repair inspection plan shall include but not be limited to: i. Method of examination~~,~~: ~~t~~The selected non-destructive examination method shall follow NBIC Part 3, Section 4~~.~~ ii. Examination intervals c) The post-repair inspection plan shall be subject to review and acceptance by the Repair Inspector, and if required, the ~~J~~jurisdiction. d) The post-repair inspection plan shall be referenced in the "Remarks" section of the Form "R" ~~r~~Report. The Form "R" ~~r~~Report shall be registered with the National Board. e) The owner or user may revise the inspection interval based on inspection results from previous inspections. f) Post-repair inspection shall be on-going until the component is removed or replaced.
Item 25-53 Part 3, Table S9.2 (19) and editorial	(19) Provide a detailed summary describing the scope of work that was completed to a pressure-retaining item ~~(PRI)~~. ~~The information to be considered w~~When describing the scope of work, one should consider includ~~e~~ing such items as:~~,~~ a. the nature of the repair (~~i.e.~~e.g., welding, bonding, cementing)~~;~~; b. the specific location of the work performed to the ~~PRI~~pressure-retaining item~~,~~; c. the steps taken to remove a defect (or ~~as~~ allow~~ed~~ed a defect ~~by 3.3.4.8~~ to remain in place per S11.2.2)~~,~~; d. the method of repair described as listed in the examples of ~~Part 3, Section 3~~3.3.3 or applicable supplement~~supplemental section if applicable,~~; and e. the acceptance testing and/or examination method used in accordance with

	the NBIC. ~~(19)~~ When additional space is required to describe the scope of work, an NB-231, Form R-4, *Report Supplement Sheet* shall be used and attached (check box). If a Form NB-403, *Report of Fitness-for-Service Assessment*~~FITNESS FOR SERVICE Form (NB-403)~~ is part of the Form R-1 repair package, check box and attach the form. Information determined to be of a proprietary nature need not be included~~,~~ but shall be stated on the form.
Item 25-53 Part 3, Table S9.3 (20) and editorial	(19) ~~The information to be considered w~~When describing the construction scope of work, one should consider includinge~~d~~ such items as~~,~~: a. the nature of the alteration (~~i.e.~~e.g., welding, bonding, cementing)~~;~~ b. the specific location of the work performed to the pressure-~~-~~retaining item~~;~~ c. the steps taken to remove a defect (or ~~as allowed by~~allow a defect to remain in place per ~~NBIC Part 3, Paragraph 3.3.4.8~~S11.2.2) ~~to remain in place;~~ and d. the method of alteration described as listed in the examples of ~~NBIC Part 3, Paragraph~~ 3.4.4 or applicable supplement. ~~(19)~~ When additional space is required to describe the construction scope, an NB-231, Form R-4, *Report Supplement Sheet* shall be used and attached (check box if needed).
Item 25-42; Item 25-59 Part 3, S11.1	**SUPPLEMENT 11** **ALTERNATIVE REPAIR AND ALTERATION METHODS** ~~**ENGINEERED ADVANCED REPAIRS AND ALTERATIONS**~~ **S11.1 SCOPE** a) This supplement provides requirements and guidelines for alternative repair and alteration methods to pressure-retaining items (PRI)s. The listed repair and alteration methods, along with any limitations and requirements, shall be used in conjunction with the applicable rules of the NBIC. b) All alternative repair and alteration ~~activities~~methods, as listed in this supplement, require acceptance by the Repair Inspector, and when required, the jurisdiction. The jurisdiction may require these activities to be performed by an organization accredited as an OUIO Certificate Holder in accordance with NB-371, *Accreditation of Owner-User Inspection Organizations*. c) An evaluation may be necessary for certain alternative repair and alteration methods to ensure safe operation of equipment and minimal risk to personnel. d) All alternative repair and alteration methods chosen shall be documented in the "R" Certificate Holder's Quality Management System (QMS).

e) Alternative repair and alteration methods are limited to those contained in this supplement.

~~a) All repair and alteration activities as listed in this supplement require acceptance by the Repair Inspector and, when required, the Jurisdiction.~~

S11.1.1 DAMAGE MECHANISM CONSIDERATIONS

a) When performing a repair or alteration, all credible damage mechanisms should be considered to ensure safety, reliability, and remaining life.

b) Brittle fracture is a concern that should be addressed when any repair or alteration requires pressure testing after it has been completed.

S11.1.2 MATERIALS OF CONSTRUCTION CONSIDERATIONS

a) Creep strength enhanced ferritic (CSEF) steels

~~1.~~ CSEF steels develop their original strength-based properties from specific heat treatment requirements. As such, for post-fabrication processing it is necessary to monitor controls on preheat, interpass temperature, and postweld heat treatment. This is to ensure adequate post-manufacturing strength properties of CSEF steels.~~CSEF materials whose properties are affected by post manufacturing processing may experience decreased tensile and creep strength properties as a result of failing to follow preheat and post weld heat treatment requirements and/or carefully monitor these processes." CSEF materials whose properties are affected by post manufacturing processing may experience decreased tensile and creep strength properties as a result of failing to follow specific weld procedure specifications and heat treatment requirements.~~

1.

~~Careful consideration should be given to the repair or alteration of PRIs that have been fabricated using CSEF materials or materials whose properties are enhanced by post manufacturing heat treatment or processing.~~

2. The user is cautioned to seek competent technical guidance when establishing welding and heat treatment requirements for CSEF materials. The repair nondestructive examination (NDE) and test methods should follow rules from the original code of construction.~~This supplement provides requirements and guidelines for engineered repairs and alterations to pressure-retaining items. These requirements shall be used in conjunction with the applicable rules of the NBIC.~~

S11.2 ~~ENGINEERED~~ ALTERNATIVE REPAIR METHODS

S11.3 ~~ENGINEERED~~ALTERNATIVE ~~-~~ALTERATION METHODS

Item 25-29 Part 3, S11.2.1 b) 4)	a) Pressure-retaining items that have localized internal thinning due to erosion and/or corrosion, and where the internal surface is not readily accessible, may be weld repaired by depositing weld metal on the external surface of the item as shown in NBIC Part 3, Figure S11.2.1-a. This method of repair is subject to approval by the Inspector, and, when required, jurisdiction. b) All of the following conditions shall apply for this repair method to be permitted: 1) The component to be repaired shall be a ferrous material; 2) The maximum design temperature of the repaired component shall not exceed 650°F (340°C), and the minimum design temperature shall not be less than -20°F (-29°C); 3) The pressure-retaining item shall be volumetrically examined for cracks in the area to be weld repaired. If cracks are detected, this repair method shall NOT *not* be used; 4) The WPS followed shall be qualified for weld metal buildup in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section IX. The nominal chemical analysis of the deposited weld metal shall be equivalent to the base material metal that is to be repaired. In addition, the nominal tensile strength of the deposited weld metal shall be equal to or exceed the specified minimum tensile strength and shall be based on the requirements of the weld consumable classification or specification. If butt welds in the component being overlaid required postweld heat treatment (PWHT) by the code of construction, the WPS followed for the weld buildup shall be qualified with PWHT;
Item 25-25, Item 25-53, Item 26-01 Part 3, S11.2.2 And editorial	**S11.2.2 Repair of Pressure-Retaining Items Without The Complete Removal of Defects** a) There may be cases instances where removal of a defect in a pressure-retaining item (PRI) is not practical at the time the defect is found. In such casesinstances, the defect may be left in place, with the approval acceptance of the Inspector, and, when required, the Jjurisdiction., Anan engineering evaluation shall be performed to aid in determinge the scope of the repair and impact to safety prior torisks associated with returning the pressure-retaining item PRI to service for a specified period of timewithout complete removal of the defect. 1) The engineering evaluation, as described in NBIC Part 2, 4.4.3, shall be performed by an organization with demonstrated competencey in defect (and flaw) characterizationfitness-for-service assessments (FFSA)s of pressure-retaining itemsPRIs.

2) The method of ~~defect evaluation and time interval for returning the pressure-retaining item back to service shall be as agreed upon by the Inspector, and when required, the j~~Jurisdiction analysis shall be determined by the organization performing the FFSA.

3) The specified period ~~of time~~ the defect can remain in service ~~after weld repair~~ shall be based on ~~no measureable defect growth during subsequent inspections,~~the remaining life calculated from the applicable FFSA~~,~~ ~~or~~ but shall not ~~to~~ exceed a period ~~of time as~~ specified by the j~~J~~urisdiction~~,~~ if applicable.

~~a)~~b) This repair method is not permitted for vessels used in lethal service, vessels designed for high-cycle operation~~,~~ ~~or~~ fatigue service, or compressed air storage, and in cases where high~~-~~-stress concentration cannot be reduced by ~~weld~~ partial repair. This repair method is not permitted for United States Department of Transportation (DOT) vessels.

~~b)~~c) One or more ~~fitness-for-service engineering evaluation~~FFSA methods ~~,~~ ~~as~~ described in NBIC Part 2, 4.4~~,~~ shall be used to determine whether any part of the defect may remain~~,~~ in the ~~pressure-retaining item~~PRI. If it is determined that the defect can remain in the ~~item~~PRI, a risk-based inspection program shall be developed as described in NBIC Part 2, 4.5 ~~to ensure inspection of the defect and monitoring of defect growth over time~~ to monitor any indication of defect growth with future operation and to validate assumptions associated with damage progression rates when estimating the remaining life. This program shall be a controlled and documented inspection program that specifies inspection intervals as agreed upon with the Inspector~~,~~ and~~,~~ when required, the jurisdiction~~, and~~. This program shall be maintained until the defect can be completely ~~removed and the item~~ repaired.

~~c)~~d) The following additional requirements shall apply to the ~~weld~~ repair of ~~pressure-retaining items~~PRIs without complete removal of defects:

1) ~~Engineering evaluation of the defect in the pressure-retaining item shall be conducted using one or more fitness-for-service condition assessment methods as described in NBIC Part 2, 4.4. Engineering evaluation of the condition assessment results shall be performed by an organization that has demonstrated industry experience in evaluating pressure-retaining items.~~, i~~If the fitness-for-service engineering evaluation~~If the FFSA requires finite element analysis, then the requirements in NBIC Part 2, 4.6 and NBIC Part 2, Supplement 11 shall be met.

2) ~~If engineering evaluation indicates a defect can remain in the pressure-retaining item, a risk-based inspection program shall be developed and implemented based on review and acceptance by the Inspector, and, when required, the Jjurisdiction. The risk-based inspection program shall be in accordance with the requirements in NBIC, Part 2, 4.4. When required, Form NB-403 shall be filed with the jurisdiction.~~

	~~3)~~2) ~~The fitness-for-service condition assessment and risk-based inspection programs shall remain in effect for the pressure-retaining item until such time that the defect can be completely removed and the item repaired.~~ The ~~fitness-for-service condition assessment~~FFSA method, results of assessment, and method of ~~weld~~ repair~~,~~ (if applicable)~~,~~ shall be documented on a Form NB-403, *Report of Fitness-for-Service Assessment* ~~(FFSA) Form~~ as described in NBIC Part 2, 4.4.1. When required, Form NB-403 shall be filed with the jurisdiction. ~~4)~~3) When ~~weld~~ repairs are performed without complete removal of ~~the~~ defects, this shall be noted on the NB-66, Form R-1, *Report of Repair* in the "Description of Work" section. The "R" Certificate Holder performing the ~~weld~~ repairs shall provide detailed information on the Form R-1, describing the method and extent, including the specific location of the ~~weld~~ repair on the ~~item~~PRI. ~~a.~~4) ~~The interval to re-inspect, or remove the item from service, or perform weld repair shall be determined based on a risk-based inspection program developed and implemented as required by NBIC Part 2, 4.5.~~ The inspection interval shall ~~not exceed the remaining life of the item, and shall~~ be documented on the Form NB-403 and in the "Remarks" section of the Form R-1. The Form NB-403 shall be affixed to the Form R-1. A National Board Commissioned Inspector holding an "R" E~~e~~ndorsement shall sign ~~both~~ the Form R-1. ~~and the~~The Form NB-403 shall be completed as described in NBIC Part 2, 5.3.4. ~~b.~~5) A copy of the completed Form R-1 with the completed Form NB-403 attached may be registered with the National Board, and when required, filed with the jurisdiction where the ~~item~~ PRI was installed.
Item 24-60, Item 25.21 Part 3, S11.2.3	S11.2.3 REPAIR OF ASME BPVC SECTION VIII, DIVISION 2 OR DIVISION 3, PRESSURE VESSELS a) Scope The following requirements shall apply for the repair of pressure vessels constructed to the requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section VIII, Division 2 or Division 3 ~~of the ASME Code~~. b) Repair Plan Prior to the commencement of work, ~~T~~the user shall prepare, or cause to have prepared, a detailed ~~plan covering the~~ scope of the repair. The "R" Certificate Holder shall prepare a detailed repair plan that fulfills this scope. 1) ~~Engineer~~ Review and Certification a. Prior to the commencement of work, ~~T~~the repair plan shall be reviewed and certified by an individual(s) ~~an engineer~~ meeting the requirements ~~criteria~~ of the original code of construction ~~ASME Section VIII, Division 2 or Division 3, as applicable,~~ for a designer, engineer, or Certifying Engineer ~~an engineer~~ signing and certifying a Manufacturer's Design Report. The review

	and certification shall ~~be such as to~~ ensure the work involved in the repair is compatible with the User's Design Specification (UDS) and ~~the~~ Manufacturer's Design Report. ~~The certifying requirement may be waived for ASME Section VIII, Division 2, Class 1 vessels that did not require the Manufacturer's Design Report to be certified during initial construction.~~ b. If the UDS is lost or destroyed, the ASME nameplate and ~~the~~ applicable ASME BPVC Section VIII, Division 2 or Division 3 Manufacturer's Data Report, Partial Data Reports, and/or Manufacturer's Design Report shall be used to reconstruct the UDS. The reconstructed UDS shall meet the requirements of and be certified in accordance with the latest edition of ASME BPVC Section VIII, Division 2 or Division 3. Note: Additional design personnel requirements or qualifications specified by the user or jurisdiction are outside the scope of this supplement. 2) Authorized Inspection Agency Acceptance After the repair plan is reviewed and certified, it shall be submitted for acceptance to the Authorized Inspection Agency/Owner-User Inspection Organization employing the Inspector performing the acceptance inspection and signing the Form R-1.
Item 25-53; Item 25-50 Part 3, S11.3.1 and editorial (S11.3.1)	**S11.3.1 ENCAPSULATION** Encapsulation is a method used to maintain the pressure-retaining capability of components such as shells, heads, piping, and valves (with the exception of firetube boilers components) by fabricating a new pressure-containing boundary over the ~~item~~ compromised component in the form of a "welded leak box" as described by ASME PCC-2, Part 2, Article 204. a) Except as required in ~~3.4.3~~S11.3.1 c) 1), ASME PCC-2 should be used as a guideline for the design of the welded leak box, and fabrication shall be in accordance with the original code of construction~~,~~ when practicable. Design of the encapsulation shall consider original design conditions, ~~taking into account~~such as current service conditions and damage mechanisms. Use of this method shall be acceptable to the ~~i~~Inspector, and when required, the jurisdiction. b) ~~AThe "R" Certificate Holder responsible for the design of the encapsulation shall ensure a F~~fitness-for-Sservice aAssessment (FFSA), ~~has been performed on the portion of the item being encapsulated in accordance with~~as described in NBIC Part 2, 4.4~~.1~~, shall identify the applicable damage mechanisms and establish the inspection requirements necessary to support~~ing~~ the continued service of the pressure-retaining item. The leak box shall not remain in place beyond the calculated remaining life of the encapsulated portion of the pressure-retaining item. 1) The inspection program shall remain in effect until such time that the identified remaining life has been reached or the encapsulated pressure-retaining item is removed. The intervals for inspection and identified remaining life of the encapsulated pressure-retaining item shall be documented on the Form NB-403, *Report of* ~~FFSA~~ *Fitness-for-Service Assessment* in the ~~"Remarks"~~ "FFSA Results / Recommendations"

	section. The ~~Report of FFSA~~ Form NB-403 shall be affixed to the NB-229, Form R-2, *Report of Alteration* and identified in the "Remarks" section. A National Board Commissioned Inspector holding an "R" ~~e~~Endorsement shall sign the Form R-2 and Form NB-403~~, Report of FFSA~~, as described in NBIC Part 2, 5.3.4. 2) The leak box shall fully encapsulate the thinned or leaking area, as specified in the FFSA, to the distance where the minimum required metal wall thickness is verified. Wall thickness in the area to be welded shall be verified ~~in the area to be welded~~. 3) A welded leak box shall not be used to encapsulate a crack unless it has been removed~~,~~ and repaired~~,~~ or otherwise treated to prevent further crack propagation. ~~in accordance with NBIC Part 3, Paragraph 3.3.4.2 a).~~ c) Hazards associated with welding on degraded components should be addressed with the ~~Owner-User by the, u~~Use of owner or user. Use of engineering controls, administrative controls, and personal protective equipment should be considered. 1) ~~When~~ If the pressure~~-~~retaining item will remain in service while implementing this method, the requirements and limitations described ~~within~~ in ASME PCC-2, Part ~~-~~1 shall be used in conjunction with ~~the Welded Leak Box Repair article in~~ ASME PCC-2, Part ~~-~~2, Article 204, "Welded Leak Box Repair~~210~~." 2) API ~~RP~~Recommended Practice ~~-~~ 2201, "Safe Hot Tapping Practices in the Petroleum and Petrochemical Industries" may be used as a guideline for identifying service restrictions and hazards associated with welding to a component that is under pressure~~, including service restrictions~~. d) Visual examination shall be performed in accordance with the NBIC Part 3, 4.4.1 e). e) Completion of the Form R-2 shall follow the requirements for preparation, distribution, and registration as described in NBIC Part 3, Section 5.
Item 24-60, Item 25.21 Part 3, S11.3.2	S11.3.2 ALTERATION OF ASME BPVC SECTION VIII, DIVISION 2 OR DIVISION 3, PRESSURE VESSELS a) Scope The following requirements shall apply for the alteration of pressure vessels constructed to the requirements of ASME BPVC Section VIII, Division 2 or Division 3. b) Alteration Plan ~~a)~~ Prior to the commencement of work, the user shall prepare, or cause to have prepared, a detailed scope of the alteration. The "R" Certificate Holder shall prepare a detailed alteration plan that fulfills this scope. 1) ~~Engineer~~ Review and Certification a. Prior to the commencement of work, ~~T~~the alteration plan shall be reviewed and certified by an individual(s) ~~an engineer~~ meeting the requirements ~~criteria~~ of the original code of construction ~~ASME Section VIII, Division 2 or Division 3, as applicable,~~ for a designer,

engineer, or Certifying Engineer ~~an engineer~~ signing and certifying a Manufacturer's Design Report. The review and certification shall ~~be such as to~~ ensure the work involved in the alteration is compatible with the ~~User's Design Specification~~UDS and ~~the~~ Manufacturer's Design Report.

~~Provided that the alteration does not introduce a condition that would require an engineer to sign the Manufacturer's Design Report for ASME Section VIII, Division 2, Class 1 vessels, the certifying requirement may be waived for vessels that did not require the Manufacturer's Design Report to be certified during initial construction.~~

~~c~~b. If the UDS is lost or destroyed, the ASME nameplate and applicable ASME BPVC Section VIII, Division 2 or Division 3 Manufacturer's Data Report, Partial Data Reports, and/or the Manufacturer's Design Report shall be used to reconstruct the UDS. The reconstructed UDS shall meet the requirements of and be certified in accordance with the latest edition of ASME BPVC Section VIII, Division 2 or Division 3.

Note: Additional design personnel requirements or qualifications specified by the user or jurisdiction are outside the scope of this supplement.

2) ~~User's Design Specification~~UDS

If the work involved in the alteration is ~~such that the work is~~ not compatible with the original UDS, or if it changes one or more requirements of ~~the original~~such ~~user's design specification~~, the user shall revise the UDS ~~user's design specification shall be revised by the user~~ with the new parameters or changes. If the code of construction requires certification of the UDS, ~~T~~the revisions shall be certified by an individual(s) ~~an engineer~~ meeting the requirements ~~criteria~~ of the original code of construction ~~ASME Section VIII, Division 2 or 3, as applicable,~~ for a designer, engineer, or Certifying Engineer ~~an engineer~~ signing and certifying a UDS~~Manufacturer's Design Report~~.

Note: Additional design personnel requirements or qualifications specified by the user or jurisdiction are outside the scope of this supplement.~~The engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying engineer.~~

3) Manufacturer's Design Report

a. 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~~UDS.

b. The supplement to the Manufacturer's Design Report shall be certified by an individual(s) ~~engineer~~ meeting the requirements ~~criteria~~ of the original code of construction ~~ASME Section VIII, Division 2 or Division 3, as~~

	~~applicable,~~ for a designer, engineer, or Certifying Engineer ~~an engineer~~ signing and certifying a Manufacturer's Design Report. **Note**: Additional design personnel requirements or qualifications specified by the user or jurisdiction are outside the scope of this supplement.~~The engineer qualification criteria of the Jurisdiction where the pressure vessel is installed should be verified before selecting the certifying engineer.~~ 4) Authorized Inspection Agency Acceptance ~~Following review and certification,~~After the alteration plan is reviewed and certified, it shall be submitted for acceptance to the Authorized Inspection Agency/Owner-User Inspection Organization ~~whose~~ employing the ~~i~~Inspector ~~will perform~~performing the acceptance inspection and signing the Form R-2.
Item 23-09; Item 26-06; Item 26-36 Part 3, S12	**SUPPLEMENT 12** **PRESSURE-RETAINING PARTS FABRICATED FROM ADDITIVELY MANUFACTURED (AM) MATERIAL** **S12.1 SCOPE** Additively manufactured pressure parts (AM parts) addressed in this supplement are those that have been fabricated from weld metal deposited by direct energy deposition (DED) using the automatic gas metal arc welding (GMAW) process. The AM part shall conform to the rules most applicable to the original code of construction for the pressure-retaining part. The requirements for installation of AM parts listed under S12.2 are based on references to existing rules for AM fabrication in other known international codes and standards. AM pressure parts that are installed shall be limited to service temperatures below the creep range (i.e., where time-independent properties govern), ~~except~~however, ~~for~~ nickel alloys and Grade 91 ~~steel~~ creep strength enhanced ferritic (CSEF) steel ~~which~~ may ~~also~~ be used in time-dependent service. **S12.2 INSTALLATION AND DOCUMENTATION OF AM PRESSURE-RETAINING PARTS** The use of AM parts that are being installed by a National Board "R" *Certificate of Authorization* Holder shall be considered an alteration and shall be documented on an NB-229, Form R-2, *Report of Alteration*. If production of AM parts is performed by a National Board "R" Certificate Holder or if it is subcontracted by the "R" Certificate Holder, the activity shall be documented on an NB-XX, *Report of Additively Manufactured (AM) Parts.*

	In addition to the requirements for an alteration, the following information shall be provided for the AM part and attached to the applicable NBIC Form(s) referenced above: a) A copy of the additive manufacturing specification (AMS) shall be provided by the Additive Manufacturer to the "R" Certificate Holder and Inspector for review and acceptance. As a minimum, the following information shall be included in the AMS: 1) The original code of construction for the part being replaced by an AM part. 2) File names with current revision for all model data describing the geometry and build strategy needed to fabricate the AM part. 3) The applicable material specification listed in the original code of construction for the AM part. 4) The applicable filler metal specification and AWS classification. 5) A list of all welding procedures and qualification records used to produce the AM part. Welding procedures shall be qualified in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section IX or other international welding standard with allowable ranges of process variables from ASME BPVC Section IX, Article VI "Material Manufacturing Using Wire-Additive Welding." 6) The nondestructive evaluation and testing requirements from the original code of construction applicable~~being applied~~ to the AM part ~~from the original code of construction~~ and from the material specification requirements for the original part being replaced. 7) Supplemental examination requirements identified by the Additive Manufacturer, "R" Certificate Holder, user, or as defined in contract specification requirements. 8) Post-processing requirements identified by the Additive Manufacturer, "R" Certificate Holder,- user, or as defined in contract specification requirements. 9) Thermal treatment requirements for the AM pressure part identified by the Additive Manufacturer, "R" Certificate Holder, user, or as defined in contract specification requirements. 10) Supplemental requirements identified by the Additive Manufacturer, user, or "R" Certificate Holder or in contract specification requirements (e.g., corrosion testing). 11) Documentation that shows the AMS has been reviewed and accepted by the Additive Manufacturer, "R" Certificate Holder,

	Inspector, Authorized Inspection Agency, and if required, the jurisdiction. b) A copy of the design calculations for the AM pressure part which shall be based on the applicable original code of construction requirements. -If the original code of construction required a specific product form for design, the replacement AM pressure part shall be shown to have met the minimum mechanical properties and shown to be similar in chemical composition to the original pressure part product form. c) Welding operator qualification record(s). d) A copy of the Additively Manufactured (AM) Material Test Report. The data recorded on the AM Material Test Report shall reflect the test results from the witness specimen(s). The following criteria are applicable to, and shall be addressed in, the AM Material Test Report: 1) At least one witness specimen shall be manufactured and tested from each AM production build. When a production component requires the use of multiple heats of filler metal, AM product witness specimens for chemical composition, tension, and other required testing shall be manufactured and tested from each heat of filler metal. 2) The witness specimen(s) shall be manufactured either immediately before, during, or immediately after each production build. The witness specimen may be a prolongation of the production build. 3) The witness specimens shall be produced using bounding heat inputs and interpass temperature that provide limiting values for tensile and toughness properties as determined by the Additive Manufacturer ~~that provide limiting values for tensile and toughness properties~~. 4) All mechanical testing shall be performed on specimens in the thermal-treated condition ~~identified~~as defined in the AMS. 5) At least one tension test specimen shall be manufactured and tested from each witness specimen. 6) At least one chemical composition test specimen shall be extracted and tested from each witness specimen. 7) When toughness testing is required by the original code of construction, at least one set of toughness test specimens shall be extracted and tested from each witness specimen.

	8) All chemical composition, hardness, tension, and toughness testing shall be performed in accordance with the requirements of S12.2 e), f), g), h), and i), below. 9) Following any production test non-compliance, components fabricated during the build shall be dispositioned using the Additive Manufacturer's Quality Management System (QMS). 10) The results of the required witness specimen testing shall be documented in a Material Test Report certified by the Additive Manufacturer. 11) The AM Material Test Report shall be included in the Additive Manufacturer's construction records. e) Chemical composition testing requirements 1) The analytical method for chemical composition testing shall be in accordance with the applicable material specification listed in the original code of construction for the AM part. 2) The chemical composition of the specimens shall conform to the ASME filler metal specification identified in the AMS. f) Mechanical property test locations 1) The build x, y, and z axes are defined in Figure S12.2-a. 2) The z axis is defined as normal to deposition layers (parallel to build direction) as shown in Figure S12.2.-a. g) Tension testing requirements 1) Tension test specimens shall be constructed with their long direction parallel to the z-axis as shown in Figure S12.2-a. 2) All room temperature tension testing shall be in accordance with the American Society for Testing and Materials (ASTM)'s ASTM E8, *Standard Test Methods for Tension Testing of Metallic Materials*. 3) All elevated temperature tension testing shall be in accordance with ASTM E21, *Standard Test Methods for Elevated Temperature Tension Tests of Metallic Materials*. Elevated temperature testing may be performed at a temperature at or above the design temperature. 4) Tension test acceptance (the allowable minimum yield and tensile strength values) shall be calculated as described in Figure S12.2-b, Table S12.2, and Examples 1 and 2, shown below. h) Hardness testing requirements 1) Hardness testing shall be performed on the witness specimen when required by the material specification, the original code of construction, or the AMS.

2) Hardness testing shall comply with ASTM E10, *Standard Test Method for Brinell Hardness of Metallic Materials*; ASTM E18, *Standard Test Methods for Rockwell Hardness of Metallic Materials*; or ASTM E92, *Standard Test Methods for Vickers Hardness and Knoop Hardness of Metallic Materials*.

i) Toughness testing requirements

1) Toughness testing shall be performed when required by the material specification, the original product form in the original code of construction, or the AMS.

2) Toughness testing shall be in the orientation shown in Figure S12.2-a.

3) The acceptance criteria for toughness testing shall be as specified by the material specification, the original product form in the original code of construction, or the AMS.

j) A copy of nondestructive test reports as required by the original code of construction to be provided by the "R" Certificate Holder or by the owner or user depending on contract specification requirements.

k) Results of the hydrostatic test, as performed in accordance with the requirements of the original code of construction, if applicable.

Figure S12.2-a - Material Manufacturing Coordinate System and Material Test Specimen Orientation

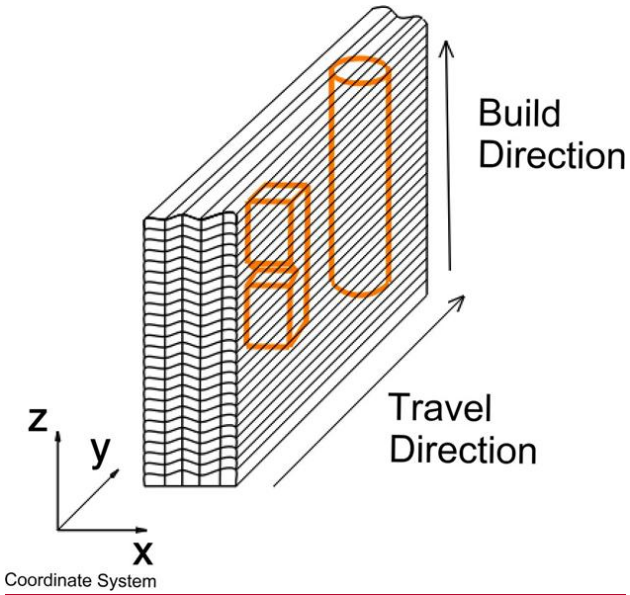
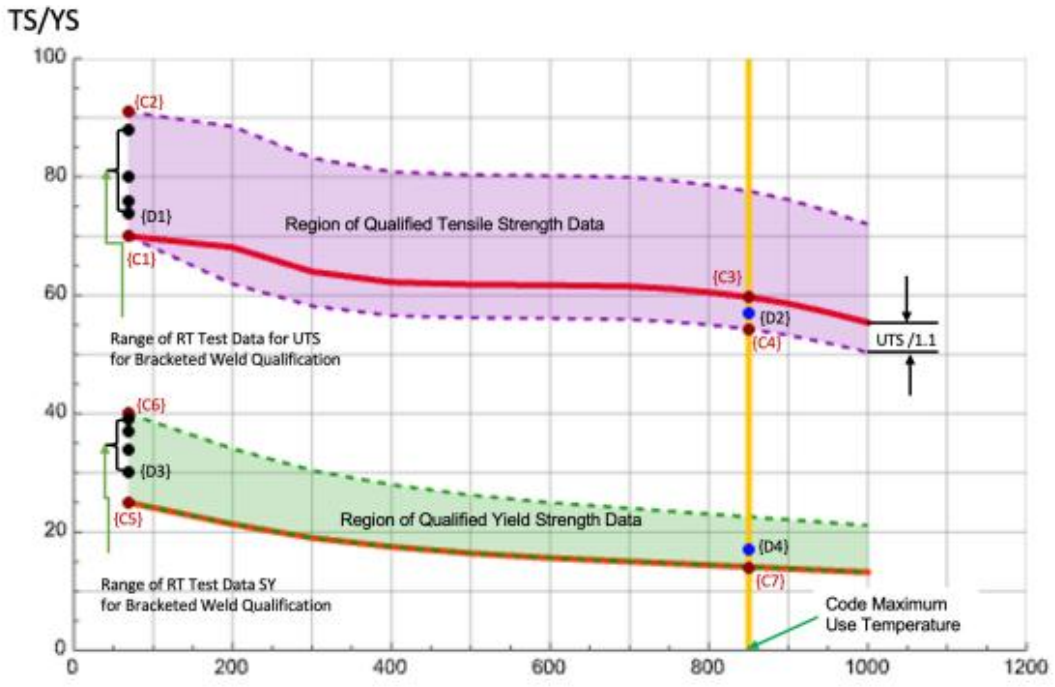


Figure S12.2-b – Bracketed Weld Qualification Material Testing



Key:

RT= radiographic testing

SY= specified yield (strength)

TS= tensile strength

UTS= ultimate tensile strength

YS= yield strength

Table S12.2 - Control Points and Data Point Definitions and Nomenclature

Point	Temperature	Strength	Description	Criteria
C1	Room	Tensile Strength	Specified Minimum Tensile Strength	Specified Minimum Tensile Strength from the material specification.
C2	Room	Tensile Strength	The measured elongation from the tensile specimen is equal to the specified minimum elongation value in the material specification.	Specified Minimum Elongation from the material specification. Note: If the elongation in all the tensile specimens exceeds the specified minimum elongation, it is not required that Control Point C2 be determined.

C3	Design	Tensile Strength	Value at Design Temperature	Tensile Strength from ASME BPVC Section II, Part D, Table U at Design Temperature.
C4	Design	Tensile Strength	Minimum Acceptable Value of Tensile Strength for High-Temperature Test	Point C3/1.1 Value from Table U at Design Temperature Divided by 1.1
C5	Room	Yield Strength	Specified Minimum Yield Strength	Specified Minimum Yield Strength from the material specification.
C6	Room	Yield Strength	The measured elongation from the tensile specimen is equal to the specified minimum elongation value in the material specification.	Specified Minimum Elongation from the material specification. Note: If the elongation in all the tensile specimens exceeds the specified minimum elongation, it is not required that Control Point C6 be determined.
C7	Design	Yield Strength	Minimum Acceptable Value of Yield Strength for High-Temperature Test	Yield Strength from ASME BPVC Section II, Part D, Table Y-1 at Design Temperature.
D1	Room	Tensile Strength	Minimum value of tensile strength from ASME BPVC Section IX, Part QW, Article VI tension test data	Tensile strength and elongation from ASME BPVC Section IX, Part QW, Article VI tension tests shall equal or exceed the specified minimum values in the material specification (Point C1). The elongation from the tension tests shall exceed the specified minimum elongation in the material specification.
D2	Design	Tensile Strength	Tensile strength value from elevated temperature tension test	Tensile strength value from ASME BPVC Section IX, Part QW, Article VI tension test shall equal or exceed value calculated for Point C4.
D3	Room	Yield Strength	Minimum value of yield strength from ASME BPVC Section IX, Part QW, Article VI tension test data	Yield strength and elongation from ASME BPVC Section IX, Part QW, Article VI tension tests shall equal or exceed the specified minimum values in the material specification (Point C5). The elongation from the tension tests shall exceed the specified minimum elongation in the material specification.
D4	Design	Yield Strength	Yield strength value from high-temperature tension test	Yield strength value from ASME BPVC Section IX, Part QW, Article VI tension test shall equal or exceed value for Point C7.

EXAMPLES SHOWING CALCULATION OF ACCEPTANCE VALUES

Given the test data shown below determined from an ASME BPVC Section IX, Article VI (QW-600 series) bracketed weld qualification testing, calculate the allowable minimum yield and tensile strength values to be used for acceptance of the tensile test specimens for qualification and production witness specimens.

Target material specification - ASME SA-403 Grade 316L
Filler material specification - ER316LSi

Control Points - Example Data SA 403 Grade 316L (ksi)

C1	C2	C3	C4	C5	C6	C7
70	Elongation Controlled	59.7	59.7/1.1 = 54.3	25	Elongation Controlled	14.1

Example 1 - Example ASME BPVC Section IX, Part QW, Article VI Data Analysis

Data Point D1 = 74 ksi
Data Point D2 = Control Point C4 = 54.3 ksi
Data Point D3 = 30 ksi
Data Point D4 = Control Point C7 = 14.1 ksi

Calculate the ~~M~~minimum ~~A~~allowable ~~T~~tensile s~~S~~trength and ~~Y~~yield ~~S~~strength for the ~~P~~production ~~W~~witness ~~S~~specimens using Equations 1 and 2.

$AMTS_{Minimum}$ = Max [C1, D1 x C4/D2] = Max [70, 74 x 54.3/54.3] = 74 ksi $AMYS_{Minimum}$ = Max [C5, D3 x C7/D4] = Max [25, 30 x 14.1/14.1] = 30 ksi

Example 2 - Example ASME BPVC Section IX, Part QW, Article VI Data Analysis

Data Point D1 = 74 ksi
Data Point D2 = Control Point C3 = 59.7 ksi
Data Point D3 = 30 ksi
Data Point D4 = 17 ksi

Calculate the m~~M~~inimum ~~A~~allowable ~~T~~tensile ~~S~~strength and ~~Y~~yield ~~S~~strength for the ~~Q~~qualification ~~B~~build ~~S~~specimen and the ~~P~~production ~~W~~witness ~~S~~specimens using Equations 1 and 2.

$AMTS_{Minimum}$ = Max [C1, D1 x C4/D2] = Max [70, 74 x 54.3/59.7] = 70 ksi $AMYS_{Minimum}$= Max [C5, D3 x C7/D4] =

	Max [25, 30 x 14.1/17] = 25 ksi **TABLE S12.3** GUIDE FOR COMPLETING FORM NB-XX, REPORT OF ADDITIVELY MANUFACTURED PARTS **See Appendix A for the full Table S12.3 and Figure S12.3** **S12.4 ADDITIONAL FORMS** **See Appendix A for S12.4 forms**
Item 23-24 Part 3, S13	**SUPPLEMENT 13** **GENERAL REQUIREMENTS FOR REPAIRS TO QUICK-ACTUATING/QUICK-OPENING CLOSURES** **S13.1 SCOPE** This supplement provides additional requirements and guidelines beyond those cited in the body text of the NBIC for repairs to quick-actuating/quick-opening closure pressure-retaining components. Such closures are referenced throughout this supplement as "quick closures." -Careful consideration shall be given to meet the requirements in NBIC Part 3, Sections 2 through 5 as appropriate, and the inspection requirements in NBIC Part 2, 2.3.6.5. This supplement applies to the general component terminology and does not include all quick-closure designs. For details, refer to the quick closure manufacturer's partial data report, manufacturer's drawings, and service and maintenance documentation. Additional documents required by the original code of construction may be available for reference. No components furnished or specified by the manufacturer of the quick closure shall be omitted unless the manufacturer's concurrence is received or sound engineering judgment is obtained. The components of quick closures include but are not limited to the following: a) Cover (e.g., head, flat plate) b) Support elements (e.g., davit hinge, post davit, vertical/slide sides) c) Locking elements (e.g., wedges, latch) d) Locking mechanism (e.g., rotating locking ring, seal flanges, lugs) e) Holding elements (e.g., pins) f) Interlock device (e.g., pressure-indicating device) g) Seal design **S13.2 REPLACEMENT PARTS FOR QUICK CLOSURES** a) Replacement pressure-retaining parts shall be identical to the original equipment furnished. Substitutions may be permitted if they are approved by the manufacturer or

if an engineering evaluation has determined the substitution acceptable. The engineering evaluation shall be documented, reviewed, and accepted by a Repair Inspector, and the jurisdiction where required.

b) Quick-closure replacement pressure-retaining parts shall be fabricated in accordance with the manufacturer's design and the original code of construction.

c) Replacement of nonpressure-retaining load-bearing parts, when different from the manufacturer's design, shall be evaluated for possible effect on the pressure-retaining parts.

d) The replacement materials and welding materials and any applicable heat treatment requirements shall be consistent with the original code of construction.

S13.3 REPAIR GUIDE FOR QUICK CLOSURES

a) The Manufacturer's Data Report, or manufacturer's drawings when available, shall be carefully reviewed to determine the material of construction of each quick closure. If material data is not available, positive material identification (PMI) to determine the material's chemistry and hardness testing shall be performed.

b) Weld repairs performed in accordance with NBIC Part 3 are permitted on quick--closure pressure-retaining components that are manufactured from steel. Hinge pins or bolts shall not be welded. Careful consideration shall be given to any requirements for the finished weld profile and postweld heat treatment (PWHT).

c) Structural deterioration or damage caused by corrosion, thinning, or cracking shall not be repaired until its extent has been determined by suitable nondestructive examination.

d) The Certificate Holder shall have a plan outlining the scope of the repair. The plan shall ensure the work involved is compatible with the original design specification and sound engineering practices.

e) Removing the quick-closure mechanism components from a vessel for installation on another vessel is *strictly prohibited*.

(f) When quick closures are repaired, the locking mechanism or locking device shall be operational in accordance with the quick closure manufacturer's specifications.

S13.4 ROUTINE REPAIRS

The following examples of repairs do not require stamping or nameplate attachment provided the repair procedure has been accepted by the Repair Inspector and the "R" Certificate Holder has verified the pressure-retaining capability of the quick closure will not be affected.

a) Replacement of consumable parts (e.g., wedges)

b) Alignment adjustments

S13.5 REPAIR OF DAMAGE

	S13.5.1 REPAIR OF QUICK-CLOSURE WELDS All welds associated with the quick-closure pressure-retaining components should be repaired in accordance with the original manufacturer's design specifications. Careful consideration shall be given to any requirements for the finished weld profile and PWHT. **S13.5.2 REPAIR OF QUICK-CLOSURE SURFACES** The repair of quick-closure surfaces shall be limited to the restoration of wasted areas through weld buildup. The final surface shall be flush with the nominal surface. Seating surfaces shall be machined back to original design specifications. External weld buildup is prohibited on closure components. Alternatively, a fitness-for-service assessment may be used to qualify local thin areas. **S13.5.3 REPAIR OF QUICK-CLOSURE MECHANISM** a) The designs of quick-closure locking mechanisms are typically proprietary; therefore, all repairs shall be performed to restore the closure to the original design specifications. If design specifications, such as original quick closure configuration and nominal thicknesses, are not available, then all repairs shall be performed by the original manufacturer. If this is not practicable, the Certificate Holder shall contact an organization competent in quick-closure design and construction to approve or establish a repair plan prior to implementation of any repairs. b) Safety devices (e.g., sensors, interlocks) removed during maintenance or repair shall be reinstalled in accordance with the original manufacturer's specifications. c) Repairs shall avoid damaging gasket materials. If damage to gasket materials occurs, the gaskets shall be replaced before the system is returned to service. **S13.6 EXAMINATIONS AND TEST METHODS** NBIC Part 3, Section 4 is applicable for all post-construction activities pertaining to examination and testing. **S13.7 CERTIFICATION/DOCUMENTATION AND STAMPING** NBIC Part 3, Section 5 is applicable for all post-construction activities pertaining to certification/documentation and stamping. Stamping may also be waived in accordance with S13.4.
Item 25-52 Part 4, 1.3.1 and editorial (1.1-1.3.1)	**1.1 SCOPE** This ~~P~~part provides guidelines and requirements for the installation, in-service inspection and testing, and repairs of pressure relief devices. **1.2 CONSTRUCTION STANDARDS FOR PRESSURE RELIEF DEVICES** a) When the standard governing the original construction is the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), installation and repairs to pressure relief devices shall conform to

	the ASME ~~Code~~ BPVC section and edition most applicable to the work planned. b) If the pressure relief device was not constructed to the ASME ~~Code~~BPVC, then installation, inspection, and repair shall, wherever possible, reference the original code of construction most applicable to the work. c) If the pressure relief device was not constructed to any recognized construction code or standard, then installation, inspection, and repair shall reference a construction standard or specification most applicable to the work. d) Where this is not possible or practicable, it is permissible to use other codes, standards, or specifications, including the ASME ~~Code~~BPVC, provided there is concurrence of the Inspector (if applicable) and the j~~J~~urisdiction where the pressure relief device is installed. **1.3 PRESSURE RELIEF DEVICES — DEFINITIONS** Refer to Section 9, *Glossary of Terms* for definitions relating to pressure relief devices. **1.3.1 ADDITIONAL DEFINITIONS RELATING TO PRESSURE RELIEF DEVICES** Unless otherwise specified in the NBIC, the definitions relating to pressure relief devices in ~~Section 2 of ASME PTC 25~~ASME BPVC Section XIII, Mandatory Appendix I shall apply.
NB15-0307 Part 4, 1.4 and editorial	1.4 ACCREDITATION a) The National Board administers four specific accreditation programs: "R" — Repairs and ~~A~~alterations to ~~P~~pressure-r~~R~~etaining i~~I~~tems "VR" — Repairs to p~~P~~ressure r~~R~~elief v~~V~~alves and pin devices "NR" — Repair and r~~R~~eplacement a~~A~~ctivities for n~~N~~uclear i~~I~~tems "T/O" — In-service t~~T~~esting ~~O~~only of ~~P~~pressure r~~R~~elief v~~V~~alves b) Organizations performing repairs and in-service testing to pressure relief valves shall be accredited as described in this section, as appropriate for the scope of work to be performed. c) Organizations performing repairs ~~and~~ or in-service testing to pressure relief valves outside the scope of the NBIC may be otherwise accredited and shall meet any additional requirements of the ~~J~~jurisdiction where the work is performed.
NB15-0307	1.4.1 ACCREDITATION PROCESS a) The National Board administers accreditation programs for authorization of

Part 4, 1.4.1 and editorial	organizations performing repairs and inservice testing to pressure relief valves and pin devices. b) Any organization may apply to the National Board to obtain a *Certificate of Authorization* for a requested scope of activities. A review shall be conducted to evaluate the organization's Quality Management System (QMS). The individual assigned to conduct the ~~evaluation~~ review shall meet the qualification requirements prescribed by the National Board. Upon completion of the review, any deficiencies regarding the organization's QMS will be documented, and a recommendation regarding issuance of a *Certificate of Authorization* will be made to the National Board. c) National Board procedures provide for a confidential review resulting in a recommendation to issue or not issue a *Certificate of Authorization*. d) The accreditation program provides requirements for organizations performing repairs and/or~~,~~ inservice testing~~, or both~~ to pressure relief valves and pin devices. Depending upon the expected scope of activities at the time of review, organizations may be authorized to perform repairs and in-service testing in the shop only, field only, or shop and field. Repair and inservice testing activities shall be limited to the scope of work authorized. e) Organizations ~~desiring~~ seeking ~~to renew or obtain~~ a National Board *Certificate of Authorization* shall apply to the National Board using forms obtained from the National Board. Renewal ~~A~~applications ~~for renewal~~ shall be accessed and submitted online through the Certificate Administrator account on the National Board Business Center ~~made~~ prior to the expiration ~~date~~ of the *Certificate of Authorization*. f) When an organization has shops in more than one location, the organization shall submit separate applications for each shop. The organization may perform repairs in its shop, in the field, or both, provided such operations are described in the organization's QMS.
Item 25-07 Part 4, 2.3.6 h) And editorial (2.3.6)	**2.3.6 INSTALLATION** Pressure relief valves and the associated discharge piping shall be installed in accordance with the heater m~~M~~anufacturer's recommendations. The installation of the pressure relief valves required for ~~T~~thermal f~~F~~luid h~~H~~eaters shall include but not be limited to following requirements: a) The pressure relief valve shall be provided with discharge piping. The cross-sectional area of discharge piping shall not be less than the full area of the valve outlet. The size of the discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity or adversely affect the operation of the attached pressure vessel relief valves. Discharge piping shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief valve.

b) The pressure relief valve shall be connected to the pressure vessel in accordance with the original code of construction.

c) The cross-~~-~~sectional area of the piping between the heater and the relief device shall be sized either to avoid restricting the flow to the pressure relief devices or made at least equal to the inlet area of the pressure relief devices connected to it.

d) When two or more required pressure relief devices are placed on one connection, the inlet cross-sectional area of this connection shall be sized either to avoid restricting the flow to the pressure relief devices or made at least equal to the combined inlet areas of the pressure relief devices connected to it.

e) Unless permitted by the code of construction, there shall be no intervening stop valve between the vessel and its pressure relief device(s)~~,~~ or between the pressure relief device and the point of discharge.

f) Pressure relief device discharges shall be arranged ~~such~~ so that they are not a hazard to personnel or other equipment, and~~,~~ when necessary, lead to a safe location, such as a catchment tank, for the disposal of fluids being relieved.

g) Discharge lines from pressure relief valves shall be designed to facilitate drainage. Drain piping shall discharge to a safe location for the disposal of the fluids being relieved. The possibility of solidification of fluid leakage into the discharge piping system shall be considered.

h) The pressure relief valve discharge shall be connected to a closed, ~~steel~~ vented metal ~~storage~~ catchment tank with solid piping (e.g., with no drip pan elbow~~,~~ or other air gap). The ~~storage~~catchment tank should be located as close to the system as possible~~,~~ but away from flammable surfaces. Overflow or high-level protection should be considered. The capacity, materials of construction, and design of the ~~storage~~ catchment tank ~~should~~shall consider the volume, pressure, and temperature of fluid which may be relieved, or the catchment tank shall be sized in accordance with the heater manufacturer's recommendations. An outdoor catchment tank~~Storage tanks located outdoors~~ shall be located ~~such~~ so that water cannot collect in ~~the vessel~~it. The following shall be considered for discharge piping hazards:

1) Both thermal and chemical reactions (personnel hazard);

2) Combustible materials (fire hazard);

3) Surface drains (pollution and fire hazard); and

4) Heat tracing for systems using high freeze point fluids along the discharge lines (to prevent blockage).

i) Pressure relief valve discharge capacity for liquid service shall be determined from the following equation:

U.S. Customary Units:

	W = 2,407KA √(P - Pd)w SI Units: W = 5.092 KA √(P - Pd)w Where: W = ~~L~~liquid ~~C~~capacity in lb/hr (kg/hr) A = ~~D~~discharge a~~A~~rea of p~~P~~ressure relief v~~V~~alve, in² (mm²) K = coefficient of discharge for valve design P = (s~~S~~et pressure + OP + a~~A~~tmosphere pressure, psia [~~(~~MPa]~~)~~) OP = o~~O~~verpressure required for pressure relief valve to reach capacity specified in code of construction Pd = p~~P~~ressure at discharge of valve, psia (MPa) w = s~~S~~pecific weight of liquid at inlet condition lb/ft³ (kg/m³) To convert lb/hr of water to gal/min, multiply the capacity in lb/hr by 1/500.
Part 4, 2.6.7 editorial	**2.6.7 TEMPERATURE AND PRESSURE RELIEF DEVICES FOR HOT WATER STORAGE TANKS/POTABLE HOT WATER STORAGE TANK** a) Each potable hot water storage tank shall be equipped with an American Society of Mechanical Engineers (ASME) / National Board (NB) certified temperature and pressure relief valve set at a pressure not to exceed the maximum allowable working pressure and 210°F.(99°C). b) Potable hot water storage tanks exceeding the pressure limit of ASME Boiler and Pressure Vessel Code (BPVC) ~~Code~~ Section IV shall meet the original code of construction and shall be protected by a pressure relief valve set not to exceed the vessel's maximum allowable working pressure. A temperature limiting device shall be installed so that the water inside the storage tank does not exceed 210°F (99°C).
NB15-0307 Part 4, 3.2 and editorial	3.2.3 (Also Part 2, 2.5.4) INSPECTION REQUIREMENTS FOR INSTALLATION CONDITION a) Ensure all covers, caps, plugs, and lift lever wires utilized for shipping or transport are removed. b) Inlet piping shall be inspected to ensure it meets the requirements of the original code of construction. For pressure relief valves (PRV)s and pin devices certified for capacity, the inlet pipe shall be checked to ensure the inlet pipe size is not smaller than the device inlet size. This requirement is not applicable for flow-resistance-certified pin devices. c) Discharge piping shall be inspected to ensure it meets the requirements of the original code of construction. For ~~pressure relief valves~~PRVs and pin devices certified for capacity, the discharge pipe shall be checked to ensure the discharge pipe size is not smaller than the device outlet size. This

requirement is not applicable for flow--resistance--certified pin devices.

d) The valve drain piping shall be checked to ensure the piping is open.

e) The discharge piping shall be checked to ensure it drains properly.

f) The inlet and discharge piping shall be checked to ensure they are not binding or placing excessive stress on the pressure relief valvePRV or pin device body, which can lead to distortion of the valve body, and leakage, or malfunction.

g) The condition and adequacy of the pipe supports shall be inspected. Discharge piping should be supported independent of the device itself.

h) The valve discharge and discharge pipe shall be checked for possible hazards to personnel.

i) The installation shall be checked to ensure that there are no intervening isolation valves between the pressure source and the valve pressure relief device (PRD) inlet or between the valve PRD outlet and its point of discharge. Isolation valves may be permitted in some pressure vessel service. (See 2.6.6 e)), and jJurisdictional requirements.) Isolation valves shall not be used for power boilers, heating boilers, or water heaters.

j) A cChange-over valves, are commonly used in pressure vessel service. They may also be used in some boiler applications.which is They are used to install two pressure relief devicePRDs on a single vessel location for the purpose of switching from one device to a spare device., This is not considered a block valve if it is arranged such so that there is no intermediate position that will isolate both pressure relief devicePRDs from the protected system. Change-over valves should be carefully evaluated to ensure they do not have excessive pressure drop that could affect the pressure relief devicePRD operation or capacity. These devices are commonly used in pressure vessel service. They may also be used in some boiler applications. It is recommended that the jJurisdiction be contacted to determine their acceptability on boiler applications.

3.2.4.3 PRESSURE VESSELS AND PIPING

Standard practice for overpressure protection devices is to not permit any type of isolation valve either before or after the device. However, some pressure vessel standards permit isolation valves under certain controlled conditions when shutting down the vessel to repair a damaged or leaking valve. If isolation block valves are employed, their use should be carefully controlled by written procedures. Block valves should have provisions to be either car-sealed or locked in an open position when not being used. For American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section VIII, Division -1 pressure vessels, see UG-156, Appendix M, and jJurisdictional rules for more information.

3.2.5 (Also Part 2, 2.5.7) GENERAL CONSIDERATIONS FOR TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF DEVICES

a) Pressure relief ~~devices~~ valves ~~(PRDs)~~ and pin devices shall be subject to periodic inspection and/or testing based upon the type of device.

b) The owner may perform testing on the unit wherever the ~~valve~~ PRD is installed or at a qualified test facility. In many cases, testing on the unit may be impractical, especially if the service fluid is hazardous or toxic. Testing on the unit may involve the bypassing of operating controls and should be performed only by qualified individuals under carefully controlled conditions. ~~It is recommended to have available a~~A written procedure to conduct this testing should be made available.

1) The Inspector should ensure that calibrated equipment has been used to perform this test, and the results should be documented by the owner.

2) If the testing is performed at a test facility, the record of this test should be reviewed to ensure the device meets the requirements of the original code of construction. Devices that have been in toxic, flammable, or other hazardous services shall be carefully decontaminated before being tested. ~~In particular~~For example, the closed bonnet of PRV~~valve~~s in these services may contain fluids that are not easily removed or neutralized. If a test cannot be safely performed, the device shall be disassembled, cleaned, decontaminated, repaired, and reset.

3) If a device has been removed for testing, the inlet and outlet connections should be checked for blockage due to product buildup or corrosion.

3.2.5.1 TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF VALVES

d) As an alternative to performing a pressure test, the owner may check the valve for freedom of operation by activating the test or “try” lever (i.e., manual check). For high-pressure boiler and process valves, this test should be performed only at a pressure greater than 75% of the stamped set pressure of the valve, otherwise the lifting device may be damaged. This test will indicate only that the valve is free to operate; it does not provide any information on the actual set pressure. All manual checks should be performed with some pressure under the valve to flush out debris from the seat. (Debris may cause leakage.)

Note: The manual check at 75% or higher is based on lift lever design requirements for ASME BPVC Section I and Section VIII valves. Code design requirements for lifting levers for ASME BPVC Section IV valves require that the valve is capable of being lifted without pressure.

3.2.6 (Also Part 2, 2.5.8) RECOMMENDED INSPECTION AND TEST FREQUENCIES FOR PRESSURE RELIEF DEVICES

Inspection and test frequencies for ~~pressure relief device~~PRDs are greatly dependent on the service, external environment, and operation of the system; therefore, only general recommendations can be given. Inspection frequency

should be based on previous inspection history, manufacturer's recommendations, or both. If ~~valves~~ devices are found to be defective or damaged during inspection, inspection intervals should be shortened until acceptable ~~inspection~~ results are obtained. Where test records or inspection history is not available, the following inspection and test frequencies in Table 3.2.6 are suggested.~~:~~

Table 3.2.6

Service	Recommended Inspection Type/Frequency (See Note 4)
Low-pressure steam ~~-~~heating boilers	Lift lever test quarterly~~,~~; set pressure test annually prior to heating season

3.2.6.1 ESTABLISHMENT OF INSPECTION AND TEST INTERVALS

Where a recommended test frequency is not ~~listed~~specified, the ~~valve~~ PRD user and Inspector ~~must~~ shall ~~determine and~~ agree ~~on a suitable~~upon an appropriate interval for inspection or inspection and test. Some ~~items~~ factors to be considered ~~in making this determination are~~include:

a) Jurisdictional requirements;

b) Records of inspections and test data ~~and inspections~~ from similar ~~processes and similar~~ devices ~~in operation~~ operating under comparable service conditions at that facility;

c) Recommendations from the device manufacturer. ~~In particular~~For example, when the ~~valve~~ PRD ~~includes~~ contains non-metallic ~~parts~~ components, such as ~~a~~ diaphragms or soft seats, periodic replacement of ~~those~~ these parts may be ~~specified~~necessary;

d) Operating history of the system. Systems with frequent upsets where a PRD~~valve~~ has actuated require more frequent inspection;

e) Results of visual inspection ~~of the device~~ and installation conditions. ~~Signs~~ Evidence of ~~valve~~PRD leakage, corrosion, or damaged ~~parts~~ components all indicate more frequent operational inspections are required;

f) ~~Installation of a valve in a system with a common discharge header. Valves~~ PRDs discharging into a common collection pipe may be affected by ~~the~~ discharge ~~of~~ from other ~~valves~~ devices, ~~by the~~ including corrosion of ~~parts in the~~ outlet components ~~portion~~ of the ~~valve~~ device or ~~the buildup~~accumulation of ~~products~~ discharged materials from those ~~valves~~ devices;

g) Ability to coordinate with planned system shutdowns. ~~The shutdown of a~~A planned system shutdown for ~~other~~ maintenance or inspection activities ~~is~~ provides an ideal ~~time~~ opportunity for the operational inspection and test of a ~~pressure relief~~ PRD ~~valve~~;

h) Critical nature of the system. Systems that are critical to plant operation, or systems whose fluid discharge ~~where the effects of the discharge of fluids from the system are particularly detrimental due to~~could result in fire hazards, environmental damage, or toxicity concerns, all call for more frequent inspection intervals to ensure proper devices ~~are operating properly~~ operation; and

i) Uncertain service conditions. Where the effects of corrosion, blockage by system fluid, or the ability of the ~~valve~~ PRD to operate under ~~given~~ service conditions are unknown (~~such as~~e.g., in a new process or installation), a relatively ~~short~~ brief inspection interval, not to exceed one year or the first planned shutdown, whichever is shorter, shall be established. At that time, the device shall be visually inspected and tested. If unacceptable test results are obtained, the inspection interval shall be reduced by 50% until suitable results are obtained.

3.2.6.2 ESTABLISHMENT OF SERVICE INTERVALS

a) The above intervals listed in Table 3.2.6 are guidelines for periodic inspection and testing. Typically, if there are no adverse findings, a ~~pressure relief valve~~ PRD would be placed back in service until the next inspection. Any unacceptable conditions that are found by the inspection shall be corrected immediately by repair or replacement of the device. Many users will maintain spare ~~pressure relief device~~PRDs so the process or system is not affected by excessive downtime.

b) ~~Pressure relief valve~~PRVs are mechanical devices that require periodic preventive maintenance even though external inspection and test results indicate acceptable performance. There may be wear on internal parts, galling between sliding surfaces, internal corrosion, or fouling which will not be evident from an external inspection or test. Periodic re-establishment of seating surfaces and the replacement of soft goods, such as ~~o~~O-rings and diaphragms, are also ~~well advised~~recommended preventive maintenance activities ~~that can prevent future problems~~. If the PRV~~valve~~ is serviced, a complete disassembly, internal inspection, and repair as necessary, such that the valve's condition and performance are restored to a like-~~-~~new condition, should be ~~done~~ performed by a National Board "VR" Certificate Holder.

c) Service records with test results and findings should be maintained for all overpressure protection devices. A service interval of no more than three inspection intervals or ten years, whichever is less, is recommended to maintain device condition. Results of the internal inspection and maintenance findings can then be used to establish

	future service intervals.
Item 25-71 Part 4, 3.3.3.4 n)	3.3.3.4 n) Testing Equipment ~~(See NBIC Part 4, Supplement 5)~~ The QMS shall include a means to control the development, addition, or modification of testing equipment to ensure the requirements of 4.6.1 b) and 4.6.3 c) are met. Note: See Supplement 5 for a guide on the sizing of pressure vessels used as part of pressure relief valve test equipment.
Item 25-72 Part 4, 3.4 b) and 3.3.5 editorial (3.3.5 and 3.4)	**3.3.5 COMPETENCY, TRAINING, AND QUALIFICATION OF PERSONNEL** **3.4 ANNUAL AUDITS** a) 6) QMS Manual Control/Procedures: 3.3.3.4 l) b) The audit results shall be documented. Mandatory items in the ~~repair~~ testing organization's scope not performed during the annual audit period shall be documented as exceptions in the audit results.
NB15-0307; Item 25-71 Part 4, Section 4	PART 4, SECTION 4 PRESSURE RELIEF DEVICES — REPAIR OF PRESSURE RELIEF VALVES AND PIN DEVICES 4.1 SCOPE This section provides requirements and guidelines that apply to repairs to pressure relief valves (PRV)s and pin devices. a) Repairs may be required because of defects found during periodic inspection, testing, operation, or maintenance. Since pressure relief devices (PRD)s are provided for safety and the protection of personnel and property, repairs are often regulated by the jurisdiction where the ~~pressure relief device~~PRD is installed. The jurisdiction should be contacted for their specific requirements. b) This section describes some of the administrative requirements for the accreditation of repair organizations. Additional administrative requirements are in NB-514, A*ccreditation of Valve Repair ("VR")* ~~*Repair*~~ *Organizations*. Some j~~J~~urisdictions may independently administer a program of authorization for organizations to perform repairs within that jurisdiction. c) Requirements for repairs and alterations to pressure-retaining items and repair and replacement activities for nuclear items are in NBIC Part 3.

4.2 GENERAL REQUIREMENTS

a) Repair of a ~~pressure relief valve~~PRV or pin device is considered to include the disassembly, replacement, re-machining, or cleaning of any critical part, lapping of a seat and disc, replacement of O-ring or seals, reassembly, adjustment, testing, or any other operation that may affect the flow passage, capacity, function, or pressure-retaining integrity of the PRD.

b) Conversions, changes, or adjustments (excluding those ~~as~~ defined in 3.2.5.5 a) or NBIC Part 2, 2.5.7.5 a)) affecting critical parts are also considered repairs. The scope of conversions may include the following changes, provided such changes are recorded on the document and the repair nameplate as required ~~for by a~~ their Quality Management System (QMS) ~~and the repair nameplate~~. (See 4.7.1.)

1) changes in service fluid;

2) changes such as bellows and soft seats; and

3) other changes that may affect type/model number.

c) The scope of repair activities shall not include changes in American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) status.

4.2.1 “VR” REPAIR

a) When a repair is being performed under ~~the~~ National Board accreditation administrative requirements ~~for National Board accreditation~~, the repair shall consist of the following operations as a minimum:

1) Complete disassembly, cleaning, and inspection of parts, repair or replacement of parts found to be defective, reassembly, testing as required by 4.6, and sealing and application of a repair nameplate. ~~When completed~~After completion, the ~~valve~~PRV’s or pin device’s condition and performance shall be equivalent to the standards for new ~~valves~~ construction.

2) The administrative requirements for National Board accreditation apply ~~only~~ to ~~valves~~ PRVs that are marked with the ASME Single Certification Mark and the “V”, “UV”, “HV”, or “NV” Designator or pin devices marked with the ASME Single Certification Mark and UD Designator, or the supplanted ASME “V”, “UV”, UD (for pin devices), “HV”, or “NV” Code ~~s~~Symbol. ~~and~~These PRDs shall have been National Board capacity-certified or flow-~~-~~resistance-~~-~~certified on the applicable medium.

4.2.2 CONSTRUCTION STANDARDS FOR THE REPAIR OF PRESSURE RELIEF DEVICES

a) For the repair of ~~pressure relief device~~PRDs, the following construction standards shall apply:

1) The applicable new construction standard used for reference during repairs shall be the original code of construction.

2) Applicable ASME Code Cases shall be used for reference during repairs when:

a. ~~T~~the device complies with an ASME Code Case; or

b. ~~T~~the device undergoes a conversion to comply with an ASME Code Case.

b) For ~~pressure relief devices~~PRDs converted in accordance with 4.2.2 a) 2), the ASME Code Case number shall be noted on the repair document and stamped on the repair nameplate.

c) A device that complies with an ASME Code Case may be converted to comply with the original code of construction.

d) For ~~pressure relief device~~PRDs converted to the original code of construction, the ASME Code Case number shall be noted on the repair document but shall not be stamped on the repair nameplate. References to that ASME Code Case shall be marked out but left legible on the original nameplate.

e) The jurisdiction where the pressure-retaining item is installed shall be consulted for any unique requirements it may have established, including construction standards and ASME Code Cases.

4.2.3 INSTALLATION OF PRESSURE RELIEF DEVICES

Installation of a ~~pressure relief device~~PRD by mechanical methods is not considered to be a repair if no changes or adjustments are made to the device. Seals installed by the device manufacturer or repair organization shall not be removed when the device is installed.

When a ~~pressure relief device~~PRD is to be installed by welding on an existing pressure-retaining item, the requirements for welded repairs in NBIC Part 3 shall be followed.

If a ~~pressure relief valve~~PRV or pin device must be disassembled or its adjustments changed as part of the installation process, the reassembly, resetting, retesting, or other such activities shall be performed by a qualified organization meeting the requirements of NBIC Part 4. For a new ~~pressure relief valve~~PRV or pin device, the original ~~valve~~ manufacturer shall perform this activity as required by the original code of construction.

The installation of a non-reclosing ~~pressure relief device~~PRD or the replaceable element of a non-reclosing ~~pressure relief device~~PRD, such as a rupture disk~~,~~ or pin, is not considered to be a repair. The manufacturer's procedures and instructions shall be followed for ~~the~~ installation of these devices.

4.2.4 INITIAL ADJUSTMENTS TO PRESSURE RELIEF VALVES AND PIN DEVICES

The initial installation testing and adjustments of a new ~~pressure relief valve~~PRV on a boiler, or a PRV or pin device on a pressure vessel, are not considered a repair if made by the manufacturer or assembler of the ~~valve~~PRD.

4.3 MATERIALS FOR PRESSURE RELIEF VALVE AND PIN DEVICE REPAIR

The materials used for repairs shall conform to the requirements of the original code of construction. The "VR" Certificate Holder is responsible for verifying identification of existing materials from original data, drawings, or unit records and for verifying identification of the materials to be installed.

4.3.1 REPLACEMENT PARTS FOR PRESSURE RELIEF DEVICES

a) Critical parts shall be fabricated by the ~~valve~~PRV or pin device manufacturer or to the manufacturer's specifications. Critical parts are those that may affect the ~~valve~~ PRD flow passage, capacity, function, or pressure-retaining integrity.

b) Critical parts not fabricated by the ~~valve~~ PRD manufacturer shall be supplied with material test certification for the material used to fabricate the part.

c) Receiving records for critical replacement parts shall be attached or traceable to the ~~valve~~ PRD repair document described in 4.8.5.4 i). These records shall conform to at least one of the following.

1) Receiving records documenting the shipping origin of the part fabricated by the PRD ~~valve~~ manufacturer (e.g., packing list) from the ~~valve~~ manufacturer or assembler of the ~~valve~~PRD type.

2) A document prepared by the "VR" Certificate Holder certifying that the replacement part used in the repair has the manufacturer's identification on the part or is otherwise labeled or tagged by the manufacturer and meets the manufacturer's acceptance criteria (e.g., critical dimensions found in maintenance manual).

3) Receiving records for critical replacement parts obtained from a source other than the PRV or pin device ~~valve~~ manufacturer or assembler of the PRD ~~valve~~ type shall include a document that provides as a minimum:

a. The part manufacturer and part designation.

b. A certifying statement that either:

1. the part was fabricated by the PRV and pin device ~~valve~~ manufacturer and meets the manufacturer's acceptance

criteria (e.g., critical dimensions found in maintenance manual); or

2. the part meets the manufacturer's specifications and was fabricated from material as identified by the attached material test report.

c. The signature of an authorized individual of the part source.

d. The name and address of the part source for whom the authorized individual is signing.

d) Material for bolting shall meet the manufacturer's specification~~,~~ but does not require material test certification if marked as required by the material specification.

4.4 WELDING FOR PRESSURE RELIEF VALVES AND PIN DEVICES

When welding is used as a repair technique during a ~~pressure relief valve~~PRV or pin device repair, the following requirements shall apply.

a) Welding shall be performed in accordance with the requirements of the original code of construction used for the ~~pressure relief valve~~PRD.

b) Cast iron and carbon or alloy steel having a carbon content of more than 0.35% shall not be ~~welded~~.

c) Defects in ~~pressure relief valve~~PRD parts, such as cracks, pits, or corrosion, that will be repaired by welding, shall be completely removed before the weld repair of the part is performed. Removal of the defect shall be verified by suitable nondestructive examination (NDE) as required.

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

4.4.7 WELD REPAIRS TO PRESSURE RELIEF VALVE AND PIN DEVICE PARTS BY AN "R" CERTIFICATE HOLDER

a) The Quality Management System (QMS) Manual ~~(QMS Manual)~~ may include controls for the "VR" Certificate Holder to have the ~~pressure relief valve~~PRV and pin device parts repaired by a National Board "R" Certificate Holder, in accordance with this section, when the following documentation is provided to the "R" Certificate Holder:

1) Code of construction, year built;

2) Part identification;

3) Part material specified; and

4) "VR" Certificate Holder's unique identifier for traceability as required by the repair inspection program.

b) Prior to performing weld repairs to ~~pressure relief valve~~PRD parts, the "R" Certificate Holder shall receive repair information required by 4.4.7 a) from the "VR" Certificate Holder responsible for the ~~pressure relief valve~~PRD repair.

1) ~~Pressure relief valve~~PRD part weld repairs shall be performed under the "R" Certificate Holder's QMS; however, the requirements for in-process involvement of the Inspector (see NBIC Part 3, 3.3.2) may be waived. The requirement for stamping is waived.

2) The process of identifying and controlling repairs shall be documented in the "R" Certificate Holder's QMS.

3) ~~Pressure relief valve~~PRD part repairs shall be documented on the NB-66, Form R-1, *Report of Repair* with a statement under the "Remarks" section (line 10) "Pressure relief valve or pin device ~~"PRV pPart Repair~~repair." The owner's name and location of installation shall be that of the "VR" Certificate Holder. The information received from the "VR" Certificate Holder, as required in 4.4.7 a), shall be noted under the "Description of Work" section (line 8).

4) Upon completion of the repair, the repaired part and completed Form R-1 shall be returned to the "VR" Certificate Holder responsible for completing the ~~pressure relief valve~~PRD repair.

4.6 PRESSURE RELIEF VALVE AND PIN DEVICE PERFORMANCE TESTING AND TESTING EQUIPMENT

Each ~~pressure relief valve~~PRV and pin device to which the "VR" Symbol is to be applied shall be subjected to the following tests by the ~~repair~~ "VR" Certificate Holder.

4.6.1 TEST MEDIUM AND TESTING EQUIPMENT

~~Valves~~ PRVs marked for steam service, or having special internal parts for steam service, shall be tested on steam. ~~Valves~~ PRVs marked for air, gas, or vapor service shall be tested with air or gas. ~~Valves~~ PRVs marked for liquid service shall be tested with water or other suitable liquid. ASME BPVC ~~Code~~ Section IV hot-water valves shall be tested on water, steam, or air. Pin devices shall be tested in accordance with the manufacturer's specified procedures and with the test media specified by the manufacturer and the appropriate ASME BPVC section.

a) Each ~~valve~~PRV or pin device shall be tested to demonstrate the following:

1) PRV s~~S~~et pressure (as defined by the ~~valve~~ PRV manufacturer and listed in NB-18, *Pressure Relief Device Certification*). Pin device set pressure by a functional test using a manufacturer's qualified pin;

2) Response to blowdown when required by the original code of construction;

3) Seat tightness; and

4) For ~~valves~~PRDs designed to discharge to a closed system, the tightness of the secondary pressure zone shall be tested as required by the original code of construction.

b) The equipment used for the performance testing prescribed above shall meet the following requirements:

1) The performance testing equipment shall include a pressure vessel of adequate volume and pressure source capacity to ensure compliance with 4.6.1 a) 1);

2) Prior to use, all performance testing equipment shall be qualified by the Certificate Holder to ensure ~~that~~ the equipment and testing procedures will provide accurate results when used within the ranges established for that equipment. This qualification may be accomplished by benchmark testing, comparisons to equipment used for verification testing as specified in the QMS, or comparisons to field performance. This qualification shall be documented. Documentation of this qualification shall be retained in accordance with Table 4.8.5.4 s). Documentation of this qualification shall include, at minimum, ~~but not be limited to~~ the following:

a. Schematic of the performance test equipment;

b. Size and pressure ranges of ~~valves~~ PRVs and pin devices to be tested and the test ~~fluid~~ medium 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 4.6.1 b) 2), the Certificate Holder shall re-qualify the performance test equipment in accordance with 4.6.1 b) 2). If the equipment was changed ~~was used~~ to satisfy the requirements of verification testing, the Certificate Holder shall notify the National Board. Additional verification testing in accordance with the QMS may be required.

4.6.4 PRESSURE TEST OF PARTS

a) Parts used in repaired ~~valve~~PRVs and pin devices that are required to be tested by the original code of construction shall be pressure tested, and documentation shall be provided according to the following categories:

1) Replacement Parts

The "VR" Certificate Holder is responsible for documentation that the appropriate pressure test has been completed.

2) Parts Repaired by Welding

These parts shall be subjected to the required pressure test. The "VR" Certificate Holder shall be responsible for documentation of such test.

b) Parts repaired by lapping, polishing, or re-machining within part specifications do not require a pressure test.

4.7 STAMPING REQUIREMENTS FOR PRESSURE RELIEF DEVICES

4.7.1 NAMEPLATES

Proper marking and identification of tested or repaired ~~valve~~PRVs and pin devices ~~is~~ are critical to ensuring acceptance during subsequent inspections~~,~~ and provide~~s~~ for traceability and identification of any changes made to the ~~valve~~PRD. All operations that require ~~the~~ a seal on a ~~valve's~~ PRD~~seals~~ to be replaced shall be identified by a nameplate, as described in 4.7.2 and 4.7.4.

4.7.2 REPAIR NAMEPLATES

When a ~~pressure relief valve~~PRV or pin device is repaired, a metal repair nameplate stamped with the information required below shall be securely attached to the ~~valve~~PRD adjacent to the original manufacturer's stamping or nameplate. If not installed directly on the ~~valve,~~PRD, the nameplate shall be securely attached to the ~~valve~~PRD in a manner that does not interfere with ~~valve~~ its operation, is independent of the external adjustment seals, and allows the ~~valve~~ PRD to be sealed in accordance with the QMS.

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

b) ~~As a minimum, t~~The ~~information on the valve~~PRD repair nameplate (see Figure 4.7.2-a) shall include, as a minimum:

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

2) The "VR" Symbol ~~S~~stamp and the National Board "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 or certified flow resistance (Kr) (if changed from original nameplate);

7) Type/~~M~~mmodel number (if changed from original nameplate); and

8) When an adjustment is made to correct for service conditions of superimposed back pressure, temperature, or both, the information on the ~~valve~~ PRD repair nameplate shall include the:

a. c~~C~~old ~~D~~ddifferential t~~T~~est p~~P~~ressure (CDTP); and

b. s~~S~~uperimposed ~~B~~bback p~~P~~ressure (BP), only when applicable.

FIGURE 4.7.2-a
EXAMPLE LAYOUT OF REQUIRED MARKINGS FOR REPAIR OF ~~ASME/~~NATIONAL BOARD/ASME ~~"~~V,~~"~~ ~~"~~UV,~~"~~ UD, AND ~~"~~HV~~"~~ ~~STAMPED~~ DESIGNATED PRESSURE RELIEF VALVES OR PIN DEVICES

4.7.3 CHANGES TO ORIGINAL PRESSURE RELIEF VALVE OR PIN DEVICE NAMEPLATE INFORMATION

a) Information on the original nameplate or stamping, such as but not limited to set pressure, capacity, blowdown, or type/model number, may no longer be valid following certain repair activities. For these repairs, the invalidated information on the original nameplate or stamping shall be marked out but left legible. Any changes to capacity shall be based on that for which the PRD~~valve~~ was originally certified. Or if a conversion has been made as described in 4.2, any changes to capacity shall be based on the capacity certification for the PRD~~valve~~ as converted. Similarly, the certified flow resistance for a pin device shall be updated if there is a change in service fluid.

b) Repair organizations shall verify the type/model number, inlet size, set pressure, and capacity information that is not marked out on the original nameplate or stamping ~~that is not marked out~~. Incorrect information on the original manufacturer's nameplate or stamping shall be marked out but left legible. Corrected information shall be indicated on the repair nameplate and noted on the repair document as required by the QMS.

4.7.4 ILLEGIBLE OR MISSING NAMEPLATES

The "VR" Certificate Holder shall not perform repairs under the "VR" Program on any ~~pressure relief valve~~PRV or pin device that cannot be positively identified by the manufacturer or through in-house sources. Such identification shall include verification of the original ASME Symbol. ~~Pressure relief valve~~PRVs or pin devices that have missing or illegible nameplates, ~~and~~ but which can be positively identified, shall be equipped with a nameplate marked "DUPLICATE," ~~which contains~~containing all original nameplate data. The duplicate nameplate shall not bear the "NB" Mark or the ASME Single Certification Mark. To indicate the original designator or code stamping, the duplicate nameplate shall be ~~stamped~~ marked

with "V", "HV", or "UV", or UD, as applicable. Illegible nameplates, if applicable, shall not be removed.

4.8.3.2 ISSUANCE OF CERTIFICATE

The following entities may apply for a National Board "VR" *Certificate of Authorization*:
Repair organizations, manufacturers, assemblers, and or users that make repairs to any of the following: the

a) ASME Code Symbol stamped or marked pressure relief valvePRVs or pin devices; and
b) PRVs or pin devices that are National Board-certified for capacity-certified or flow -resistance certified pressure relief valves may apply to the National Board for a *Certificate of Authorization* to use the "VR" Symbol.

4.8.5.4 OUTLINE OF REQUIREMENTS FOR A QMS

The following establishes the minimum requirements of the written description of the QMS. Each valve PRD repair organization shall develop its own QMS that meets the requirements of its organization. For this reason, it is not possible to develop one QMS that could apply to more than one organization. The written description shall include, as a minimum, the following features:

a) Title Page

The title page shall include the name and address of the company to which the National Board *Certificate of Authorization* is to be issued.

b) Revision Log

A revision log shall be included to ensure revision control of the QMS Manual. The log should contain sufficient space for date, description and section of revision, company approval, and National Board acceptance.

c) Contents Page

The contents page shall should list and reference by section, by paragraph, or and page number, the subjects and exhibits contained therein.

d) Statement of Authority and Responsibility

A statement of authority and responsibility shall be dated and signed by an officer of the company. It shall include:

1) A statement that the "VR" Symbol shall be applied only to pressure relief valvePRVs and pin devices that meet both of the following conditions:

a. Aare marked with the ASME Single Certification Mark and the "V", "UV", "HV", UD, or "NV" Designator or the supplanted ASME "V", "UV", "HV", UD, or "NV" Code Ssymbol and have been capacity-

certified or flow--resistance--certified by the National Board; and

b. Hhave been disassembled, inspected, and repaired by the Certificate Holder such that the valves' PRD's condition and performance are equivalent to the standards for new pressure relief valves or pin devicesconstruction.

2) The title of the individual responsible for ensuring the QMS is followed and who has authority and freedom to affect responsibility;

3) A statement that if there is a disagreement in the implementation of the written QMS Manual, the matter is toshall be referred to a higher authority in the company for resolution; and

4) The title of the individual authorized to approve revisions to the written QMS Manual and the method by which such revisions are to be submitted to and accepted by the National Board before implementation.

e) Organization Chart

A chart showing the relationship between management, purchasing, repairing, inspection, and quality control personnel shall be included and shall reflect the organization currently in place.

f) Scope of Work

1) The scope of work section shall indicate the scope and type of valve PRD repairs, including conversions of which the organization is capable and intends to perform. The location of repairs (e.g., shop only, field only, shop and field), ASME BPVC Code section(s) to which the repairs apply, test media used (e.g., air, gas, liquid, steam, or combinations thereof), and special processes (e.g., machining, welding, postweld heat treatment, nondestructive examination, or combinations thereof) shall be specifically addressed.

2) The types and sizes of valves PRDs to be repaired, pressure ranges, and other limitations, such as engineering and test facilities, should also be addressed.

g) Drawings and Specification Control

The drawings and specification control system shall provide procedures ensuring the latest applicable drawings, specifications, and instructions required are used for valve PRD repair, including conversions, inspection, and testing.

h) Material and Part Control

The material and part control section shall describe the purchasing, receiving, storageing, and issuing of parts.

1) The title of the individual responsible for the purchasing of all material shall be stated.

2) The title of the individual responsible for certification and other records as required shall be stated.

3) All incoming material and parts shall be checked for conformance with the purchase order, and~~,~~ where applicable, the material specifications or drawings. Indicate how material or part is identified and how identity is maintained by the QMS.

i) Repair and Inspection Program

The repair and inspection program section shall include reference to a document (e.g., a report, traveler, or checklist) that outlines the specific repair and inspection procedures used in the repair of ~~pressure relief valve~~PRVs and/or pin devices. Repair procedures shall require verification that the critical parts meet the ~~valve~~PRD manufacturer's specifications. Supplement 4 outlines recommended procedures ~~covering~~ for repairs of specific items. This document shall be retained in accordance with Table 4.8.5.4 s).

1) Each ~~valve~~PRV, pin device, or group of ~~valves~~ PRDs shall be accompanied by the repair document referenced in 4.8.5.4 i), above, for processing through the plant. Each ~~valve~~ PRD shall have a unique identifier (e.g., repair serial number, shop order number, etc.) appearing on the repair documentation and repair nameplate ~~such that~~for traceability ~~is established~~.

2) The document referenced in 4.8.5.4 i), above, shall describe the original nameplate information, including the ASME Code Symbol, and if applicable, the repair nameplate information. For pilot-operated valves, the manufacturer's unique identifier on the pilot and main valve shall also be recorded. In addition, the document shall include documentation of material checks, replacement parts, conversion parts (or both), reference to items such as the WPS~~s~~, fitup, NDE technique, heat treatment, and pressure test method~~s~~ to be used. Application of the "VR" Symbol to the repair nameplate shall be recorded in this document. Specific conversions performed with the new type/model number shall be recorded on this document. There shall be a space for "signoffs" at each operation to verify that each step has been properly performed.

3) The QMS shall include a method of controlling the repair or replacement of critical ~~valve~~PRV and/or pin device parts. The method of identifying each spring shall be indicated on the repair document described 4.8.5.4 i). Such identification shall be based on the manufacturer's spring chart current at the time of the repair. An exception would be if the spring (bearing different identification) is removed from the ~~valve~~ PRD during the repair, it may be reinstalled, provided the "VR" Certificate Holder has verified the spring is acceptable to the manufacturer. Such verification shall be documented on the repair document ~~described in 4.8.5.4 i)~~.

4) The QMS shall also describe the controls used to ensure that any personnel engaged in the repair of ~~pressure relief valves~~ PRDs are

trained and qualified in accordance with this section.

j) Welding, NDE, and Heat Treatment (when applicable)

The QMS Manual shall ~~indicate the title of the person(s) responsible for and~~ describe the system used in the selection, development, approval, and qualification of WPSs, including the qualification of welders and welding operators in accordance with the provisions of 4.4. The QMS Manual shall also indicate the title of the person(s) responsible for this system.

1) The QMS Manual may include controls for the "VR" Certificate Holder to have a part of a ~~the pressure relief valve part~~PRD repaired by a National Board "R" Certificate Holder, ~~per~~ in accordance with ~~4.~~4.7.

2) The completed Form R-1 shall be ~~noted on and~~ attached to the "VR" Certificate Holder's repair document required in 4.8.5.4 i)~~.~~, with the use of such annotated on the repair document. Similarly, NDE and heat treatment techniques shall be ~~covered~~ noted in the QMS Manual. When outside services are used for NDE and heat treatment, the QMS Manual shall describe the system whereby the use of such services meets the requirements of the applicable section of the ASME ~~Code~~BPVC.

k) ~~Valve~~PRV and Pin Device Testing, Setting, and Sealing

The QMS shall include provisions that each ~~valve~~PRD is tested and set, with all external adjustments sealed according to the requirements of the applicable ASME ~~Code~~ BPVC section and the NBIC. The seal shall identify the "VR" Certificate Holder performing the repair. Abbreviations or initials shall be permitted, provided such identification is defined in the QMS and acceptable to the National Board.

l) PRV~~alve~~ and Pin Device Repair Nameplates

An effective ~~valve~~ stamping system shall be established to ensure proper stamping of each ~~valve~~PRD as required by 4.7.2. The QMS Manual shall include a description or drawing of the nameplate.

m) Calibration

1) The QMS Manual shall describe a system for the calibration of examination, measuring, and test equipment used in the performance of repairs. Documentation of these calibrations shall include the standard used and the results. Calibration records shall be retained in accordance with Table 4.8.5.4 s).
2) All calibration standards shall be calibrated against certified equipment having ~~known~~ valid relationships to nationally recognized standards.

n) QMS Manual Control

The QMS Manual and referenced procedures shall include:

1) Measures to control the issuance of and revisions to the QMS Manual;

2) Provisions for a review of the QMS in order to maintain the manual current with the NBIC and ~~the~~ applicable sections of the ASME ~~Code~~BPVC;

3) The title(s) of the individual(s) responsible for preparation, revision distribution, approval, and implementation ~~control, revisions, and review~~ of the QMS Manual;

4) Provision of a controlled copy of the accepted ~~written~~ QMS Manual to be submitted to the National Board; and

5) Provision that revisions to the QMS Manual shall be submitted to and accepted by the National Board prior to being implemented.

o) Nonconformities

The QMS shall establish measures for the identification, documentation, evaluation, segregation, and disposition of nonconformities. A nonconformity is a condition of any material, item, product, or process in which one or more characteristics do not conform to the established requirements. This may include data discrepancies, procedural or documentation deficiencies, or material defects. The title(s) of the individual(s) involved in this process shall also be included.

p) Exhibits

Forms used in the QMS shall be included in the QMS Manual with a written description. Forms exhibited should be marked “SAMPLE” and completed in a manner typical of actual ~~valve~~ PRD repair procedures.

q) Testing Equipment

The QMS shall include a means to control the development, addition, or modification of testing equipment to ensure the requirements of 4.6.1 b) and 4.6.3 c) are met.

Note: See Supplement 5 for a guide on the sizing of pressure vessels used as part of ~~pressure relief valve~~PRV test equipment.

r) Field Repairs

If field repairs are included in the scope of work, the QMS shall address any differences or additions required to properly control this activity, including the following:

1) Provisions for receipt and inspection of replacement parts, including parts received from the ~~owner-user~~owner or user, shall be addressed;

2) If ~~owner-user~~owner or user personnel will assist with repairs,

provisions for the use of ~~owner-user~~those personnel shall be included; and

3) Provisions for use of ~~owner-user~~owner or user measurement and test equipment, if applicable, shall be addressed.

s) Records Retention

The QMS Manual shall describe a system for filing, maintaining, and easily retrieving records supporting or substantiating the administration of the QMS within the scope of the "VR" *Certificate of Authorization*. The record retention schedule described in the QMS Manual shall follow the instructions identified in Table 4.8.5.4.s).

TABLE 4.8.5.4 s)

Reports, Records, or Documents for "VR" Certificate Holders	Instructions	Minimum Retention Period
Form "R" Reports associated with a ~~pressure relief valve~~PRD that required welding as part of the repair	Record retention shall be in accordance with NBIC Part 3, Table 1.5.1.	Refer to NBIC Part 3, Table 1.5.1.
Record of repair or inspection	The repair and inspection program section shall include reference to a document (e.g., a report, traveler, or checklist) that outlines the specific repair and inspection procedures used in the repair of ~~pressure relief valves~~ PRDs.	5 years
Records related to equipment qualification and instrument calibration	Prior to use, all performance testing equipment shall be qualified by the Certificate Holder to ensure the equipment and testing procedures will provide accurate results when used within their established ranges. This qualification may be accomplished by benchmark testing, comparisons to equipment used for verification testing as specified in the QMS, or	5 years after the subject piece of equipment or instrument is retired

			comparisons to field performance.		
		Record of lift assist device qualification	Prior to use, all lift assist devices shall be qualified by the Certificate Holder to ensure the equipment and testing procedures will provide accurate results when used within their established ranges. Lift assist device qualification may be accomplished using verification testing as specified in the QMS or using comparisons to field performance. This qualification shall be documented.	5 years after the lift assist device is retired	
		Records of employee training and qualification	Each repair organization shall establish minimum qualification requirements for the positions within the organization directly relating to ~~pressure relief valve~~ PRD repair. Each repair organization shall document the evaluation and acceptance of an individual's qualification for the applicable position.	5 years after termination of employment	
		Training and qualification r~~R~~ecords of personnel not in the Certificates Holder's employ ~~training and qualification.~~	The repair organization may use the services of personnel not in their employ to assist the Certificate Holder in the performance of repairs, provided such personnel meet the requirements of Section 4.10. Each repair organization shall document	5 years after the completion of work performed by the individual not in the Certificate Holder's employ	

			the evaluation and acceptance of an individual's qualification for the applicable position.	
		Records of audits of the QMS~~.~~	The repair organization shall audit the QMS on an annual basis. Audit results shall be documented, and any exclusions shall be noted.	5 ~~Y~~years
Item 25-01 Part 4, 4.7.3	**4.7.3 CHANGES TO ORIGINAL PRESSURE RELIEF VALVE NAMEPLATE INFORMATION** a) Information on the original nameplate or stamping, such as but not limited to set pressure, capacity, blowdown, or type/model number may no longer be valid following certain repair activities. For these repairs, the entire field containing the invalidated information on the original nameplate or stamping shall be marked out but left legible. Any changes to capacity shall be based on that for which the valve was originally certified. Or if a conversion has been made as described in 4.2, any changes to capacity shall be based on the capacity certification for the valve as converted. b) Repair organizations shall verify the type/model number, inlet size, set pressure, and capacity on the original nameplate or stamping that is not marked out. The entire field containing ~~I~~incorrect information on the original manufacturer's nameplate or stamping 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 QMS.			
NB15-0307 And editorial Part 4, Supplement 4	SUPPLEMENT 4 RECOMMENDED PROCEDURES FOR REPAIRING PRESSURE RELIEF VALVES AND PIN DEVICES S4.1 SCOPE			

	a) This supplement contains recommended procedures for the repair, packaging, shipping, and transportation of pressure relief valves (PRV)s and pin devices. S4.2 contains recommended procedures for the repair of spring-loaded ~~pressure relief valve~~PRVs. S4.3 contains recommended procedures for the repair of various pilot--operated ~~types of pressure relief valve~~PRVs. S4.4 contains recommended procedures for the repair of weight--loaded vents. S4.5 contains information on pin devices. S4.6 contains information on packaging, shipping, and transportation. b) ~~It is essential that the r~~Repair organizations shall establish ~~basic,~~ specific procedures for the repair of ~~pressure relief valve~~PRVs and pin devices. ~~The purpose of these recommended procedures is to provide the repair organization with guidelines for this important aspect of valve repair. It is realized that t~~There are many types of ~~valve~~PRVs, pin devices, and repair conditions ~~under which they are repaired and, for this reason~~, so ~~the specific items in~~some of these recommended procedures may not apply, or they may be inadequate for ~~each of those~~ a device type~~s~~ or to the detailed repairs ~~that may be~~ required for ~~each valve~~ a PRD. c) Prior to removal, repair, or disassembly of a ~~pressure relief valve~~ PRD, ensure that all sources of pressure have been removed.

S4.2 Spring-Loaded Pressure Relief Valves

b) Preliminary test as received

2) Determine set pressure or c~~C~~old ~~D~~ddifferential t~~T~~est p~~P~~ressure (CDTP) in accordance with the manufacturer's recommendations and appropriate American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) ~~Code~~ ~~Ss~~section. Do not allow test pressure to exceed 116% of set pressure unless otherwise specified by the owner. A minimum of three tests is usually required to obtain consistent results.

S4.5 Pin Devices

Prior to removing a pin device from a system for a repair or disassembly, ensure that all sources of pressure have been removed from the pin device.

a) Visual inspection as received

1) This information shall be recorded:

a. User (customer) identification number.

b. Complete original pin device nameplate data, previous repair nameplate data, and any important information from the customer.

c. Condition of tamper-proof seals. Ensure they are intact.

d. Condition of bonnet top, columns, and buckling pin screw. Check for any damage or bending. Note: Bent columns will result in a misalignment of the upper and lower pin holders, causing the pin device to malfunction, in which case it shall be removed from service.

2) Check for any unusual damage, or any missing or misapplied parts per the manufacturer's assembly drawing.

3) If sufficient damage or other unusual conditions that may pose a safety risk during preliminary testing are detected, then proceed directly to S4.5 c)

4) For pin devices that are to be repaired in place, proceed to S4.5 c) unless preliminary testing has been requested by the owner.

b) Preliminary test as received (consult manufacturer's instructions throughout)

1) Information from the recommended preliminary performance

test and subsequent disassembly and inspections will provide a basis for any repair interval change that is necessary to ensure the pin device will function as intended.

2) One of the following tests should be performed on the pin device:~~.~~

a. Measure lift force to move the plug from the closed position to the open position. This can be performed with a force gage or by using pressure *without* the pin. Repeat three times and record the data. Check for compliance with the manufacturer's range of acceptable values.

b. Reseat the plug fully into the seat. Some manufacturers supply a tool for this purpose. Otherwise, turn the adjuster screw. Measure the torque required to fully seat (without vertical movements in conjunction to the plug). Check the required seating torque for compliance with the manufacturer's range of acceptable values.

c. Conduct one set pressure test using the manufacturer's pin designated for the specific device. Do not allow the test pressure to exceed 110% of set pressure unless otherwise specified by the owner.

3) If the test results from S4.5 b) 2. are outside the manufacturer's recommendations and set pressure tests are outside the ASME limits or agreed upon tolerance, proceed to S4.5 c).

4) Record test results and test bench identification data.

c) Disassembly (consult manufacturer's instructions throughout)

1) Remove pin protective cage (screen), if applicable.

2) Prior to any disassembly, ensure the plug is reseated. Reseating may require a torque wrench as specified in S4.5 b) 2. b. Once the plug is seated, remove the gag or shipping pin, if applicable.

3) Remove the required seals on the bonnet flange bolts, if applicable.

4) Remove the bonnet flange bolts.

5) Remove the bonnet flange assembly, which includes the bonnet flange, columns, upper pin holder top, and buckling pin adjuster screw. Lift the bonnet flange assembly vertically using a strap on the upper pin holder top.

~~5.~~6) Remove the bonnet/plug assembly out of the seat using thread or the nut on top of the plug assembly. Ensure the plug assembly, including the top where the buckling pin is inserted, is not

damaged.

~~a.~~ After carefully lifting the plug assembly out of the body, place it on a clean surface. Be careful not to damage the plug seat area.

~~6)~~7) Remove the plug from the bonnet. Inspect all seals and replace. Check the bonnet bore for cleanliness and for wear and scratches. If there are minor scratches, you may polish the bore. Ensure material is not removed from the bore as this is a critical dimension.

~~7)~~8) Remove the plug seat from the body, if applicable, and clean and replace the seals.

d) Cleaning

1) Clean the adjuster screw or holding nut.
2) Thoroughly clean all small parts. (Caution: do not use a cleaning method that will damage the parts.)
3) Do not clean using a chemical solution except under acceptable circumstances.
4) Protect seating surfaces and nameplates prior to cleaning.
5) Clean the inside of the body as needed.

e) Inspection

1) Check all parts for corrosion.
2) Check the nozzle for cracks or unusual wear using NDE as applicable.
3) Check the plug and stem assembly for cracks or unusual wear using NDE as applicable.
4) Check the bonnet guide for wear.
5) Check that the adjuster screw or holding nut is free of galling or damage.
6) Check the flange gasket facings for wear and cuts.
7) Check the pin bearing points for fit and engagement.

f) Assembly (consult manufacturer's instructions throughout)

1) Install the seat in the body.
2) Install the plug back into the bonnet with new seals, and ensure the plug is moving freely. If the plug is moving freely, install the nut on the piston/plug, and set it aside for reinstalling the assembly back onto the body.

3) Install the bonnet plug assembly back into the body carefully.

4) After installing the bonnet flange and tightening the flange studs, ensure the plug is inserted and fully seated into the plug seat and moving freely. During this step of the assembly process, care shall be taken to ensure the plug is centered and free to move inside the plug seat.

5) Measure the opening pressure without the pin to confirm it complies with the original manufacturer's load or pressure measurements.

g) Testing

Test data shall be recorded. Testing shall be performed in accordance with the manufacturer's recommendations and appropriate ASME BPVC section. To preclude unsafe and unstable pin device operations or erroneous performance test results, low-volume testing equipment (e.g., gas cylinders without a test vessel, hand pumps, tubing) should be avoided.

h) Sealing

~~1.~~ After final adjustments are made and quality control inspection is complete and accepted, all external adjustments shall be sealed with a means of identification of the repair organization, as required by the original code of construction.

i) Nameplate

The repairer will place a repair nameplate on each repaired pin device. The nameplate shall, as a minimum, meet the requirements of 4.7.1.

~~i.~~j) Installation of new pin (consult manufacturer's instructions throughout)

~~a.~~1) For pin devices with shipping pins, with zero pressure on the inlet or outlet, the shipping pin shall be removed and replaced with a pin tagged and traceable to the manufacturer, with matching set pressure, service, and pin device nameplate information.

~~1)~~2) Install pins that are straight, without any deflection, visual defect, or damage.

3) Ensure the pin device piston assembly moves freely without excessive resistance or force.

4) Reseat the piston assembly with the pin installed.

S4.6~~5~~ PACKAGING, SHIPPING, AND TRANSPORTATION OF PRESSURE RELIEF DEVICES

a) The improper packaging, shipment, and transport of pressure relief devices can have detrimental effects on device operation. Pressure relief devices should be treated with the same precautions as instrumentation, with care taken to avoid rough handling or contamination prior to installation.

b) The following practices are recommended for spring-loaded ~~pressure relief valve~~PRVs and pilot-operated ~~pressure relief valve~~PRVs:

1) PRVs and applicable pin devices ~~Valves~~ should be securely fastened to pallets in the vertical position to avoid side loads on guiding surfaces; threaded and socket-weld ~~pressure relief valve~~PRVs and pin devices ~~valves~~ up to NPS 2 (DN 50) may be securely packaged and cushioned during transport.

2) ~~valve li~~nlet and outlet connections, drain connections, and bonnet vents should be protected during shipment and storage to avoid internal contamination ~~of the valve~~. Ensure all covers and plugs are removed prior to installation.

3) ~~The valve~~PRVs should not be picked up or carried using the lifting lever. Lifting levers should be wired or secured so they cannot be moved while the valve is being shipped or stored. These wires shall be removed before the valve is placed in service.

4) Pilot valve tubing should be protected during shipment and storage to avoid damage.

5) ~~Valve~~PRVs and pin devices for special services, including but not limited to oxygen, chlorine, and hydrogen peroxide, should be packaged in accordance with the appropriate standards and/or owner procurement requirements.

THE NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD INSPECTION CODE
2027 DRAFT EDITION

Appendix A

S12.3 FORM NB-XX, REPORT OF ADDITIVELY MANUFACTURED (AM) PARTS

FIGURE S12.3

FORM NB-XX, PAGE 1 OF 2

THE
NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

NB-XX, Rev.0 (XX/XX/26)

FORM NB-XX, REPORT OF ADDITIVELY MANUFACTURED (AM) PARTS

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

_____ [Authorized Rep. initials]

_____ [Inspectors initials]

_____ (Form " R-2" Associated registration no.)

_____ (Form "NB-XX" unique ~~doc no.~~)

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

1. MANUFACTURED BY: _____ (name of producer)

I (address)

2. MANUFACTURED FOR: _____ (name of "R" certificate Holder/Purchaser)

_____ (address)

3. ORIGINAL PRODUCT FORM or ORDERED 'RAW' MATERIAL: _____ ORIGINAL DESIGN CODE:
(product form and specification number per design documents)

4. AM MATERIAL: _____ DESIGN CODE: _____ CODE DESIGN BY: _____
(corresponding product form and specification no. from Section II, Part A, B, & D)

5. REASON FOR AM USE (optional): _____

_____

6. REMARKS: _____

7. DESCRIPTION OF PARTS

Name of Part or Component	Use of Integrated Backing Y/N ("Convergent Manufacturing)	Qty. of parts	Line No. from associated 'R2'	Manufacturer's Identifying No. of 'finished part' or 'component'	Manufacturer's Drawing No. (~~include~~ mark no., BOM line no. or location if possible).)	Design Temp (if applicable)	Design Pressure	Year Built

8. ALTERATION/MODIFICATION ORIGINAL OR EXISTING PART AND AM PART INFORMATION

Original Raw Mat'l Part No.	Original Material Specification No.	Original Size and Shape (diameter/dimensions)	AM Part No.	AM Corresponding Material Specification (Include integrated backing spec. if applicable)	AM Part Size and Shape (diameter/dimensions)	Filler Mat'l and SFA Classification

9. REMARKS: _____

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors • 1055 Crupper Avenue, Columbus, Ohio 43229-1183

FIGURE S12.3

FORM NB-XX, PAGE 2 OF 2

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NB-XX, Rev.0 (XX/XX/2026)

11. CUSTOMER APPROVAL (IF REQUIRED): _____
(Approver name and title or position.)

12. APPROVAL REQUESTED DATE: _____ APPROVAL DATE: _____

13. CONDITIONS (IF APPLICABLE): _____

_____
(Form "R2" Associated Registration no.)

_____
(Form "NB-XX" unique doc no.)

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

CERTIFICATE OF COMPLIANCE

I, _____, certify that to the best of my knowledge and belief the statements made in this report are correct and that all material, fabrication, construction, and workmanship of the described parts conforms to the *National Board Inspection Code* and the standards of construction cited.

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

Date _____, _____ _____ Signed _____
(name of "R" Certificate holder) (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, where required, issued by the Jurisdiction _____ and employed

have inspected the part described in this report on _____ _____ and state that to the best of my knowledge and belief the parts comply with the applicable requirements of the *National Board Inspection Code*.

_____ of _____

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

Date _____, _____ Signed _____ Commissions _____
(Inspector) (National Board and jurisdiction No. including endorsement)

TABLE S12.3

GUIDE FOR COMPLETING FORM NB-XX, REPORT OF ADDITIVELY MANUFACTURED PARTS

Reference to Circled Numbers in the Form	Description
(1)	Initials of the National Board "R" *Certificate of Authorization* authorized representative who ~~registers~~will register the related NB-229, Form R-2, *Report of Alteration* and Form NB-XX, *Report of Additively Manufactured (AM) Parts,* as applicable.
(2)	Initials of the Inspector who certified the completed Form R-2 and Form NB-XX for registration.
(3)	When registering a Form R-2 Report with the National Board, this line is solely designated for reference to the unique sequential number assigned by the "R" Certificate Holder. When the "R" Form is not to be registered, indicate~~d~~ so by "N/A.". ~~-~~ As described in NBIC Part 3, ~~Paragraph~~ 5.6, a log shall be maintained identifying unique and sequentially numbered Form "R" R~~r~~eports that are registered with the National Board.
(4)	When registering Form NB-XX with the National Board supplemental to the associated Form R-2, this line is solely designated for reference to the unique identifier assigned by the AM DED Part producer or "R" Certificate Holder to the Form NB-XX. When the "R" Form is not to be registered as indicated by "N/A" per line 3, Form NB-XX shall remain with, or attached to, the associated Form R-2.
(5)	If applicable, document the unique purchase order, job, or tracking number assigned by the organization performing work.
(6)	The name and address of the AM DED near net shape material/part producer responsible for the manufacture of the additively manufactured (AM) part as it is listed on Form NB-XX and the related NB-229, Form R-2 for the applicable component.
~~a)~~(7)	National Board "R" Certificate Holder who ~~manufactured~~ is responsible for the installation and use of the~~welded~~ additively manufactured (AM) part~~s as it appears is listed on the "Certificate of Authorization."~~Document both the name and address of the National Board "R" Certificate Holder who is responsible for the additively manufactured (AM) parts as listed on the *Certificate of Authorization.* If the AM DED part is purchased by an organization other than the "R" Certificate Holder, on behalf of the "R" Certificate Holder, note both the purchasing organization and the responsible "R" Certificate Holder.
~~(4)~~	~~Document the name and address of the organization that purchased the parts for incorporation into the repair or alteration. If the part's origin is unknown or the part was built for stock, so state this.~~
~~(5)~~(8)	Document the ~~name of the organization responsible for specifying the code design conditions, if known. If the~~ original material product form (e.g., casting, forging, fitting, pipe, or plate) and the full material specification and grade for which the AM DED Part is being used as a replacement/alteration. If ~~of design conditions are is~~ not known, state "unknown."
(9)	Name, section, and division of the original design code for the part being replaced, if known. If the original design code is not known, state "unknown."

(10) Indicate the complete corresponding material specification number and grade for which the AM DED material/part will be qualified (e.g., the original material specification of the part being replaced) as a replacement/alteration.

(11) Name, section, and division of the design code, if known. If the design is not known, state "unknown." In addition, indicate code edition year used for fabrication.

~~(6)~~(12) Document the name of the organization responsible for performing the code design, if known. If the code design organization is not known, state "unknown."

~~(7)~~(13) ~~Indicate code addenda date used for fabrication, if applicable.~~ Optional. Indicate the reason for using an AM DED part in lieu of the original material specification and product form.

~~(8)~~(14) ~~Indicate the code paragraph reference for the formula used to establish the maximum allowable working pressure (MAWP), if known. If the code reference of the formula is not known, state "unknown."~~Include any remarks that may clarify information needed to support alteration approval and use of the AM DED Part.

~~(9)~~(15) ~~If available, i~~Identify the part/component by the part's original name or~~,~~ function, or use the original equipment manufacturer's "mark" or "item number."

(16) If AM DED Part is using integrated backing, i.e., has a substrate starting material that is a product form other than AM DED, e.g., pipe, forging, casting, fitting, or plate, Indicate the substrate or integrated backing material specification and grade.

~~(10)~~(17) The quantity of named parts.

~~(11)~~(18) ~~Match~~ Indicate the line number ~~of~~ andpart reference~~s~~ for Identification of Parts ~~in item 5~~from the associated Form R-2 ~~and~~ along with the Description of Parts ~~in item 6.~~

(19) Indicate the manufacturer's serial number or identification number for the named part.

(20) Indicate the drawing number for the named part.

(21) Indicate the Design Temperature (if required)~~MAWP~~ for the part, if known.

(22) Indicate the Design Pressure for the part, if known. Also ~~i~~indicate the test pressure, if applied. Note alternatively, test pressure information may be added to the remarks.

(23) Identify the year in which fabrication/construction of the item was completed.

(24) ~~Use the inside diameter for size: indicate shape as square, round, etc.~~Indicate the original material specification raw material part number if known, if not known, state "unknown".

(25) Indicate the complete original material specification number and grade.

(26) Indicate the~~-~~ size and shape (OD, ID, nominal thickness, etc.) of the ~~plate and the minimum thickness after forming.~~original part or parts being replaced. Use the remarks section to clarify if needed. Examples of shape may include flat, dished, nozzle, flanged, etc.

(27) Indicate ~~the shape as flat, dished, ellipsoidal, or hemispherical.~~the AM Part number or unique identifying mark.

(28) Indicate the ~~minimum thickness after forming.~~AM DED corresponding material specification and grade from Section II, Part A or B.

(29) Indicate the size and shape (OD, ID, nominal thickness, etc.) of the AM DED part or parts replacing original parts. Use the remarks section to clarify if needed. Examples of shape may include flat, dished, nozzle, flanged, or combinations of contours if manufacturing complex shapes etc.

~~Indicate the complete material specification number and grade for the head or end.~~

~~Indicate the outside diameter.~~

~~Indicate the minimum thickness of tubes.~~

(30) ~~Indicate the complete material specification number and grade for tubes.~~Indicate the filler material and SFA Classification for the weld wire used in the AM DED part build

(31) Indicate any additional information pertaining to the work involved (e.g., code cases). The part manufacturer is to indicate the extent they have performed any or all of the design function. If the part manufacturer performed only a portion of the design, state which portion.

(32) When registering an NB-2~~30~~29, Form R-~~3~~2, ~~Report of Parts Fabricated by Welding~~ with the National Board, this line is solely designated for a unique sequential number assigned by the "R" Certificate Holder. When the "R" Form is not to be registered, indicate so by "N/A." As described in NBIC Part 3, 5.6, a log shall be maintained identifying unique and sequentially numbered Form "R" Reports that are registered with the National Board. Same as line 3

(33) ~~i~~ When registering Form NB-XX with the National Board supplemental to the associated Form R-2, this line is solely designated for reference to the unique identifier assigned by the AM DED Part producer or "R" Certificate Holder to the Form NB-XX. When the "R" Form is not to be registered as indicated by "N/A" per line 3, Form NB-XX shall remain with, or attached to, the associated Form R-2. Same as line 4.

(34) ~~f applicable, document the unique purchase order, job, or tracking number assigned by the organization performing work.~~ If applicable, document the unique purchase order, job, or tracking number assigned by the organization performing work. Same as line 5.

(35) Optional: Indicate the acceptance of use of AM DED as a replacement for the original material specification by the customer or end user if required. This may be either a name or title/position. Type or print the name of the authorized ~~representative of the "R" Certificate Holder attesting to the accuracy of the work described.~~individual. If not applicable, state “N/A”

(36) Optional: Indicate ~~National Board "R" Certificate of Authorization number.~~the date approval for the use of AM DED was requested. If not applicable, state “N/A”

(37) Optional: Indicate the date approval for the use of AM DED was granted. If not applicable, state “N/A”

(38) Optional: Indicate any conditions under which agreement is necessary to for AM DED part acceptance. If not applicable, state “N/A”

~~b)~~

~~(38)~~(39) Signature of the National Board "R" *Certificate of Authorization* authorized representative.

~~(39)~~(40) Type or print the name of the Inspector.

~~(40)~~(41) Indicate the Inspector's ~~j~~Jurisdiction.

~~(41)~~(42) Indicate the Inspector's employer.

~~(42)~~(43) Indicate the address of the Inspector's employer (city and state or province).

~~(43)~~(44) Indicate the month, day, and year of the final inspection by the Inspector.

~~(44)~~(45) Indicate the month, day, and year the completed Form "R" Report was signed by the Inspector.

~~(45)~~(46) Signature of the Inspector.

~~(46)~~(47) The Inspector's National Board C~~c~~ommission number and endorsement that qualifies the Inspector to sign this report, and when required by the ~~J~~jurisdiction, the applicable s~~S~~tate or p~~P~~rovincial numbers.

S12.4 ADDITIONAL FORMS

FIGURE S12.4-a

SAMPLE WELD PROCEDURE SPECIFICATION RECORD FOR AM PARTS

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NB-XX, Rev. 0(07/13/26)

SAMPLE WELD PROCEDURE SPECIFICATION RECORD (WPS) FOR ADDITIVELY MANUFACTURED DIRECT ENERGY DEPOSITION PARTS

Organization Name

_____

WPS Number _____

Revision _____

Date _____

By _____

GMAW AUTOMATIC WELDING

Related AMPS or Software Control Files

_____

_____

SUPPORTING PQR NUMBERS

Low Heat Input / Interpass

Thin Wall _____

Thick Wall _____

High Heat Input / Interpass

Thin Wall _____

Thick Wall _____

Integrated Backing (Yes / No) _____

Base Metal P-No. _____

Group Number _____

FILLER METALS

Filler Metal Specification and Classification

_____

F-Number _____

A-Number _____ Diameter _____

Supplemental Filler Metal _____

Feed Rate or Volume _____

Alloy Type _____

PREHEAT

Preheat and Interpass Temperature

Minimum _____

Maximum _____

Preheat Maintenance (Yes / No) _____

Time and Temperature

_____

HEAT TREATMENT

Postweld Heat Treatment

Time and Temperature Range

_____

Other Notes

GASES

Gas Type	Composition	Flow Rate
Shielding		
Trailing		
Backing		

SAMPLE WELD PROCEDURE SPECIFICATION RECORD (WPS) CONT'D.

ELECTRICAL CHARACTERISTICS

Amperage or WFS Range

_____

Voltage Range _____

Transfer Mode _____

Polarity _____

Waveform Controlled (Yes / No) _____

Minimum Heat Input _____

Maximum Heat Input _____

TECHNIQUE

Number of Electrodes _____

Electrode Spacing _____

CTWD _____

Nozzle Size _____

Cleaning Method _____

Peening (Yes / No) _____

Oscillation _____

Width _____

Minimum _____ Maximum _____

Frequency

Minimum _____ Maximum _____

Bead Dimensions _____

Maximum Bead Width

Maximum Bead Thickness _____

ADDITIONAL NOTES

_____

_____

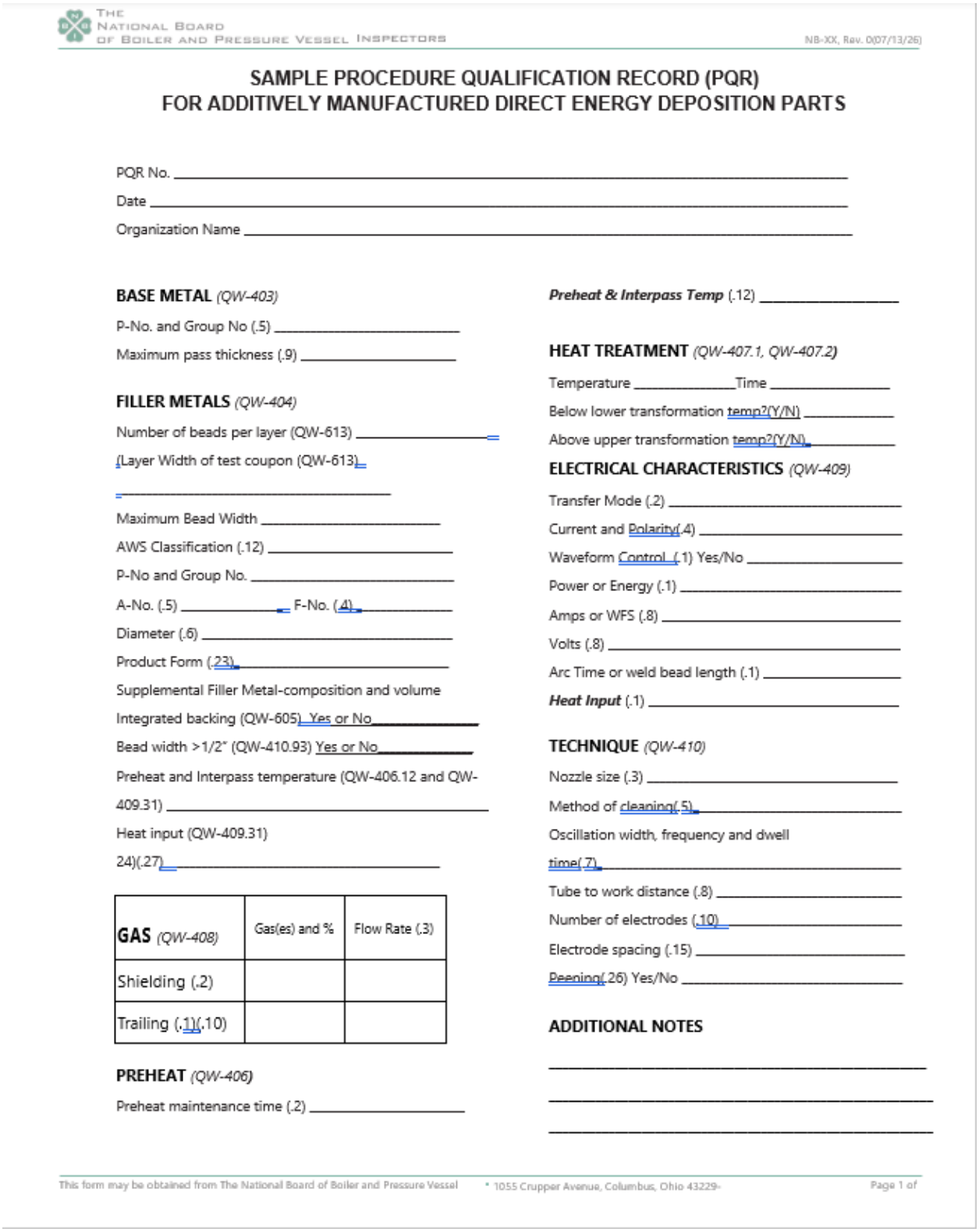
_____

_____

_____

FIGURE S12.4-b

SAMPLE PROCEDURE QUALIFICATION RECORD (PQR) FOR AM PARTS



THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NB-XX, Rev. 0(07/13/26)

SAMPLE PROCEDURE QUALIFICATION RECORD (PQR) FOR ADDITIVELY MANUFACTURED DIRECT ENERGY DEPOSITION PARTS

PQR No. _____

Date _____

Organization Name _____

BASE METAL *(QW-403)*

P-No. and Group No (.5) _____

Maximum pass thickness (.9) _____

FILLER METALS *(QW-404)*

Number of beads per layer (QW-613) _____

(Layer Width of test coupon (QW-613)_

_____

Maximum Bead Width _____

AWS Classification (.12) _____

P-No and Group No. _____

A-No. (.5) _____ F-No. (.4)_____

Diameter (.6) _____

Product Form (.23)_____

Supplemental Filler Metal-composition and volume

Integrated backing (QW-605) Yes or No_____

Bead width >1/2" (QW-410.93) Yes or No_____

Preheat and Interpass temperature (QW-406.12 and QW-409.31) _____

Heat input (QW-409.31)

24)(.27)_____

GAS *(QW-408)*	Gas(es) and %	Flow Rate (.3)
Shielding (.2)		
Trailing (.1)(.10)		

PREHEAT *(QW-406)*

Preheat maintenance time (.2) _____

Preheat & Interpass Temp (.12) _____

HEAT TREATMENT *(QW-407.1, QW-407.2)*

Temperature _____Time _____

Below lower transformation temp?(Y/N) _____

Above upper transformation temp?(Y/N)_____

ELECTRICAL CHARACTERISTICS *(QW-409)*

Transfer Mode (.2) _____

Current and Polarity(.4) _____

Waveform Control (.1) Yes/No _____

Power or Energy (.1) _____

Amps or WFS (.8) _____

Volts (.8) _____

Arc Time or weld bead length (.1) _____

Heat Input (.1) _____

TECHNIQUE *(QW-410)*

Nozzle size (.3) _____

Method of cleaning(.5)_____

Oscillation width, frequency and dwell

time(.7)_____

Tube to work distance (.8) _____

Number of electrodes (.10)_____

Electrode spacing (.15) _____

Peening(.26) Yes/No _____

ADDITIONAL NOTES

_____

_____

_____

This form may be obtained from The National Board of Boiler and Pressure Vessel * 1055 Crupper Avenue, Columbus, Ohio 43229- Page 1 of

SAMPLE PROCEDURE QUALIFICATION RECORD (PQR) CONT'D.

Guidance Document from the *National Board Inspection Code*

Tensile test:

Specimen ID	Width	UTS (KSI or MPa)	Weld Metal Only			HAZ Only
			Test temperature	YS (KSI or MPa)	% Elongation	Break location

CVN tests:

Specimen ID	Location (weld or HAZ & edge or center)	Test temperature	Result 1 (ft-lb or J)	Result 2 (ft-lb or J)	Result 3 (ft-lb or J)	Average

Bend Tests:

Specimen ID	Location (weld or HAZ)	Type & Figure No.	Result

Chemical Composition:

Element	Value	Element	Value

Other tests or notes:

_____

I certify that this record is correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel code.

Organization: _____ Date _____ Certified by: _____

FIGURE S12.4-c

MATERIAL TEST REPORT (MTR) FOR AM PARTS

MATERIAL TEST REPORT
SAMPLE FORM FOR ADDITIVELY MANUFACTURED DIRECT ENERGY DEPOSITION PARTS

1. AM PRODUCER'S NAME: _____

   _____
   (address)

2. CUSTOMER NAME: _____

   _____
   (address)

3. PART NO.: _____
4. TRACKING OR SHOP IDENTIFYING No.: _____
5. PURCHASE ORDER No.: _____
6. SUPPORTING PQR OR PQR DOCUMENT No.: _____
7. DATE: _____

Electrode Test Results

Electrode Designation per AWS A5.01 Lot Class S3	
Material	.045 SuperArc L-598 (Electrode Designation)
Classification	SFA-5.18 ER70S-6 (AWS Lot/Class)

Chemical Analysis (Electrode) Lot # XXXXXX		
weight %	Requirement	Results
C	0.06 – 0.15	0.07
Mn	1.40 – 1.85	1.47
P	0.025 max.	0.005
S	0.035 max.	0.024
Si	0.80 – 1.15	0.87
Ni	0.15 max.	0.01
Cr	0.5 max.	0.02
Mo	0.15 max.	0.01
V	0.03 max.	0.01
Cu	0.5 max.	0.16

Test Coupon (Witness Sample) Results

Testing Condition	**Requirement**	**Results**
Posted Heat Treatment	12-13 hours @ 1150 ± 25°F	12 hours @ 1150°F
Chemical Analysis (Test Coupon)	**Test Coupon**	(Coupon identifying name/no.)
weight %	**Requirement**	**Results**
C	0.2 max.	0.09
Mn	1.6 max.	1.07
Si	1.0 max.	0.59
Ni	0.50 max.	0.01
Cr	0.20 max.	0.02
Mo	0.30 max.	0.01
Mechanical Property Results (Test Coupon)	**Test Coupon**	(Coupon identifying name/no.)
	Requirement	**Results**
Tensile Strength, ksi	60 min.	78
Yield Strength 0.2% offset, ksi	32 min.	62
Elongation, % in 2 inches	22 min.	25
Hardness, Brinell	200 max.	165
Impact Energy (ft-lbs @ -50°F)		
Average of 3 tests	20 min.	57
Lowest Specimen	15 min.	48
Lateral Expansion	Not Required	--

CERTIFICATION STATEMENT

We, _____(Producer Name, Certifying individual) _____ certify that the statements made in this report are correct.

Date _____ Signed _____
Authorized Representative