



NATIONAL BOARD INSPECTION CODE

PRESSURE
RELIEF DEVICES

PART
4



DIAMOND

ANNIVERSARY

NATIONAL BOARD INSPECTION CODE

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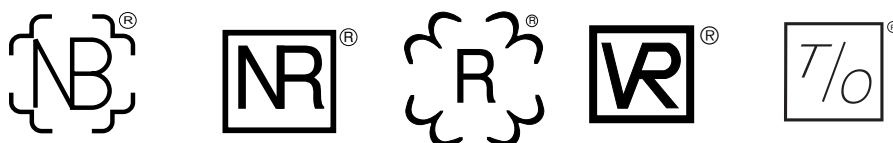
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PART 4 — PRESSURE RELIEF DEVICES

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INTRODUCTION

It is the purpose of the *National Board Inspection Code* (NBIC) to maintain the integrity of pressure-retaining items by providing rules for post-construction activities including installation, and after the items have been placed into service, by providing rules for inspection and repair and alteration, thereby ensuring that these items may continue to be safely used.

The NBIC is intended to provide rules, information, and guidance to manufacturers, Jurisdictions, inspectors, owner-users, installers, contractors, and other individuals and organizations performing or involved in post-construction activities, thereby encouraging the uniform administration of rules pertaining to pressure retaining items.

SCOPE

The NBIC recognizes three important areas of post-construction activities where information, understanding, and following specific requirements will promote public and personal safety. These areas include:

- Installation
- Inspection
- Repairs and Alterations

The NBIC provides rules, information, and guidance for post-construction activities, but does not provide details for all conditions involving pressure-retaining items. Where complete details are not provided in this code, the code user is advised to seek guidance from the Jurisdiction and from other technical sources.

The words shall, should, and may are used throughout the NBIC and have the following intent:

- Shall – action that is mandatory and required.
- Should – indicates a preferred but not mandatory means to accomplish the requirement unless specified by others, such as the Jurisdiction.
- May – permissive, not required or a means to accomplish the specified task.

ORGANIZATION

The NBIC is organized into four parts to coincide with specific post-construction activities involving pressure-retaining items. Each part provides general and specific rules, information, and guidance within each applicable post-construction activity. Other NBIC parts or other published standards may contain additional information or requirements needed to meet the rules of the NBIC. Specific references are provided in each part to direct the user where to find this additional information. NBIC parts are identified as:

- Part 1, Installation – This part provides requirements and guidance to ensure all types of pressure retaining items are installed and function properly. Installation includes meeting specific safety criteria for construction, materials, design, supports, safety devices, operation, testing, and maintenance.
- Part 2, Inspection – This part provides information and guidance needed to perform and document inspections for all types of pressure-retaining items. This part includes information on personnel safety, non-destructive examination, tests, failure mechanisms, types of pressure equipment, fitness for service, risk-based assessments, and performance-based standards.
- Part 3, Repairs and Alterations – This part provides requirements and guidance to perform, verify, and document acceptable repairs or alterations to pressure retaining items regardless of code of construction. Alternative methods for examination, testing, heat treatment, etc., are provided when the original code of construction requirements cannot be met. Specific acceptable and proven repair methods are also provided.
- Part 4, Pressure Relief Devices – This part provides information and guidance to ensure pressure relief devices are installed properly, information and guidance needed to perform and document inspections for pressure relief devices, and information and guidance to perform, verify, and document acceptable repairs to pressure relief devices.

Each NBIC part is divided into major sections as outlined in the Table of Contents.

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

TEXT IDENTIFICATION AND NUMBERING

Each page in the text will be designated in the top header with the publication's name, part number, and part title. The numbering sequence for each section begins with the section number followed by a dot to further designate major sections (e.g., 1.1, 1.2, 1.3). Major sections are further subdivided using dots to designate subsections within that major section (e.g., 1.1.1, 1.2.1, 1.3.1). Subsections can further be divided as necessary. Paragraphs under sections or subsections shall be designated with small letters in parenthesis (e.g., a), b), c)) and further subdivided using numbers in parenthesis (e.g., 1), 2), 3)).

Subdivisions of paragraphs beyond this point will be designated using a hierarchical sequence of letters and numbers followed by a dot.

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

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

SUPPLEMENTS

Supplements are contained in each part of the NBIC to provide requirements and guidance only pertaining to a specific type of pressure-retaining item (e.g., Locomotive Boilers, Historical Boilers, Graphite Pressure Vessels.) Supplements follow the same numbering system used for the main text only preceded by the Letter "S." Each page of the supplement will be tabbed to identify the supplement number.

EDITIONS

Editions, which include revisions and additions to this code, are published every two years. Editions are permissive on the date issued and become mandatory six months after the date of issue.

CODE STAMPING

ASME Code "Stamping" referenced throughout the NBIC includes the ASME Boiler and Pressure Vessel Code Symbol Stamps used for conformity assessment prior to the 2010 edition/2011 addendum and the equivalent ASME Certification Mark with Designator required to meet the later editions of the ASME Boiler and Pressure Vessel Code Sections. When other construction codes or standards are utilized for repairs or alterations, stamping shall mean the identification symbol stamp required by that code or standard.

INTERPRETATIONS, CODE ADDITIONS AND CODE REVISIONS

The NBIC Committee meets regularly to consider requests for interpretations, revisions, and additions for this code. Interpretations are provided for each part and are specific to the code edition and addenda referenced in the interpretation and may be used with subsequent editions of the NBIC, provided the requirements have not changed. Interpretations provide clarification of existing rules in the code only and are not part of this code. Code revisions and additions are considered to accommodate technological developments, address administrative requirements, or to clarify code intent.

Interested parties may submit requests for interpretations, code revisions, and code additions through the National Board Business Center by following these steps:

1. Navigate to <https://buscenter.nationalboard.org> in your web browser;
2. Sign in to the Business Center (this may require creating an account);
3. Navigate to the NBIC tab and select “Make a Request”;
4. Select your request type; and
5. Fill out all fields in the request form and submit your request.

National Board staff will review all new requests before submitting them to the NBIC Committee for consideration at the next scheduled NBIC meeting.

JURISDICTIONAL PRECEDENCE

Reference is made throughout this code to the requirements of the “Jurisdiction.” Where any provision herein presents a direct or implied conflict with any Jurisdictional regulation, the Jurisdictional regulation shall govern.

UNITS OF MEASUREMENT

Both U.S. customary units and metric units are used in the NBIC. The value stated in U.S. customary units or metric units are to be regarded separately as the standard. Within the text, the metric units are shown in parentheses. In Part 2, Supplement 6 and Part 3, Supplement 6 regarding DOT Transport Tanks, the metric units are shown first with the U.S. customary units shown in parentheses.

U.S. customary units or metric units may be used with this edition of the NBIC, but one system of units shall be used consistently throughout a repair or alteration of pressure-retaining items. It is the responsibility of National Board accredited repair organizations to ensure the appropriate units are used consistently throughout all phases of work. This includes materials, design, procedures, testing, documentation, and stamping. The NBIC policy for metrication is outlined in each part of the NBIC.

ACCREDITATION PROGRAMS

The National Board administers four specific accreditation programs as shown below:

- “R”.....Repairs and Alterations to Pressure-Retaining Items (NB-415)
- “VR”.....Repairs to Pressure Relief Valves (NB-514)
- “NR”.....Repair and Replacement Activities for Nuclear Items (NB-417)
- “T/O”.....Testing of Pressure Relief Valves (NB-528)

The administrative requirements for the accreditation for these accreditation programs can be viewed on the National Board Website at www.nationalboard.org.

The National Board also administers accredits four specific inspection agency programs as shown below:

New Construction

National Board Acceptance of Authorized Inspection Agencies (AIA) Accredited by the American Society of Mechanical Engineers (ASME) (NB-360)

Inservice

Accreditation of Authorized Inspection Agencies (AIA) Performing Inservice Inspection Activities (NB-369)

Owner-User

Accreditation of Owner-User Inspection Organizations (OUIO) (NB-371)

Owners or users may be accredited for both a repair and inspection program provided the requirements for each accreditation program are met.

Federal Government

Accreditation of Federal Inspection Agencies (FIA) (NB-390)

These programs can be viewed on the National Board Website at www.nationalboard.org. For questions or further information regarding these programs contact the National Board by phone at (614) 888-8320 or by fax at (614) 847-1828.

CERTIFICATES OF AUTHORIZATION FOR ACCREDITATION PROGRAMS

Any organization seeking an accredited program may apply to the National Board to obtain a *Certificate of Authorization* for the requested scope of activities. A confidential review shall be conducted to evaluate the organization's quality system. Upon completion of the evaluation, a recommendation will be made to the National Board regarding issuance of a *Certificate of Authorization*.

Certificate of Authorization scope, issuance, and revisions for National Board accreditation programs are specified in the applicable National Board procedures. When the quality system requirements of the appropriate accreditation program have been met, a *Certificate of Authorization* and appropriate National Board symbol stamp shall be issued.

FOREWORD

The National Board of Boiler and Pressure Vessel Inspectors is an organization comprised of Chief Inspectors for the states, cities, and territories of the United States and provinces and territories of Canada. It is organized for the purpose of promoting greater safety to life and property by securing concerted action and maintaining uniformity in post-construction activities of pressure-retaining items, thereby ensuring acceptance and interchangeability among Jurisdictional authorities responsible for the administration and enforcement of various codes and standards.

In keeping with the principles of promoting safety and maintaining uniformity, the National Board originally published the NBIC in 1946, establishing rules for inspection and repairs to boilers and pressure vessels. The *National Board Inspection Code* (NBIC) Committee is charged with the responsibility for maintaining and revising the NBIC. In the interest of public safety, the NBIC Committee decided, in 1995, to revise the scope of the NBIC to include rules for installation, inspection, and repair or alteration to boilers, pressure vessels, piping, and nonmetallic materials.

In 2007, the NBIC was restructured into three parts specifically identifying important post-construction activities involving safety of pressure-retaining items. This restructuring provides for future expansion, transparency, uniformity, and ultimately improving public safety.

In 2017, the NBIC was once again restructured into 4 parts, adding a new Part 4, Pressure Relief Devices. This purpose of this restructuring was to provide one distinct integrated part for pressure relief devices compiled from all PRD information referenced in Part 1, Installation; Part 2, Inspection; and Part 3, Repairs and Alterations.

The NBIC Committee's function is to establish rules of safety governing post-construction activities for the installation, inspection, and repair and alteration of pressure-retaining items, and to interpret these rules when questions arise regarding their intent. In formulating the rules, the NBIC Committee considers the needs and concerns of individuals and organizations involved in the safety of pressure-retaining items. The objective of the rules is to afford reasonably certain protection of life and property, so as to give a reasonably long, safe period of usefulness. Advancements in design and material and the evidence of experience are recognized.

The rules established by the NBIC Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design, or as limiting in any way an organization's freedom to choose any method that conforms to the NBIC rules.

The NBIC Committee meets regularly to consider revisions of existing rules, formulation of new rules, and respond to requests for interpretations. Requests for interpretation must be addressed to the NBIC Secretary in writing and must give full particulars in order to receive Committee consideration and a written reply. Proposed revisions to the code resulting from inquiries will be presented to the NBIC Committee for appropriate action.

Proposed revisions to the code approved by the NBIC Committee are submitted to the American National Standards Institute and published on the National Board web-site to invite comments from all interested persons. After the allotted time for public review and final approval, the new edition is published. The Foreword, Introduction, Personnel and Index Sections of the NBIC are provided for guidance and informational purposes only and shall not be considered a part of the Code. These sections are not approved by the NBIC Committee or submitted to the American National Standards Institute.

Organizations or users of pressure-retaining items are cautioned against making use of revisions that are less restrictive than former requirements without having assurance that they have been accepted by the Jurisdiction where the pressure-retaining item is installed.

The general philosophy underlying the NBIC is to parallel those provisions of the original code of construction, as they can be applied to post-construction activities. The NBIC does not contain rules to cover all details of post-construction activities. Where complete details are not given, it is intended that individuals or organizations, subject to the acceptance of the Inspector and Jurisdiction when applicable, provide details

for post-construction activities that will be as safe as otherwise provided by the rules in the original code of construction.

Activities not conforming to the rules of the original code of construction or the NBIC must receive specific approval from the Jurisdiction, who may establish requirements for design, construction, inspection, testing, and documentation.

There are instances where the NBIC serves to warn against pitfalls; but the code is not a handbook, and cannot substitute for education, experience, and sound engineering judgment. It is intended that this edition of the NBIC not be retroactive. Unless the Jurisdiction imposes the use of an earlier edition, the latest effective edition is the governing document.

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PART 4, SECTION 1

PRESSURE RELIEF DEVICES — GENERAL AND ADMINISTRATIVE REQUIREMENTS

1.1 SCOPE

This 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 ASME Code, installation and repairs to pressure relief devices shall conform to the ASME Code section and edition most applicable to the work planned.
- b) If the pressure relief device was not constructed to the ASME Code, 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, provided there is concurrence of the Inspector (if applicable) and the Jurisdiction where the pressure relief device is installed.

1.3 PRESSURE RELIEF DEVICES — DEFINITIONS

Refer to Section 9, *Glossary* 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 shall apply.

1.4 ACCREDITATION

- a) The National Board administers four specific accreditation programs:
 - “R” — Repairs and Alterations to Pressure-Retaining Items
 - “VR” — Repairs to Pressure Relief Valves
 - “NR” — Repair and Replacement Activities for Nuclear Items
 - “T/O” — In-service Testing Only of Pressure Relief Valves
- 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 in-service testing to pressure relief valves outside the scope of the NBIC may be accredited and shall meet any additional requirements of the Jurisdiction where the work is performed.

1.4.1 ACCREDITATION PROCESS

- a) The National Board administers accreditation programs for authorization of organizations performing repairs and in-service testing to pressure relief valves.
- 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 System. The individual assigned to conduct the evaluation shall meet the qualification requirements prescribed by the National Board. Upon completion of the evaluation, any deficiencies within the organization's Quality System will be documented and a recommendation will be made to the National Board regarding issuance of a *Certificate of Authorization*.
- c) National Board procedures provide for the confidential review resulting in recommendations to issue or not issue a *Certificate of Authorization*.
- d) The accreditation program provides requirements for organizations performing repairs and in-service testing to pressure relief valves. Depending upon the expected scope of activities at the time of review, organizations may be authorized to perform repairs and in-service testing either in the shop only, field only, or shop and field. Repair and in-service testing activities shall be limited to the scope of work authorized.
- e) Organizations desiring to renew or obtain a National Board *Certificate of Authorization* shall apply to the National Board using forms obtained from the National Board. Application for renewal shall be 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 or in the field, provided such operations are described in the organization's Quality System.

PART 4, SECTION 2

PRESSURE RELIEF DEVICES — INSTALLATION OF PRESSURE RELIEF DEVICES

2.1 SCOPE

NBIC Part 4 Section 2 provides requirements for the installation of pressure relief devices on power boilers, steam heating boilers, hot-water heating boilers, hot-water supply boilers, potable water heaters, pressure vessels and piping.

The correct selection of appropriate pressure relief devices (PRDs) and the proper installation of those devices are critical to the safe operation of pressure retaining items. Following are requirements for the installation of pressure relief devices for protection of different types of pressurized equipment. See NBIC Part 1 for general installation requirements.

2.2 PRESSURE RELIEF VALVES FOR POWER BOILERS

See NBIC Part 1, 2.2 for the boilers covered under Part 4, 2.2

2.2.1 GENERAL REQUIREMENTS

(21)

- a) Only direct spring loaded, pilot operated, or power actuated pressure relief valves designed to relieve steam shall be used for steam service.
- b) Pressure relief valves shall be manufactured in accordance with a national or international standard.
- c) Deadweight or weighted-lever pressure relief valves shall not be used.
- d) For high temperature water boilers, pressure relief valves shall have a closed bonnet, and valve bodies shall not be constructed of cast iron.
- e) Pressure relief valves with an inlet connection greater than NPS 3 (DN 80) and used for pressure greater than 15 psig (100 kPa), shall have a flanged or a welded inlet connection. The dimensions of flanges subjected to boiler pressure shall conform to the applicable standards.
- f) When a pressure relief valve is exposed to outdoor elements that may affect operation of the valve, the valve may be shielded with a cover. The cover shall be vented and arranged to permit servicing and normal operation of the valve.
- g) All covers, caps, and/or plugs utilized for shipping or transport shall be removed prior to installation or being placed in service.
- h) Any wire or restraining device on lifting lever utilized for shipping or transport shall be removed prior to being placed in service.

2.2.2 NUMBER

(21)

At least one National Board capacity certified pressure relief valve shall be installed on the boiler. If the boiler has more than 500 ft² (47 m²) of bare tube water heating surface, or if an electric boiler has a power input of more than 3.76 million BTU/hr (1100 kW), two or more National Board capacity certified pressure relief valves shall be installed. For a boiler with combined bare tube and extended water-heating surface exceeding 500 ft² (47 m²), two or more pressure relief valves are required only if the maximum designed steaming capacity of the boiler exceeds 4,000 lb/hr (1,800 kg/h).

2.2.3 LOCATION

- a) Pressure relief valves shall be placed on, or as close as physically possible, to the boiler proper.
- b) Pressure relief valves shall not be placed on the feedline.
- c) Pressure relief valves shall be connected to the boiler independent of any other connection without any unnecessary intervening pipe or fittings. Such intervening pipe or fittings shall not be longer than the face-to-face dimension of the corresponding tee fitting of the same diameter and pressure rating as listed in the applicable standards.

2.2.4 CAPACITY

- a) The pressure relief valve capacity for each boiler shall be such that the valve or valves will discharge all the steam that can be generated by the boiler without allowing the pressure to rise more than 6% above the highest pressure at which any valve is set and in no case to more than 6% above the maximum allowable working pressure of the boiler.
- b) The minimum relieving capacity for other than electric boilers and forced-flow steam generators with no fixed steam line and waterline shall be estimated for the boiler and waterwall heating surfaces as given in Table 2.2.4, but in no case shall the minimum relieving capacity be less than the maximum designed steaming capacity as determined by the manufacturer.
- c) The required relieving capacity, C , of the pressure relief valves on a high temperature water boiler shall be determined as follows:

$$C=Q/L$$

Where,

C = required relieving capacity in lbs/hr (kg/hr)

Q = maximum output in BTU/hr (W) at the boiler nozzle obtained by the firing of any fuel for which the unit is designed

L = 1000 BTU/lb (646 W • hr/kg)

- d) The minimum pressure relief valve relieving capacity for electric boilers shall not be less than 3.5 lbs/hr/ kW (1.6 kg/hr/kW) input.
- e) If the pressure relief valve capacity cannot be computed, or if it is desirable to prove the computations, it should be checked by any one of the following methods; and if found insufficient, additional relieving capacity shall be provided:
 - 1) By performing an accumulation test, that is, by shutting off all other steam discharge outlets from the boiler and forcing the fires to the maximum. This method should not be used on a boiler with a superheater or reheater or on a high-temperature water boiler.
 - 2) By measuring the maximum amount of fuel that can be burned and computing the corresponding evaporative capacity upon the basis of the heating value of the fuel.
 - 3) By determining the maximum evaporative capacity by measuring the feedwater. The sum of the pressure relief valve capacities marked on the valves shall be equal to or greater than the maximum evaporative capacity of the boiler. This method should not be used on high-temperature water boilers.

TABLE 2.2.4

MINIMUM POUNDS OF STEAM PER HOUR PER SQUARE FOOT OF HEATING SURFACE
LB STEAM/HR FT² (KG STEAM/HR M²)

	Firetube Boiler	Watertube Boiler
Boiler Heating Surface		
Hand-fired	5 (24)	6 (29)
Stoker-fired	7 (34)	8 (39)
Oil, gas, or pulverized fuel-fired	8 (39)	10 (49)
Waterwall Heating Surface		
Hand-fired	8 (39)	8 (39)
Stoker-fired	10 (49)	12 (59)
Oil, gas, or pulverized coal	14 (68)	16 (78)
Copper-finned Watertubes		
Hand-fired		4 (20)
Stoker-fired		5 (24)
Oil, gas, or pulverized fuel-fired		6 (29)

Notes:

- When a boiler is fired only by a gas having a heat value not in excess of 200 Btu/ft³ (7.5MJ/m³), the minimum relieving capacity should be based on the values given for hand-fired boilers above.
- The heating surface shall be computed for that side of the boiler surface exposed to the products of combustion, exclusive of the superheating surface. In computing the heating surface for this purpose only the tubes, fireboxes, shells, tubesheets, and the projected area of headers need to be considered, except that for vertical firetube steam boilers, only that portion of the tube surface up to the middle gage cock is to be computed.
- For firetube boiler units exceeding 8000 Btu/ft² (9085 J/cm²) (total fuel Btu (J) Input divided by total heating surface), the factor from the table will be increased by 1 (4.88) for every 1000 Btu/ft² (1136 J/cm²) above 8000 Btu/ft² (9085 J/cm²). For units less than 7000 Btu/ft² (7950 J/cm²), the factor from the table will be decreased by 1 (4.88).
- For watertube boiler units exceeding 16000 Btu/ft² (18170 J/cm²) (total fuel Btu input divided by the total heating surface) the factor from the table will be increased by 1 (4.88) for every 1000 Btu/ft² (1136 J/cm²) above 16000 Btu/ft² (18170 J/cm²). For units with less than 15000 Btu/ft² (17034 J/cm²), the factor in the table will be decreased by 1 (4.88) for every 1000 Btu/ft² (1136 J/cm²) below 15000 Btu/ft² (17034 J/cm²).

2.2.5 SET PRESSURE

One or more pressure relief valves on the boiler proper shall be set at or below the maximum allowable working pressure. If additional valves are used, the highest pressure setting shall not exceed the maximum allowable working pressure by more than 3%. The complete range of pressure settings of all the pressure relief valves on a boiler shall not exceed 10% of the highest pressure to which any valve is set. Pressure setting of pressure relief valves on high temperature water boilers may exceed this 10% range.

2.2.6 FORCED-FLOW STEAM GENERATORS

For a forced-flow steam generator with no fixed steamline and waterline, equipped with automatic controls and protective interlocks responsive to steam pressure, pressure relief valves may be provided in accordance with the above paragraphs identified in 2.2.5 or the following protection against overpressure shall be provided:

- a) One or more power-actuated pressure relief valves shall be provided in direct communication with the boiler when the boiler is under pressure and shall receive a control impulse to open when the maximum allowable working pressure at the superheater outlet is exceeded. The total combined relieving capacity of the power actuated pressure relief valves shall be not less than 10% of the maximum design steaming capacity of the boiler under any operating condition as determined by the manufacturer. The valves shall be located in the pressure part system where they will relieve the overpressure. An isolating stop valve of the outside-screw-and-yoke type should be installed between the power actuated pressure relief valve and the boiler to permit repairs provided an alternate power-actuated pressure relief valve of the same capacity is so installed as to be in direct communication with the boiler.
- b) Pressure relief valves shall be provided having a total combined relieving capacity, including that of the power-actuated pressure relief valve, of not less than 100% of the maximum designed steaming capacity of the boiler, as determined by the manufacturer. In this total, credit in excess of 30% of the total relieving capacity shall not be allowed for the power-actuated pressure relief valves actually installed. Any or all of the pressure relief valves may be set above the maximum allowable working pressure of the parts to which they are connected, but the set pressures shall be such that when all these valves (together with the power-actuated pressure relief valves) are in operation the pressure will not rise more than 20% above the maximum allowable working pressure of any part of the boiler, except for the steam piping between the boiler and the prime mover.
- c) When stop valves are installed in the water steam flow path between any two sections of a forced-flow steam generator with no fixed steamline and waterline:
 - 1) The power-actuated pressure relief valve shall also receive a control impulse to open when the maximum allowable working pressure of the component, having the lowest pressure level upstream to the stop valve, is exceeded.
 - 2) The pressure relief valve shall be located to provide overpressure protection for the component having the lowest working pressure.
 - 3) A reliable pressure-recording device shall always be in service and records kept to provide evidence of conformity to the above requirements.

2.2.7 SUPERHEATERS

- a) Every attached superheater shall have one or more pressure relief valves. The location shall be suitable for the service intended and shall provide the overpressure protection required. The pressure drop upstream of each pressure relief valve shall be considered in determining the set pressure and relieving capacity of that valve. If the superheater outlet header has a full, free steam passage from end to end and is so constructed that steam is supplied to it at practically equal intervals throughout its length so that there is a uniform flow of steam through the superheater tubes and the header, the pressure relief valve or valves may be located anywhere in the length of header.
- b) The pressure-relieving capacity of the pressure relief valve or valves on an attached superheater shall be included in determining the number and size of the pressure relief valves for the boiler provided there are no intervening valves between the superheater pressure relief valve and the boiler and the discharge capacity of the pressure relief valve or valves, on the boiler, as distinct from the superheater, is at least 75% of the aggregate capacity required.

- c) Every independently fired superheater that may be shut off from the boiler and permit the superheater to become a fired pressure vessel shall have one or more pressure relief valves having a discharge capacity equal to 6 lbs steam/hr/ft² (29 kg steam/hr/m²) of superheater surface measured on the side exposed to the hot gases.
- d) Every pressure relief valve used on a superheater discharging superheated steam at a temperature over 450°F (230°C) shall have a casing, including the base, body, bonnet, and spindle constructed of steel, steel alloy, or equivalent heat-resistant material. The valve shall have a flanged inlet connection or a welding-end inlet connection. The seat and disk shall be constructed of suitable heat-erosive and corrosive-resistant material, and the spring fully exposed outside of the valve casing so that it is protected from contact with the escaping steam.

2.2.8 ECONOMIZERS

An economizer that may not be isolated from a boiler does not require a pressure relief valve. Economizers that may be isolated from a boiler or other heat transfer device, allowing the economizer to become a fired pressure vessel, shall have a minimum of one pressure relief valve. Discharge capacity, rated in lbs/hr (kg/hr), of the pressure relief valve or valves shall be calculated from the maximum expected heat absorption rate in Btu/hr (kJ/hr) of the economizer, and will be determined from manufacturer data, divided by 1,000 Btu/lb (2,326 kJ/kg). The pressure relief valve shall be located as close as possible to the economizer outlet.

2.2.9 PRESSURE REDUCING VALVES

- a) Where pressure reducing valves are used, one or more pressure relief valves shall be installed on the low pressure side of the reducing valve in those installations where the piping or equipment on the low pressure side does not meet the requirements for the steam supply piping.
- b) The pressure relief valves shall be located as close as possible to the pressure reducing valve.
- c) Capacity of the pressure relief valves shall not be less than the total amount of steam that can pass from the high pressure side to the low pressure side and be such that the pressure rating of the lower pressure piping or equipment shall not be exceeded.
- d) The use of hand-controlled bypasses around reducing valves is permissible. The bypass around a reducing valve may not be greater in capacity than the reducing valve unless the piping or equipment is adequately protected by pressure relief valves or meets the requirements of the high pressure system.
- e) See Supplement 1 for additional information on the calculation of the required capacity of pressure relief valves installed after pressure-reducing valves.

2.2.10 INSTALLATION AND DISCHARGE REQUIREMENTS

(21)

- a) Every boiler shall have outlet connections for the pressure relief valve, or valves, independent of any other outside steam connection, the area of opening shall be at least equal to the aggregate areas of inlet connections of all of the attached pressure relief valves. An internal collecting pipe, splash plate, or pan should be used, provided the total area for inlet of steam is not less than twice the aggregate areas of the inlet connections of the attached pressure relief valves. The holes in such collecting pipes shall be at least 1/4 in. (6 mm) in diameter, and the least dimension in any other form of opening for inlet of steam shall be 1/4 in. (6 mm). If pressure relief valves are attached to a separate steam drum or dome, the opening between the boiler proper and the steam drum or dome shall be not less than 10 times the total area of the pressure relief valve inlet.
- b) Every pressure relief valve shall be connected so as to stand in an upright position with spindle vertical.

- c) The opening or connection between the boiler and the pressure relief valve shall have at least the area of the valve inlet and the inlet pipe to the pressure relief valve shall be as short and straight as possible, no longer than twice the center-to-end (face) dimension of a corresponding tee fitting of the same diameter, pressure class, and connection type. When a discharge pipe is used, the cross-sectional area shall not be less than the full area of the valve outlet or of the total of the areas of the valve outlets. It shall be as short and straight as possible and arranged to avoid undue stresses on the valve or valves.
- d) No valves of any type except a changeover valve shall be placed between the pressure relief valves and the boiler, nor on the discharge pipe between the pressure relief valves and the atmosphere.

A changeover valve may be used provided the changeover valve is in accordance with the original code of construction. It is recommended that the Jurisdiction be contacted to determine the acceptability of the changeover valves on boiler applications.

- e) When two or more pressure relief valves are used on a boiler, they shall be installed either separately, as twin valves made by placing individual valves on a Y-base, or duplex valves having two valves in the same body casing. If twin or duplex valves are used, they shall be of equal size.
- f) When two valves of different sizes are installed singly, the relieving capacity of the smaller valve shall not be less than 50% of that of the larger valve.
- g) When a boiler is fitted with two or more pressure relief valves on one connection, this connection to the boiler shall have a cross-sectional area not less than the combined areas of inlet connections of all the pressure relief valves with which it connects.
- h) All pressure relief valves shall be piped to a safe point of discharge. Provision for an ample gravity drain shall be made in the discharge pipe at or near each pressure relief valve, and where water or condensation may collect. Each valve shall have an open gravity drain through the casing below the level of the valve seat. For iron- and steel-bodied valves exceeding NPS 2 (DN 50), the drain hole shall be tapped not less than NPS 3/8 (DN 10).
- i) Discharge piping from pressure relief valves on high temperature water boilers shall have adequate provisions for water drainage as well as steam venting.
- j) If a muffler is used on a pressure relief valve, it shall have sufficient outlet area to prevent back pressure from interfering with the proper operation and discharge capacity of the valve. The muffler plates or other devices shall be so constructed as to avoid a possibility of restriction of the steam passages due to deposits. Mufflers shall not be used on high temperature water boiler pressure relief valves.

2.2.11 SUPPORTS, FOUNDATIONS, AND SETTINGS

Each boiler pressure relief valve and its associated piping must be safely supported. Design of supports, foundations, and settings shall consider vibration (including seismic where necessary), movement (including thermal movement), and loadings (including reaction forces) in accordance with Jurisdictional requirements, manufacturer's recommendations, and/or other industry standards, as applicable.

2.3 OVERPRESSURE PROTECTION FOR THERMAL FLUID HEATERS

2.3.1 GENERAL REQUIREMENTS

Thermal fluid heaters shall be provided with overpressure protection in accordance with the code of construction.

2.3.2 PRESSURE RELIEF VALVES (21)

Thermal fluid heaters shall be equipped with one or more pressure relief valves unless the option for over-pressure protection by system design is utilized (when permitted by the original code of construction). When pressure relief valves are used, the following shall apply:

- a) Pressure relief valve(s) shall be of a totally enclosed type.
- b) A lifting lever shall not be used in pressure relief valve(s). A body drain is not required.
- c) Pressure relief valves shall be in accordance with the code of construction and designed for liquid, vapor, or combination service as required for the specific installation, service fluids, and overpressure conditions.
- d) Cast iron fittings shall not be used.
- e) Copper and copper alloys shall not be used.
- f) The inlet connection to the valve shall be not less than NPS ½ (DN 15).

2.3.3 LOCATION (21)

Pressure relief valves shall be connected to the heater in accordance with the original code of construction.

2.3.4 CAPACITY (21)

The pressure relief valve(s) shall have sufficient capacity to prevent the pressure vessel from exceeding the maximum pressure specified in the vessel code of construction.

2.3.5 SET PRESSURE (21)

- a) When a single relief valve is used, the set pressure marked on the device shall not exceed the maximum allowable working pressure.
- b) When more than one pressure relief valve is provided to obtain the required capacity, only one pressure relief valve set pressure needs to be set at or below the maximum allowable working pressure. The set pressure of the additional relief valves shall be such that the pressure cannot exceed the maximum pressure permitted by the code of construction.

2.3.6 INSTALLATION (21)

Pressure relief valves and the associated discharge piping shall be installed in accordance with the heater Manufacturer's recommendations. The installation of the pressure relief valves required for Thermal Fluid Heaters 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 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 discharge shall be connected to a closed, vented storage tank with solid piping (no drip pan elbow, or other air gap). The storage 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 of the storage tank should consider the volume of fluid which may be relieved or sized in accordance with the heater manufacturer's recommendation. Storage tanks located outdoors shall be located such that water cannot collect in the vessel. 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);
 - 4) Heat tracing for systems using high freeze point fluids along the discharge line (prevent blockage).
- i) Pressure relief valve discharge capacity for liquid service shall be determined from the following equation:
- For Liquid:
U.S. Customary Units:
- $$W = 2,407KA \sqrt{(P - P_d)w}$$
- SI Units:
- $$W = 5.092 KA \sqrt{(P - P_d)w}$$
- Where:
- W = Liquid Capacity in lb/hr (kg/hr).
- A = Discharge Area of Pressure relief Valve, in² (mm²)
- K = coefficient of discharge for valve design
- P = (Set pressure + OP + Atmosphere pressure, psia (Mpa)
- OP = Overpressure required for Pressure Relief Valve to reach capacity specified in code of construction
- P_d = Pressure at discharge of valve, psia (Mpa)
- w = Specific 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.

2.4 PRESSURE RELIEF VALVES FOR STEAM HEATING, HOT WATER HEATING, AND HOT WATER SUPPLY BOILERS

See NBIC Part 1, 3.2 for the scope of pressure retaining items covered by Part 4, 2.4.

2.4.1 GENERAL REQUIREMENTS

(21)

The following general requirements pertain to the installation of pressure relief valves on heating boilers.

- a) All covers, caps, and/or plugs utilized for shipping or transport shall be removed prior to installation or being placed in service.
- b) Any wire or restraining device on lifting lever utilized for shipping or transport shall be removed prior to being placed in service.

2.4.1.1 INSTALLATION OF PRESSURE RELIEF VALVES FOR HEATING BOILERS

2.4.1.1.1 PERMISSIBLE INSTALLATION

Pressure relief valves shall be located at the top side of the boiler. The top side of the boiler shall mean the highest practicable part of the boiler proper but in no case shall the pressure relief valves be located below the normal operating level and in no case shall the pressure relief valve be located below the lowest permissible water level. They shall be connected directly to a tapped or flanged opening in the boiler, to a fitting connected to the boiler by a short nipple, to a Y-base, or to a valveless header connecting steam or water outlets on the same boiler. Coil or header type boilers shall have the pressure relief valve located on the steam or hot water outlet end. Pressure relief valves shall be installed with their spindles vertical. The opening or connection between the boiler and any pressure relief valve shall have at least the area of the valve inlet.

2.4.1.1.2 REQUIREMENTS FOR COMMON CONNECTIONS FOR TWO OR MORE VALVES

- a) When a boiler is fitted with two or more pressure relief valves on one connection, this connection shall have a cross-sectional area not less than the combined areas of inlet connections of all the pressure relief valves with which it connects.
- b) When a Y-base is used, the inlet area shall be not less than the combined outlet areas. When the size of the boiler requires a pressure relief valve larger than NPS 4 (DN 100), two or more valves having the required combined capacity shall be used. When two or more valves are used on a boiler, they may be single, directly attached, or installed on a Y-base.

2.4.1.2 THREADED CONNECTIONS

A threaded connection may be used for attaching a valve.

2.4.1.3 PROHIBITED INSTALLATIONS

Pressure relief valves shall not be connected to an internal pipe in the boiler.

2.4.1.4 USE OF SHUTOFF VALVES PROHIBITED

No shutoff valve of any description shall be placed between the pressure relief valve and the boiler or on discharge pipes between such valves and the atmosphere.

(21) 2.4.1.5 PRESSURE RELIEF VALVE DISCHARGE PIPING

- a) A discharge pipe shall be used. Its internal cross-sectional area shall be not less than the full area of the valve outlet or of the total of the valve outlets that discharge into the pipe, and shall be as short and straight as possible and arranged as to avoid undue stress on the valve or valves. A union may be installed in the discharge piping close to the valve outlet. When an elbow is placed on a pressure relief valve discharge pipe, it shall be located close to the valve outlet downstream of the union to minimize reaction moment stress.
- b) The discharge from pressure relief valves shall be so arranged that there will be no danger of scalding attendants. The pressure relief valve discharge shall be piped away from the boiler to a safe point of discharge, and there shall be provisions made for properly draining the piping. The size and arrangement of discharge piping shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the relieving devices below that required to protect the boiler.
- c) Discharge piping shall be rated for the discharge fluid conditions of pressure and temperature including a minimum and maximum design temperature. Material selection for the discharge piping shall consider the reduction in material toughness at the low end of design temperature and the reduction in material strength at the high end of design temperature. Rigid pipe or tubing should be used for discharge lines that carry hot water or steam.
- d) Plastic discharge pipe and fittings are permitted (when compatible with the process fluid, system design temperatures, and other ambient conditions such as light and humidity) and shall conform to NSF/ANSI 14 Plastics Piping System Components and Related Materials.
- e) Discharge piping shall be rated for any static pressure present and the back pressure that may develop when the pressure relief device is at full capacity. Where multiple pressure relief devices or vents discharge into common piping, the back pressure that could develop due to simultaneous flow from all sources shall be considered.

2.4.1.6 TEMPERATURE AND PRESSURE RELIEF VALVES

Hot-water heating or supply boilers limited to a water temperature of 210°F (99°C) may have one or more National Board capacity certified temperature and pressure relief valve(s) installed. The requirements of 2.4.1.1 through 2.4.1.5 shall be met, except as follows:

- a) A Y-type fitting shall not be used.
- b) If additional valves are used, they shall be temperature and pressure relief valves.
- c) When the temperature and pressure relief valve is installed directly on the boiler with no more than 4 in. (100 mm) maximum interconnecting piping, the valve may be installed in the horizontal position with the outlet pointed down.

(21) 2.4.2 PRESSURE RELIEF VALVE REQUIREMENTS FOR STEAM HEATING BOILERS

- a) Pressure relief valves shall be manufactured in accordance with a national or international standard.
- b) Each steam boiler shall have one or more National Board capacity certified pressure relief valves of the spring pop type adjusted and sealed to discharge at a pressure not to exceed 15 psig (100 kPa).
- c) No pressure relief valve for a steam boiler shall be smaller than NPS 1/2 (DN 15). No pressure relief valve shall be larger than NPS 4 (DN 100).
- d) The minimum valve capacity in lbs/hr (kg/hr) shall be as follows:
 - 1) The minimum pressure relief capacity as declared on the boiler nameplate for the specified fuel.

- 2) If the capacity is not marked on the boiler nameplate or the fuel has been changed; the capacity shall be the greater of the following:
 - a) Minimum mass of steam per area of heating surface; lbs steam/hr ft² (kg steam/hr m²), as specified in Table 2.9.1.3.
 - b) The maximum output method; required valve capacity is determined by the following equation:

$$Capacity(lb/hr) = \frac{Heat\ Input\left(\frac{BTU}{hr}\right)}{1,000\left(\frac{BTU}{lb}\right)} \quad Capacity(kg/hr) = \frac{Heat\ Input\left(\frac{kJ}{hr}\right)}{2,326\left(\frac{kJ}{kg}\right)}$$

The Heat Input shall be based upon the firing of the highest energy content fuel used in the unit.

- 3) For cast-iron boilers, the minimum valve capacity shall be determined by the maximum output method.

In many cases, a relieving capacity greater than the minimum capacity specified by these rules have to be provided. In every case, the requirement of 2.4.2 e) shall be met.

- e) The pressure relief valve capacity for each steam boiler shall be such that with the fuel burning equipment installed, and operated at maximum capacity, the pressure cannot rise more than 5 psig (34 kPa) above the maximum allowable working pressure.
- f) When operating conditions are changed, or additional boiler heating surface is installed, the valve capacity shall be increased, if necessary, to meet the new conditions and be in accordance with 2.4.2 e). The additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.

2.4.3 PRESSURE RELIEF VALVE REQUIREMENTS FOR HOT WATER HEATING OR HOT WATER SUPPLY BOILERS

- a) Pressure relief valves shall be manufactured in accordance with a national or international standard.
- b) Each hot-water heating or hot-water supply boiler shall have at least one National Board capacity certified pressure relief valve, of the automatic reseating type set to relieve at or below the maximum allowable working pressure of the boiler.
- c) Hot-water heating or hot-water supply boilers limited to a water temperature not in excess of 210°F (99°C) may have, in lieu of the valve(s) specified in (b) above, one or more National Board capacity certified temperature and pressure relief valves of the automatic reseating type set to relieve at or below the maximum allowable working pressure of the boiler.
- d) When more than one pressure relief valve is used on either hot-water heating or hot water supply boilers, the additional valves shall be National Board capacity certified and may have a set pressure within a range not to exceed 6 psig (40 kPa) above the maximum allowable working pressure of the boiler up to and including 60 psig (414 kPa), and 5% for those having a maximum allowable working pressure exceeding 60 psig (414 kPa).
- e) No pressure relief valve shall be smaller than NPS 3/4 (DN 20) nor larger than NPS 4 (DN 100), except that boilers having a heat input not greater than 15,000 Btu/hr (4.4 kW) should be equipped with a rated pressure relief valve of NPS 1/2 (DN 15).
- f) The required relieving capacity, in lbs/hr (kg/hr), of the pressure relief valve(s) on a boiler shall be the greater of that determined by dividing the maximum output in Btu/hr (W) at the boiler nozzle obtained by the firing of any fuel for which the unit is installed by 1,000 Btu/hr/lb (645 W/kg), or shall be determined

on the basis of lbs steam/hr/ft² (kg steam/hr/m²) as given in Table 2.2.4. For cast-iron boilers, the minimum valve capacity shall be determined by the maximum output method. In many cases a greater relieving capacity of valves will have to be provided than the minimum specified by these rules. In every case, the requirements of 2.4.3 h) shall be met.

- g) When operating conditions are changed, or additional boiler heating surface is installed, the valve capacity shall be increased, if necessary, to meet the new conditions and be in accordance with 2.4.3 h). The additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.
- h) Pressure relief valve capacity for each boiler with a single pressure relief valve shall be such that, with the fuel burning equipment installed and operated at maximum capacity, the pressure cannot rise more than 10% above the maximum allowable working pressure. When more than one pressure relief valve is used, the over pressure shall be limited to 10% above the set pressure of the highest set valve allowed by 2.4.3 b).

2.4.4 TEMPERATURE AND PRESSURE RELIEF VALVE REQUIREMENTS FOR POTABLE WATER HEATERS

- a) Each water heater shall have at least one National Board capacity certified temperature and pressure relief valve. No temperature and pressure relief valve shall be smaller than NPS 3/4 (DN 20).
- b) The pressure setting shall be less than or equal to the maximum allowable working pressure of the water heater. However, if any of the other components in the hot-water supply system (such as valves, pumps, expansion or storage tanks, or piping) have a lesser working pressure rating than the water heater, the pressure setting for the temperature and pressure relief valve(s) shall be based upon the component with the lowest maximum allowable working pressure rating. If more than one temperature and relief valve is used, the additional valve(s) may be set within a range not to exceed 10% above the set pressure of the first valve.
- c) The required relieving capacity in Btu/hr (W) of the temperature and pressure relief valve shall not be less than the maximum allowable input unless the water heater is marked with the rated burner input capacity of the water heater on the casing in a readily visible location, in which case the rated burner input capacity may be used as a basis for sizing the temperature and pressure relief valves. The relieving capacity for electric water heaters shall be 3500 Btu/hr (1.0 kW) per kW of input. In every case, the following requirements shall be met. Temperature and pressure relief valve capacity for each water heater shall be such that with the fuel burning equipment installed and operating at maximum capacity, the pressure cannot rise more than 10% above the maximum allowable working pressure.

Many temperature and pressure relief valves have a National Board capacity certified rating which was determined according to ASME Code requirements, and a lower Canadian Standards Association (CSA) rating value. Where the ASME Code is the only referenced code of construction the National Board capacity certified rating may be used. If the water heater is not an ASME vessel, or the CSA rating is required by another standard (such as a plumbing or building code) then that rating shall be used.

- d) If operating conditions are changed or additional heating surface is installed, the temperature and pressure relief valve capacity shall be increased, if necessary, to meet the new conditions and shall be in accordance with the above provisions. In no case shall the increased input capacity exceed the maximum allowable input capacity. The additional valves required, on account of changed conditions, may be installed on the outlet piping providing there is no intervening valve.

2.4.4.1 INSTALLATION

Temperature and pressure relief valves shall be installed by either the water heater manufacturer or installer before a water heater is placed in operation.

2.4.4.2 PERMISSIBLE INSTALLATIONS

Temperature and pressure relief valves shall be connected directly to a tapped or flanged opening in the top of the water heater or to a fitting connected to the water heater by a short nipple. Temperature and pressure relief valves shall be installed with their spindles upright and vertical with no horizontal connecting pipe, except that, when the temperature and pressure relief valve is installed directly on the water heater vessel with no more than 4 in. (100 mm) maximum interconnecting piping, the valve may be installed in the horizontal position with the outlet pointed down. The center line of the temperature and pressure relief valve connection shall be no lower than 4 in. (100 mm) from the top of the shell. No piping or fitting used to install the temperature and pressure relief valve shall be of nominal pipe size less than that of the valve inlet.

2.4.4.3 REQUIREMENTS FOR COMMON CONNECTION FOR TWO OR MORE VALVES (21)

- a) When a potable water heater is fitted with two or more temperature and pressure relief valves on one connection, this connection shall have a cross sectional area not less than the combined areas of inlet connections of all the temperature and pressure relief valves with which it connects.
- b) When the size of the water heater requires a temperature and pressure relief valve larger than NPS 4 (DN 100) two or more valves having the required combined capacity shall be used. When two or more valves are used on a water heater, they may be single, directly attached, or installed on a Y-base.

2.4.4.4 THREADED CONNECTIONS

A threaded connection may be used for attaching a temperature and pressure relief valve.

2.4.4.5 PROHIBITED INSTALLATIONS

Temperature and pressure relief valves shall not be connected to an internal pipe in the water heater or a cold water feed line connected to the water heater.

2.4.4.6 USE OF SHUTOFF VALVES PROHIBITED

No shutoff valve of any description shall be placed between the temperature and pressure relief valve and the water heater or on discharge pipes between such valves and the atmosphere.

2.4.4.7 TEMPERATURE AND PRESSURE RELIEF VALVE DISCHARGE PIPING (21)

- a) The discharge from temperature and pressure relief valves shall be so arranged that there will be no danger of scalding attendants. When the temperature and pressure relief valve discharge is piped away from the water heater to the point of discharge, there shall be provisions for properly draining the piping and valve body. The size and arrangement of discharge piping shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the relieving devices below that required to protect the water heater.
- b) When a discharge pipe is used, it shall be not less than the nominal size of the valve outlet and shall be as short and straight as possible and so arranged as to avoid undue stress on the valve. When an elbow is placed on a temperature and pressure relief discharge pipe, it shall be located close to the valve outlet.

- c) Where multiple valves relieve into a common discharge pipe, the cross-sectional flow area of the common discharge pipe shall be equal to or greater than the sum of the individual temperature and pressure valve discharge pipe areas.
- d) Discharge piping shall be rated for the discharge fluid conditions of pressure and temperature including a minimum and maximum design temperature. Material selection for the discharge piping shall consider the reduction in material toughness at the low end of design temperature and the reduction in material strength at the high end of design temperature. Rigid pipe or tubing should be used for discharge lines that carry hot water or steam.
- e) Plastic discharge pipe and fittings are permitted (when compatible with the process fluid, system design temperatures, and other ambient conditions such as light and humidity) and shall conform to NSF/ANSI 14 Plastics Piping System Components and Related Materials.
- f) Discharge piping shall be rated for any static pressure present and the back pressure that may develop when the pressure relief device is at full capacity. Where multiple pressure relief devices or vents discharge into common piping, the back pressure that could develop due to simultaneous flow from all sources shall be considered.

2.4.5 PRESSURE RELIEF VALVES FOR TANKS AND HEAT EXCHANGERS

2.4.5.1 STEAM TO HOT-WATER SUPPLY

When a hot-water supply is heated indirectly by steam in a coil or pipe within the service limitations set forth in Part 1, 3.2, *Definitions*, the pressure of the steam used shall not exceed the safe working pressure of the hot water tank, and a pressure relief valve at least NPS 1 (DN 25), set to relieve at or below the maximum allowable working pressure of the tank, shall be applied on the tank.

2.4.5.2 HIGH TEMPERATURE WATER TO WATER HEAT EXCHANGER

When high temperature water is circulated through the coils or tubes of a heat exchanger to warm water for space heating or hot-water supply, within the service limitations set forth in Part 1, 3.2, *Definitions*, the heat exchanger shall be equipped with one or more National Board capacity certified pressure relief valves set to relieve at or below the maximum allowable working pressure of the heat exchanger, and of sufficient rated capacity to prevent the heat exchanger pressure from rising more than 10% above the maximum allowable working pressure of the vessel.

2.4.5.3 HIGH TEMPERATURE WATER TO STEAM HEAT EXCHANGER

When high temperature water is circulated through the coils or tubes of a heat exchanger to generate low pressure steam, within the service limitations set forth in Part 1, 3.2, *Definitions*, the heat exchanger shall be equipped with one or more National Board capacity certified pressure relief valves set to relieve at a pressure not to exceed 15 psig (100 kPa), and of sufficient rated capacity to prevent the heat exchanger pressure from rising more than 5 psig (34 kPa) above the maximum allowable working pressure of the vessel. For heat exchangers requiring steam pressures greater than 15 psig (100 kPa), refer to NBIC Part 1, Section 2 or Section 4.

2.5 PRESSURE VESSEL PRESSURE RELIEF DEVICES

See NBIC Part 1, 4.1 for the scope of pressure vessels covered by the requirements of Part 4, 2.5.

Pressure relief devices protecting pressure vessels shall meet the following requirements:

2.5.1 DEVICE REQUIREMENTS

- a) Pressure relief devices shall be manufactured in accordance with a national or international standard and be certified for capacity or flow resistance by the National Board.
- b) Dead weight or weighted lever pressure relief valves shall not be used.
- c) An unfired steam boiler shall be equipped with pressure relief valves as required in NBIC Part 4, 2.2.
- d) Pressure relief devices shall be selected (i.e., material, pressure, etc.) and installed such that their proper functioning will not be hindered by the nature of the vessel's contents.

2.5.2 NUMBER OF DEVICES

At least one device shall be provided for protection of a pressure vessel. Pressure vessels with multiple chambers with different maximum allowable working pressures shall have a pressure relief device to protect each chamber under the most severe coincident conditions.

2.5.3 LOCATION

- a) The pressure relief device shall be installed directly on the pressure vessel, unless the source of pressure is external to the vessel and is under such positive control that the pressure cannot exceed the maximum overpressure permitted by the original code of construction and the pressure relief device cannot be isolated from the vessel, except as permitted by 2.5.6 e) 2).
- b) Pressure relief devices intended for use in compressible fluid service shall be connected to the vessel in the vapor space above any contained liquid or in the piping system connected to the vapor space.
- c) Pressure relief devices intended for use in liquid service shall be connected below the normal liquid line. The liquid level during upset conditions shall be considered.

2.5.4 CAPACITY

- a) The pressure relief device(s) shall have sufficient capacity to ensure that the pressure vessel is not exposed to pressure greater than that specified in the original code of construction.
- b) Pressure vessels that can be exposed to fire or other sources of unexpected external heat may require supplemental pressure relief devices to provide additional relieving capacity.
 - 1) The combined capacity of all installed pressure relief devices shall be adequate to prevent the pressure from rising more than 21% above maximum allowable working pressure.
 - 2) The set point of any supplemental pressure relief device(s) shall not exceed 110% of the maximum allowable working pressure. If a single pressure relief device is utilized to protect the vessel during both operational and fire or other unexpected external heating conditions, the set point shall not exceed maximum allowable working pressure.
- c) Vessels connected together by a system of piping not containing valves that can isolate any pressure vessel may be considered as one unit when determining capacity requirements.
- d) Heat exchangers and similar vessels shall be protected with a pressure relief device of sufficient capacity to avoid overpressure in case of internal failure.
- e) When a non-reclosing device is installed between a pressure relief valve and the pressure vessel, the reduction in capacity due to installation of the non-reclosing device shall be determined in accordance with the code of construction by use of a National Board certified Combination Capacity Factor (CCF).

For rupture disks, if a certified combination capacity factor is not available, the capacity of the pressure relief valve shall be multiplied by 0.9 and this value used as the capacity of the combination installation.

- f) The owner shall document the basis for selection of the pressure relief devices used, including capacity, and have such calculations available for review by the Jurisdiction.

2.5.5 SET PRESSURE

- a) When a single pressure relief device is used, the set pressure marked on the device shall not exceed the maximum allowable working pressure.
- b) When more than one pressure relief device is provided to obtain the required capacity, only one pressure relief device set pressure needs to be at the maximum allowable working pressure. The set pressures of the additional pressure relief devices shall be such that the pressure cannot exceed the overpressure permitted by the code of construction.

(21) 2.5.6 INSTALLATION AND DISCHARGE PIPING REQUIREMENTS

- a) The opening through all pipe and fittings between a pressure vessel and its pressure relief device shall have at least the area of the pressure relief device inlet. The characteristics of this upstream system shall be such that the pressure drop will not reduce the relieving capacity below that required or adversely affect the proper operation of the pressure relief device. When a discharge pipe is used, the size shall be such that any pressure that may exist or develop will not reduce the relieving capacity below that required or adversely affect the proper operation of the pressure relief device. It shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.
- b) A non-reclosing device installed between a pressure vessel and a pressure relief valve shall meet the requirements of 2.5.6 a).
- c) The opening in the pressure vessel wall shall be designed to provide unobstructed flow between the vessel and its pressure relief device.
- 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 flow to the pressure relief devices or made at least equal to the combined inlet areas of the pressure relief devices connected to it. The flow characteristics of the upstream system shall satisfy the requirements of 2.5.6 a).
- e) There shall be no intervening stop valves between the vessel and its pressure relief device(s), or between the pressure relief device(s) and the point of discharge, except under the following conditions:
 - 1) When these stop valves are so constructed or positively controlled that the closing of the maximum number of block valves at one time will not reduce the pressure relieving capacity below the required relieving capacity.
 - 2) Upon specific acceptance of the Jurisdiction, when necessary for the continuous operation of processing equipment of such a complex nature that shutdown of any part is not feasible, a full area stop valve between a pressure vessel and its pressure relief device may be provided for inspection and repair purposes only. This stop valve shall be arranged so that it can be locked or sealed open, and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station.
 - 3) A full area stop valve may also be placed on the discharge side of a pressure relief device when its discharge is connected to a common header for pressure relief devices to prevent discharges from these other devices from flowing back to the first device during inspection and repair. This stop valve shall be arranged so that it can be locked or sealed open, and it shall not be closed except

by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked and sealed in the open position before the authorized person leaves the station. This valve shall only be used when a stop valve on the inlet side of the pressure relief device is first closed.

- 4) A pressure vessel in a system where the pressure originates from an outside source may have a stop valve between the vessel and the pressure relief device, and this valve need not be sealed. Pressure vessels designed for human occupancy (such as decompression or hyperbaric chambers) shall be provided with a quick opening stop valve between the pressure vessel and its pressure relief valve. The stop valve shall be normally sealed open with a frangible seal and be readily accessible to the pressure relief attendant.
- f) All pressure relief devices shall relieve to a safe point of discharge.
- g) Discharge lines from pressure relief devices shall be designed to facilitate drainage or be fitted with drains to prevent liquid from collecting in the discharge side of a pressure relief device. The size of discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the pressure relief device or adversely affect the operation of the pressure relief device. It shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.
- h) Pressure relief devices shall be installed so they are readily accessible for inspection, repair, or replacement.
- i) Pressure vessel pressure relief devices and discharge piping shall be safely supported. The reaction forces due to discharge of pressure relief devices shall be considered in the design of the inlet and discharge piping. Design of supports, foundations, and settings shall consider vibration (including seismic where necessary), movement (including thermal movement), and loadings (including reaction forces during device operation in accordance with Jurisdictional requirements, manufacturer's recommendations, and/or other industry standards, as applicable).

2.5.7 TEMPERATURE AND PRESSURE RELIEF DEVICES FOR HOT WATER STORAGE TANKS/POTABLE HOT WATER STORAGE TANK (21)

- a) Each potable hot water storage tank shall be equipped with an ASME/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 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).
- c) Each hot water storage tank shall be equipped with an ASME/NB certified pressure relief valve set at a pressure not to exceed the maximum allowable working pressure.
- d) The temperature and pressure relief valves shall meet the requirements of 2.5.1 through 2.5.6 above.

2.6 PIPING SYSTEM PRESSURE RELIEF DEVICES

See NBIC Part 1, Section 5 for the piping systems associated with Part 4, 2.6.

When required by the original code of construction, piping shall be protected by pressure relief devices in accordance with the following requirements.

2.6.1 DEVICE REQUIREMENTS

- a) Pressure relief devices shall be manufactured in accordance with a national or international standard and be certified for capacity or flow resistance by the National Board.
 - 1) In certain cases piping codes of construction permit the use of regulators, which may include integral pressure relief valves to limit the pressure in a piping system. In this case, capacity certification of the pressure relief valve is not required.
 - 2) Some piping codes of construction permit the use of pressure relief devices without capacity certification. In this case, capacity certification of the pressure relief device by the National Board is not required.
- b) Dead weight or weighted lever pressure relief devices shall not be used.
- c) Pressure relief devices shall be selected (i.e., material, pressure, etc.) and installed such that their proper functioning will not be hindered by the nature of the piping system's contents.

2.6.2 NUMBER OF DEVICES

At least one pressure relief device shall be provided for protection of a piping system. A pressure relief device installed on a pressure vessel or other component connected to the piping system may be used to meet this requirement. Portions of piping systems with different maximum allowable working pressures shall have a pressure relief device to protect each portion separately.

(21) 2.6.3 LOCATION

Pressure relief devices, except those covered by NBIC Part 4, 2.2 through 2.4, may be installed at any location in the system provided the pressure in any portion of the system cannot exceed the maximum over-pressure permitted by the original code of construction. Pressure drop to the pressure relief device under flowing conditions shall be considered when determining pressure relief device location. The pressure-relief device shall not be isolated from the piping system except as permitted by 2.6.6 e).

2.6.4 CAPACITY

- a) The pressure relief device(s) shall have sufficient capacity to ensure that the piping is not exposed to pressures greater than that specified in the original code of construction.
- b) When a non-reclosing device is installed between a pressure relief valve and the pipe, the reduction in capacity due to installation of the non-reclosing device shall be determined in accordance with the code of construction by use of a National Board certified Combination Capacity Factor (CCF). For rupture disks, if a certified combination capacity factor is not available, the capacity of the pressure relief valve shall be multiplied by 0.9 and this value used as the capacity of the combination installation.
- c) The owner shall document the basis for selection of the pressure relief devices used, including capacity, and have such calculations available for review by the Jurisdiction, when required.

2.6.5 SET PRESSURE

- a) When a single pressure relief device is used, the set pressure marked on the device shall not exceed the maximum allowable working pressure, except when allowed by the original code of construction.
- b) When more than one pressure relief device is provided to obtain the required capacity, only one pressure relief device set pressure need be at or below the maximum allowable working pressure. The set

pressures of the additional pressure relief devices shall be such that the pressure cannot exceed the overpressure permitted by the code of construction.

2.6.6 INLET AND DISCHARGE PIPING REQUIREMENTS

- a) The opening through all pipes and fittings between a piping system and its pressure relief device shall have at least the area of the pressure relief device inlet. The characteristics of this upstream system shall be such that the pressure drop will not reduce the relieving capacity below that required or adversely affect the operation of the pressure relief device.
- b) A non-reclosing device installed between a piping system and a pressure relief valve shall meet the requirements of 2.6.6 a).
- c) The opening in the pipe shall be designed to provide unobstructed flow between the pipe and its pressure relief device.
- d) When two or more required pressure relief devices are placed on the connection, the inlet cross-sectional area of this connection shall be sized either to avoid restricting flow to the pressure relief devices or made at least equal to the combined inlet areas of the pressure relief devices connected to it. The flow characteristics of the upstream system shall satisfy the requirements of 2.6.6 a).
- e) There shall be no intervening stop valves between the piping system and its pressure relief device(s), or between the pressure relief device(s) and the point of discharge except under the following conditions:
 - 1) These stop valves shall be so constructed or positively controlled that the closing of the maximum number of block valves at one time will not reduce the pressure relieving capacity below the required relieving capacity;
 - 2) Upon specific acceptance of the Jurisdiction, when necessary for the continuous operation of processing equipment of such a complex nature that shutdown of any part is not feasible, a full area stop valve between a piping system and its pressure relief device may be provided for inspection and repair purposes only. This stop valve shall be arranged so that it can be locked or sealed open and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station;
 - 3) A full area stop valve may be placed on the discharge side of a pressure relief device when its discharge is connected to a common header for pressure relief devices to prevent discharges from these other devices from flowing back to the first device during inspection and repair. This stop valve shall be arranged so that it can be locked or sealed open and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station. This valve shall only be used when a stop valve on the inlet side of the pressure relief device is first closed; or
 - 4) A piping system where the pressure originates from an outside source may have a stop valve between the system and the pressure relief device, and this valve need not be sealed open, provided it also closes off that vessel from the source of pressure.
- f) Pressure relief device discharges shall be arranged such that they are not a hazard to personnel or other equipment and, when necessary, lead to a safe location for disposal of fluids being relieved.
- g) Discharge lines from pressure relief devices shall be designed to facilitate drainage or be fitted with drains to prevent liquid from collecting in the discharge side of a pressure relief device. The size of discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the pressure relief device or adversely affect the operation of the pressure relief device. It

shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.

- h) The reaction forces due to discharge of pressure relief devices shall be considered in the design of the inlet and discharge piping.
- i) Pressure relief devices shall be installed so they are accessible for inspection, repair, or replacement.

PART 4, SECTION 3

PRESSURE RELIEF DEVICES — IN-SERVICE INSPECTION OF PRESSURE RELIEF DEVICES

3.1 SCOPE

This section provides general guidelines and requirements for conducting in-service inspection and testing of pressure relief devices.

The inspection of pressure relief devices is often coordinated with the inspection of the system. See NBIC Part 2 for in-service inspection requirements and procedures for other portions of the equipment not discussed in this section.

3.2 GENERAL

- a) The most important appurtenances on any pressurized system are the pressure relief devices provided for overpressure protection of that system. These are devices such as pressure relief valves, rupture disks, and other non-reclosing devices that are called upon to operate and reduce an overpressure condition.
- 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 critical to ensure their continued functioning and to provide assurance that they will be available when called upon to operate. See 3.2.6 for recommended testing frequency for PRDs.
- d) Inspection areas of concern include:
 - 1) Correct set pressure (matching of set pressure to MAWP);
 - 2) Safety considerations;
 - 3) Device data;
 - 4) Condition of the device;
 - 5) Condition of the installation; and
 - 6) Testing and operational inspection.

3.2.1 PRESSURE RELIEF DEVICE DATA

- a) Nameplate marking or stamping of the device should be compared to stamping on the protected pressure-retaining item. For a single device, the set pressure shall be no higher than the maximum allowable working pressure (MAWP) marked on the protected pressure-retaining item or system.
- b) When more than one pressure relief device is provided to obtain the required capacity, only one pressure relief device set pressure need be at or below the maximum allowable working pressure. The set pressure of additional devices may exceed the MAWP, as permitted by the original code of construction.
- c) Verify nameplate capacity and, if possible, compare to system capacity requirements.
- d) Check identification on seals and ensure they match nameplates or other identification (repair or reset nameplate) on the valve or device.

3.2.2 INSPECTION REQUIREMENTS FOR DEVICE CONDITION

- a) The valve or device shall be checked for evidence that it is leaking or not sealing properly. Evidence of leakage through pressure-relief valves may indicate that the system is being operated at a pressure that is too close to the valve's set pressure. (See Supplement 2 for guidance on the pressure differential between the pressure relief valve set pressure and system operating pressure.)
- b) Seals for adjustments shall be intact and show no evidence of tampering.
- c) Connecting bolting should be tight and all bolts intact.
- d) The valve or device should be examined for deposits or material buildup.
- e) The valve or device shall be checked for evidence of rust or corrosion.
- f) The valve or device shall be checked for damaged or misapplied parts.
- g) If a drain hole is visible, the valve or device should be checked to ensure it is not clogged with debris or deposits.
- h) The valve or device shall be checked for test gags left in place after pressure testing of the unit.
- i) Bellows valves shall be checked to ensure the bonnet vent is open or piped to a safe location. The vent shall not be plugged since this will cause the valve set pressure to be high if the bellows develops a leak. Leakage noted from the vent indicates the bellows is damaged and will no longer protect the valve from the effects of back pressure.

(21) 3.2.3 INSPECTION REQUIREMENTS FOR INSTALLATION CONDITION

- a) Ensure all covers, caps, plugs, and/or 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, the inlet pipe shall be checked to ensure the inlet pipe size is not smaller than the device inlet size.
- c) Discharge piping shall be inspected to ensure it meets the original code of construction. For pressure relief valves, the discharge pipe shall be checked to ensure the discharge pipe size is not smaller than the device outlet size.
- 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 valve 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 inlet or between the valve outlet and its point of discharge. Isolation valves may be permitted in some pressure vessel service. (See 2.5.6 e)), and Jurisdictional requirements. Isolation valves shall not be used for power boilers, heating boilers, or water heaters.
- j) A change-over valve, which is used to install two pressure relief devices on a single vessel location for the purpose of switching from one device to a spare device, is not considered a block valve if it

is arranged such that there is no intermediate position that will isolate both pressure relief devices 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 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 Jurisdiction be contacted to determine their acceptability on boiler applications.

3.2.4 ADDITIONAL INSPECTION REQUIREMENTS

The following are additional items that should be considered for the specified types of installations or services.

3.2.4.1 POWER BOILERS

If boilers 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.

3.2.4.2 HOT-WATER HEATING BOILERS, HOT WATER SUPPLY BOILERS, AND WATER HEATERS

- a) These units generally do not use any water treatment and therefore may be more prone to problems with deposits forming that may impair a safety device's operation. Particular attention should be paid to signs of leakage through valves or buildups 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 the valve inlet.
- c) Water heaters will have cleaner water due to continuous makeup. However, these valves usually have a thermal element that will cause the valve to open slightly when the water is heated and the heat is not removed from the system. When this hot water evaporates in the discharge piping, scale deposits may tend to form in the valve inlet and outlet.

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 ASME Section VIII, Div. 1 pressure vessels, see UG-135, Appendix M, and Jurisdictional rules for more information.

3.2.4.4 RUPTURE DISKS

- a) Rupture disks or other non-reclosing devices may be used as sole relieving devices or in combination with pressure relief valves to protect pressure vessels.
- b) The selection of the correct rupture disk device for the intended service is critical to obtaining acceptable disk performance. Different disk designs are intended for 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 prebulged solid metal disks are typically

used with an operating pressure that is 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. 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 disk material is also critical to obtaining acceptable service life from the disk. 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 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 shall be the expected temperature of the disk when the disk is expected to burst and will usually be related to the process temperature, not the temperature on the pressure vessel nameplate.
 - 2) Markings indicating direction of flow should be carefully checked to ensure they are correct. Some rupture disks when installed in the incorrect position may burst well above the stamped pressure.
 - 3) The marked burst pressure for a rupture disk installed at the inlet of a pressure relief valve shall be equal to or less than the pressure relief valve set pressure. A marked burst pressure of 90% to 100% of the pressure relief valve set pressure is recommended. A disk with a non-fragmenting design that cannot affect the pressure relief valve shall be used.

Note: If the pressure 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 that the space between the rupture disk and a pressure relief valve is supplied with a pressure gage, try cock, or telltale indicator to indicate signs of leakage through the rupture disk. The pressure relief valve 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 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 dependent on the nature of the contents and operation of the system and only general recommendations can be given. Inspection frequency should be based on previous inspection history. If devices have been found to be leaking, defective, or damaged by system contents during inspection, intervals should be shortened until acceptable inspection results are obtained. With this in mind, the inspection frequency guidelines specified in 3.2.6 are suggested for similar services.

- 8) Rupture disks are often used to isolate pressure relief valves 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, a visual inspection is the only inspection that can be performed. A rupture disk that is removed from its holder shall not be reinstalled unless recommended by the manufacturer. A rupture disk contained in an assembly that can be removed from a system without releasing the force maintaining the contact between the disk and holder, such as pre-torqued, welded, soldered, and some threaded assemblies, may be suitable for reinstallation after visual inspection. The manufacturer should be consulted for specific recommendations.
- 10) It is recommended that all rupture disks be periodically replaced to prevent unintended failure while in service due to deterioration of the device. Rupture disks should be carefully checked 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.

3.2.5 TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF DEVICES

- a) Pressure relief valves shall be tested periodically to ensure that they are free to operate and will operate in accordance with the requirements of the original code of construction. Testing should include device set or opening pressure, reclosing pressure, where applicable, and seat leakage evaluation. Tolerances specified for these operating requirements in the original code of construction shall be used to determine the acceptability of test results.
- b) Testing may be accomplished by the owner on the unit where the valve 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 only be performed by qualified individuals under carefully controlled conditions. It is recommended that a written procedure be available to conduct this testing.
 - 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 was performed at a test facility, the record of this test should be reviewed to ensure the valve meets the requirements of the original code of construction. Valves which have been in toxic, flammable, or other hazardous services shall be carefully decontaminated before being tested. In particular, 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 valve shall be disassembled, cleaned, and decontaminated, repaired, and reset.
 - 3) If a valve has been removed for testing, the inlet and outlet connections should be checked for blockage by product buildup or corrosion.
- c) Valves may be tested using lift assist devices when testing at full pressure may cause damage to the valve being tested, or it is impractical to test at full pressure due to system design considerations. Lift assist devices apply an auxiliary load to the valve spindle or stem, and using the measured inlet pressure, applied load and other valve data allow the set pressure to be calculated. If a lift assist device is used to determine valve set pressure, the conditions of 4.6.3 shall be met. It should be noted that false set pressure readings may be obtained for valves which are leaking excessively or otherwise damaged.
- d) If valves are not tested on the system using the system fluid, the following test mediums shall be used:
 - 1) High pressure boiler pressure relief valves, high temperature hot-water boiler pressure relief valves, low pressure steam heating boilers: steam;
 - 2) Hot-water heating boiler pressure relief valves: steam, air, or water;

- 3) Hot water heater temperature and pressure relief valves: air or water;
- 4) Air and gas service process pressure relief valves: air, nitrogen, or other suitable gas;
- 5) Liquid service process pressure relief valves: water or other suitable fluid;
- 6) Process steam service pressure relief valves: steam or air with manufacturer's steam to air correction factor.

Note: Valves being tested after a repair must be tested on steam except as permitted by 4.6.2.

- e) As an alternative to a pressure test, the valve may be checked by the owner for freedom of operation by activating the test or "try" lever (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 or the lifting device may be damaged. This test will only indicate that the valve is free to operate and does not provide any information on the actual set pressure. All manual checks should be performed with some pressure under the valve in order to flush out debris from the seat that could cause leakage.

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

- f) Systems with multiple valves will require the lower set valves to be held closed to permit the higher set valves to be tested. A test clamp or "gag" should be used for this purpose. The spring compression screw shall not be tightened. It is recommended that the test clamps be applied in accordance with the valve manufacturer's instructions when the valve is at or near the test temperature, and be applied hand tight only to avoid damage to the valve stem or spindle.
- g) Upon completion of set pressure testing, all pressure relief valve gags shall be removed.

3.2.5.1 CORRECTIVE ACTION

If a valve is found to be stuck closed, the system should immediately be taken out of service until the condition can be corrected, unless special provisions have been made to operate on a temporary basis (such as additional relief capacity provided by another valve.) The owner shall be notified and corrective action such as repairing or replacing the inoperable valve shall be taken.

3.2.5.2 VALVE ADJUSTMENTS

- a) If a set pressure test indicates the valve does not open within the requirements of the original code of construction, but otherwise is in acceptable condition, minor adjustments (defined as no more than twice the permitted set pressure tolerance) shall be made by a "VR" or "T/O" Certificate Holder to reset the valve to the correct opening pressure. All adjustments shall be resealed with a seal identifying the responsible organization and a tag shall be installed identifying the organization and the date of the adjustment.
- b) If a major adjustment is needed, this may indicate the valve is in need of repair or has damaged or misapplied parts. Its condition should be investigated accordingly.

(21) 3.2.6 RECOMMENDED INSPECTION AND TEST FREQUENCIES FOR PRESSURE RELIEF DEVICES

Frequency of test and inspection of pressure relief devices is 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 and/or manufacturer's recommendations. If, during inspection, valves are found to be defective or damaged, intervals should be

shortened until acceptable inspection results are obtained. Where test records and/or inspection history are not available, the following inspection and test frequencies are suggested:

TABLE 3.2.6

(21)

Service	Inspection Type/Frequency
Power boilers less than 400 psi (2.76 MPa)	Lift lever test every six months, set pressure test annually or prior to planned boiler shutdown
Power boilers 400 psi (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
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, remove and inspect temperature probe for damage, buildup or corrosion every three years.
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

Note 1:

For safety reasons, removal and testing on a steam test bench is recommended. Such testing will avoid damaging the pressure relief valve by discharge of a steam water mixture, which could occur if the valve is tested in place.

Note 2:

The frequencies specified for the testing of pressure relief valves on boilers is primarily based on differences between high pressure boilers that are continuously manned, and lower pressure automatically controlled boilers that are not monitored by a boiler operator at all times. When any boiler experiences an overpressure condition such that the pressure relief valves actuate, the valves should be inspected for seat leakage and other damage as soon as possible and any deficiencies corrected.

Note 3:

The temperature probe shall be checked for the condition of the coating material and freedom of movement without detaching. If the probe pulls out or falls off during inspection, the valve shall be repaired or replaced. Due to the relatively low cost of temperature and pressure relief valves for this service, it is recommended that a defective valve be replaced with a new valve if a repair or resetting is indicated.

3.2.6.1 ESTABLISHMENT OF INSPECTION AND TEST INTERVALS

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

- a) Jurisdictional requirements;
- b) Records of test data and inspections from similar processes and similar devices in operation at that facility;
- c) Recommendations from the device manufacturer. In particular, when the valve includes non-metallic parts such as a diaphragm or soft seat, periodic replacement of those parts may be specified;
- d) Operating history of the system. Systems with frequent upsets where a valve has actuated require more frequent inspection;
- e) Results of visual inspection of the device and installation conditions. Signs of valve leakage, corrosion or damaged parts all indicate more frequent operational inspections;
- 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 other valves by the corrosion of parts in the outlet portion of the valve or the buildup of products discharged from those valves;
- g) Ability to coordinate with planned system shutdowns. The shutdown of a system for other maintenance or inspection activities is an ideal time for the operational inspection and test of a pressure relief valve;
- h) Critical nature of the system. Systems that are critical to plant operation or where the effects of the discharge of fluids from the system are particularly detrimental due to fire hazard, environmental damage, or toxicity concerns all call for more frequent inspection intervals to ensure devices are operating properly; and
- i) Where the effects of corrosion, blockage by system fluid, or ability of the valve to operate under given service conditions are unknown (such as in a new process or installation), a relatively short 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 are guidelines for periodic inspection and testing. Typically if there are no adverse findings, a pressure relief valve 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 devices so the process or system is not affected by excessive downtime.
- b) Pressure relief valves 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-rings and diaphragms are also well advised preventive maintenance activities that can prevent future problems. If the 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 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.

3.3 ACCREDITATION OF “T/O” TEST ONLY ORGANIZATIONS

3.3.1 SCOPE

- a) This section provides requirements that must be met for an organization to obtain a National Board *Certificate of Authorization* to use the “T/O” Certification Mark for in-service testing and performing minor adjustments of pressure relief valves constructed in accordance with the requirements of the ASME Code.
- b) For administrative requirements to obtain or renew a National Board “T/O” *Certificate of Authorization* and “T/O” Certification Mark, refer to NB-528, Accreditation of “T/O” Test Only Organizations.
- c) Authorization to use the official National Board “T/O” Certification Mark as shown in Figure 3.5.2-a), will be granted by the National Board provided the requirements of the administrative rules in NB-528 and the NBIC are met.

3.3.2 JURISDICTIONAL PARTICIPATION

The National Board member Jurisdiction in which the “T/O” organization is located is encouraged to participate in the review and demonstration of the applicant’s quality system. The Jurisdiction may require participation in the review of the testing organization and the demonstration and acceptance of the repair organization’s quality system manual.

3.3.3 QUALITY SYSTEM

3.3.3.1 GENERAL

Each applicant for a new or renewed “T/O” *Certificate of Authorization* shall have and maintain a quality system which shall establish that all of these rules and administrative procedures and applicable ASME Code requirements, testing, inspection, sealing, and applying the “T/O” Certification Mark will be met.

3.3.3.2 WRITTEN DESCRIPTION

A written description, in the English language, of the system the applicant will use shall be available for review and shall contain, as a minimum, the features set forth in 3.3.3.4. This description may be brief or voluminous, depending upon the projected scope of work, and shall be treated confidentially. In general, the quality system shall describe and explain what documents and procedures the testing firm will use to validate a test and/or minor adjustment.

3.3.3.3 MAINTENANCE OF A CONTROLLED COPY

Each applicant to whom a “T/O” *Certificate of Authorization* is issued shall maintain thereafter a controlled copy of the accepted quality system manual with the National Board. Except for changes that do not affect the quality system, revisions to the quality system manual shall not be implemented until such revisions are accepted by the National Board.

3.3.3.4 OUTLINE OF REQUIREMENTS FOR A QUALITY SYSTEM

(21)

The following establishes the minimum requirements of the written description of the quality system. It is required that each testing organization develop its own quality system that meets the requirements of its organization. For this reason it is not possible to develop one quality system 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 is required to ensure revision control of the quality system 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 should list and reference, by section paragraph or 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 "T/O" Certification Mark shall be used only for pressure relief valves that meet the following conditions:
 - a) Are marked with an ASME "V", "UV", or "HV" Code symbol or marked with the ASME Certification Mark with "V", "UV", or "HV" designator and have been capacity certified by the National Board;
 - b) Have been visually inspected, and successfully tested in accordance with this program; and
 - c) Only external adjustments to restore the nameplate set pressure and/or performance of a pressure relief valve shall be made under the provisions of this program. If disassembly, change of set pressure, or additional repairs are necessary, the valve shall be repaired by a National Board "VR" Certificate Holder or replaced.
- 2) The title of the individual responsible for ensuring that the quality system is followed and who has authority and freedom to affect the responsibility;
- 3) A statement that if there is a disagreement in the implementation of the written quality system, the matter is to 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 quality system and the method by which such revisions are to be submitted to the National Board for acceptance before implementation.

e) Organization Chart

A chart showing the relationship between management, inspection, testing, and quality control personnel is required and shall reflect the actual organization in place.

f) Scope of Work

- 1) The scope of work section shall indicate the scope and type of valve testing the organization is capable of and intends to perform. The location of testing (shop, shop and field, or field only), ASME Code Section(s) to which the tests apply, and the test medium (air, gas, liquid, or steam, or combinations thereof) shall be included.
- 2) The types and sizes of valves to be tested, pressure ranges and other limitations shall also be addressed.

g) Specification Control

The specification control system shall provide procedures assuring that the latest applicable specifications and instructions required are used for valve inspection and testing.

h) Inspection and Testing Program

The inspection and testing program section shall include reference to a document (such as an inspection and test report, or checklist) that outlines the specific inspection and testing procedures used in the testing of pressure relief valves. Provisions shall be made to retain this document for a period of at least five years.

- 1) Each valve or group of valves shall be accompanied by the document referred to above for processing through the plant. Each valve shall have a unique identifier assigned by the Test Only organization (e.g., job serial number, shop order number, work order number, etc.) appearing on the test documentation and test only nameplate such that traceability is established.
- 2) The document referred to above shall describe the original nameplate information, including the ASME Code symbol stamping and, if applicable, the repair nameplate information. In addition, it shall include pressure test methods to be used. Application of the "T/O" Certification Mark to the test only nameplate shall be recorded in this document. There shall be a space for "signoffs" at each operation to verify that each step has been properly performed by qualified personnel.
- 3) The system shall also describe the controls used to ensure that any personnel engaged in the testing of pressure relief valves are trained and qualified in accordance with 3.4.

i) Valve Adjustment and Sealing

- 1) The system shall include provisions that each pressure relief valve requiring adjustment as permitted by 3.2.5.2 shall have existing seal(s) removed only for the required adjustment(s), be tested, set, and external adjustment(s) re-sealed according to the requirements of the applicable ASME Code Section and the NBIC. The seal shall identify the "T/O" Certificate Holder performing the test or making the adjustment. Abbreviations or initials are permitted, provided such identification is defined in the quality system and acceptable to the National Board.
- 2) The system shall include provisions that each pressure relief valve requiring the use of a Lift Assist Device for testing as permitted by 3.2.5 c) may have the seal(s) removed for testing. Upon completion of testing, external adjustments shall be re-sealed in accordance with i) 1) above.

j) Test Only Nameplates

The quality system shall include a description of a nameplate or a drawing. An effective valve marking system shall be established to ensure proper marking and nameplate attachment for each valve as required by 3.5.2. The manual shall include a description of the nameplate or a drawing.

k) Calibration

- 1) The quality system shall describe a system for the calibration of examination, measuring, and test equipment used in the performance of testing. Documentation of these calibrations shall include the standard used and the results.
- 2) All calibration standards shall be calibrated against certified equipment having known valid relationships to nationally recognized standards.

l) Manual Control/Procedures

The quality system manual and referenced procedures shall include:

- 1) Measures to control the issuance of and revisions to the quality system manual;

- 2) Provisions for a review of the system in order to maintain the manual current with these rules and the applicable sections of the ASME Code;
- 3) The title(s) of the individual(s) responsible for preparation, revision distribution, approval, and implementation of the quality system manual;
- 4) Provision for a controlled copy of the written quality system manual to be submitted to the National Board for acceptance prior to implementation; and
- 5) Revisions shall be submitted for acceptance by the National Board prior to being implemented.

m) Nonconformities

The quality system 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. These may include, but are not limited to, data discrepancies, procedural and/or documentation deficiencies, or material defects. Also, the title(s) of the individual(s) involved in this process shall be included.

n) Testing Equipment (See NBIC Part 4, Supplement 5)

The quality system shall include a means to control the development, addition, or modification of testing equipment to ensure the requirements of NBIC Part 4, 4.6.1 b) are met.

o) Field Testing

If field testing is included in the scope of work, the system shall address any differences or additions to the quality system required to properly control this activity, including the following:

- 1) Provisions for annual audits of field activities shall be included;
- 2) Provisions for use of owner-user measurement and test equipment, if applicable, shall be addressed.

p) Records Retention

The quality manual shall describe a system for filing, maintaining, and easily retrieving records supporting or substantiating the administration of the Quality System within the scope of the "T/O" *Certificate of Authorization*. The record retention schedule described in the Quality System Manual is to follow the instructions identified in Table 3.3.3.4 p).

q) Exhibits

Forms used in the quality system shall be included in the manual with a written description. Forms exhibited should be marked "SAMPLE" and completed in a manner typical of actual valve testing procedures.

TABLE 3.3.3.4 p)

Reports, Records, or Documents for "T/O" Certificate Holders	Instructions	Minimum Retention Period
a) Record of testing or inspection	The testing and inspection program section shall include reference to a document (such as a report, traveler, or checklist) that outlines the specific testing and inspection procedures used in the testing of pressure relief valves.	5 years
b) Records related to equipment qualification and instrument calibration	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 quality system, or comparisons to field performance.	5 years after the subject piece of equipment or instrument is retired.
c) Record of lift assist device qualification	Prior to use, all lift assist devices 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 used for verification testing as specified in the quality system or comparisons to field performance. This qualification shall be documented.	5 years after the lift assist device is retired.
d) Records of employee training and qualification	Each testing organization shall establish minimum qualification requirements for those positions within the organization as they directly relate to pressure relief valve testing. Each testing organization shall document the evaluation and acceptance of an individual's qualification for the applicable position.	5 years after termination of employment.

3.3.4 TESTING & ADJUSTMENT

- a) Each Pressure Relief Valve to be tested shall be inspected in accordance with Section 3.2.2.
- b) Pressure Relief Valves with missing or illegible nameplates shall not be tested under the T/O program and shall be referred to a "VR" Certificate Holder or replaced.
- c) Pressure Relief Valves shall be tested to confirm that the Set Pressure (defined as the average of at least three consecutive tests) is within the allowable tolerance specified by the applicable ASME Code Section and NBIC. Test Results, including Test Gauge Identification, shall be recorded on the document referred to above. Pressure Relief Valve seals shall not be removed unless required for adjustment or testing using a lift assist device.

- d) Testing organizations may obtain a “T/O” *Certificate of Authorization* for field testing, either as an extension to their in-shop/plant scope, or as a field-only scope, provided that the Quality System includes the following provisions:
- 1) Qualified technicians in the employ of the certificate holder perform such testing;
 - 2) An acceptable quality system covering field testing, including field audits is maintained; and
 - 3) Functions affecting the quality of the tested valves are supervised from the address of record where the “T/O” certification is issued.

3.3.4.1 AUDIT REQUIREMENTS

Upon issuance of a *Certificate of Authorization*, provided field tests are performed, annual audits of the work carried out in the field shall be performed to ensure that the requirements of the certificate holder’s quality system are met. The audit shall include, but not be limited to, performance testing, in accordance with paragraph 4.6, of valve(s) that were tested in the field. The audits shall be documented.

3.4 TRAINING AND QUALIFICATION OF PERSONNEL

3.4.1 CONTENTS OF TRAINING PROGRAM

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

- a) Applicable ASME Code and NBIC requirements;
- b) Responsibilities within the organization’s quality system;
- c) Knowledge of the technical aspects and mechanical skills for making set pressure and/or blowdown adjustments to pressure relief valves;
- d) Knowledge of the technical aspects and mechanical skills for marking and sealing of pressure relief valve adjustments.

3.5 MARKING REQUIREMENTS FOR VALVES TESTED UNDER THE T/O PROGRAM

3.5.1 NAMEPLATES

Proper marking and identification of tested valves is critical to ensuring acceptance during subsequent inspections, and also provide for traceability and identification to the valve.

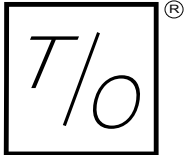
3.5.2 TEST ONLY NAMEPLATE & VALVE SEALING

When a pressure relief valve is tested, a metal test only nameplate marked with the information required below shall be securely attached to the valve adjacent to the original manufacturer’s stamping or nameplate and/or repair nameplate. If not installed directly on the valve, the nameplate shall be securely attached to the valve independent of the external adjustment seals in a manner that does not interfere with valve operation and sealed in accordance with the quality system.

- a) Existing manufacturer/assembler and “VR” nameplates if applicable shall not be removed.

- b) Existing manufacturer/assembler, “VR”, and/or “TO” seals shall remain in place unless removal is required to perform testing or adjustment. Following testing, the valve shall be resealed by the responsible “T/O” Certificate Holder.
- c) Any previous test only nameplates shall be removed.
- d) As a minimum, the information on the “T/O” nameplate (see Figure 3.5.2-a) shall include:
 - 1) The name of responsible organization preceded by the words “Tested by” shall be applied.
 - 2) Date of test shall be applied;
 - 3) Set pressure shall be applied;
 - 4) Unique identifier of test shall be applied (eg. shop order number, work order number, job serial number, etc.);
 - 5) The “T/O” Certification Mark as provided by the National Board; and
 - 6) National Board “T/O” certificate number.

FIGURE 3.5.2-a REQUIRED MARKINGS FOR TESTING OF ASME/NATIONAL BOARD “V,” “UV,” AND “HV” STAMPED PRESSURE RELIEF VALVES UNDER THE “T/O” PROGRAM

TESTED BY	_____
	CERTIFICATE HOLDER
	_____
	DATE OF TEST

	SET PRESSURE

	UNIQUE IDENTIFICATION
_____ NATIONAL BOARD “T/O” CERTIFICATE NUMBER	

PART 4, SECTION 4

PRESSURE RELIEF DEVICES — REPAIR OF PRESSURE RELIEF VALVES

4.1 SCOPE

This section provides requirements and guidelines that apply to repairs to pressure relief valves.

- a) Repairs may be required because of defects found during periodic inspection, testing, operation, or maintenance. Since pressure relief devices are provided for safety and the protection of personnel and property, repairs are often regulated by the Jurisdiction where the pressure relief device 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 can be found in NB-514, *Accreditation of "VR" Repair Organizations*. Some Jurisdictions 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 can be found in NBIC Part 3.

4.2 GENERAL REQUIREMENTS

- a) Repair of a pressure relief valve is considered to include the disassembly, replacement, re-machining, or cleaning of any critical part, lapping of a seat and disc, reassembly, adjustment, testing, or any other operation that may affect the flow passage, capacity, function, or pressure-retaining integrity.
- b) Conversions, changes, or adjustments (excluding those as defined in 3.2.5.2 a) or Part 2 Paragraph 2.5.7.2.a)) affecting critical parts are also considered repairs. The scope of conversions may include changes in service fluid and changes such as bellows, soft seats, and other changes that may affect Type/Model number provided such changes are recorded on the document as required for a quality system and the repair nameplate. (See 4.7.1)
- c) The scope of repair activities shall not include changes in ASME Code status.

4.2.1 "VR" REPAIR

- a) When a repair is being performed under the administrative requirements for National Board Accreditation, a 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, sealing and application of a repair nameplate. When completed, the valve's condition and performance shall be equivalent to the standards for new valves.
 - 2) The administrative requirements for National Board Accreditation apply only to valves that are marked with the ASME Certification Mark and the "V", "UV", "HV", or "NV" Designator or the supplanted ASME "V", "UV", "HV" or "NV" Code symbol and have been capacity certified on the applicable fluid by the National Board.

4.2.2 CONSTRUCTION STANDARDS FOR PRESSURE RELIEF DEVICES

For pressure relief devices, the applicable new construction standard to be used for reference during repairs is the ASME Code. ASME Code Cases shall be used for repairs when they were used in the original

construction of the valve. ASME Code Cases may be used when they have been accepted for use by the NBIC Committee and the Jurisdiction where the pressure-retaining item is installed.

- a) For pressure relief devices, the Code Case number shall be noted on the repair document and, when required by the code case, stamped on the repair nameplate.
- b) The Jurisdiction where the pressure retaining item is installed shall be consulted for any unique requirements it may have established.

4.2.3 INSTALLATION OF PRESSURE RELIEF DEVICES

Installation of a pressure relief device by mechanical methods is not considered to be a repair, as long as 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 is to be installed by welding on an existing pressure retaining item, the requirements of Part 3 of the NBIC for welded repairs shall be followed.

If a pressure relief valve must be disassembled or its adjustments changed as part of the installation process, the reassembly, resetting, retesting or other such activities shall be done by a qualified organization which meets the requirements of NBIC Part 4. For a new pressure relief valve, 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 or the replaceable element of a non-reclosing pressure relief device such as a rupture disk is not considered to be a repair. The manufacturer's procedures and instruction shall be followed for the installation of these devices.

4.2.4 INITIAL ADJUSTMENTS TO PRESSURE RELIEF VALVES

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

4.3 MATERIALS FOR PRESSURE RELIEF VALVE REPAIR

The materials used in making 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 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 manufacturer or to the manufacturer's specifications. Critical parts are those that may affect the valve flow passage, capacity, function, or pressure-retaining integrity.
- b) Critical parts not fabricated by the valve manufacturer shall be supplied with material test certification for the material used to fabricate the part.
- c) Replacement critical parts receiving records shall be attached or be traceable to the valve repair document (see 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 valve manufacturer (such as packing list) from the valve manufacturer or assembler of the valve 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 replacement critical parts obtained from a source other than the valve manufacturer or assembler of the 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 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

When welding is used as a repair technique during a pressure relief valve 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.
- 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 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 NDE as required.
- d) Consideration shall be given to the condition of the existing material, especially in the weld preparation area.

4.4.1 WELDING PROCEDURE SPECIFICATIONS

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

4.4.2 STANDARD WELDING PROCEDURE SPECIFICATIONS

A "VR" Certificate Holder may use one or more applicable Standard Welding Procedure Specifications shown in NBIC Part 3, 2.3.

4.4.3 PERFORMANCE QUALIFICATION

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

4.4.4 WELDING RECORDS

The “VR” Certificate Holder shall maintain a record of the results obtained in welding procedure qualifications, except for those qualifications for which the provisions of 4.4.2 are used, and of the results obtained in welding performance qualifications. These records shall be certified by the “VR” Certificate Holder and shall be available to the National Board.

4.4.5 WELDER’S IDENTIFICATION

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

4.4.6 WELDER’S CONTINUITY

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

- a) When the welder or welding operator has not welded using a specific process during a period of six months or more, their qualifications for that process shall expire.
- b) When there is specific reason to question their ability to make welds that meet the specification, the qualification that supports the welding that is being performed shall be revoked. All other qualifications not questioned remain in effect.

4.4.7 WELD REPAIRS TO PRESSURE RELIEF VALVE PARTS BY AN “R” STAMP HOLDER

- a) The quality system manual may include controls for the “VR” Certificate Holder to have the pressure relief valve part repaired by a National Board “R” Certificate Holder, per this section provided 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 (PRV) 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 repair.
 - 1) PRV part weld repairs shall be performed under the “R” Certificate Holder’s quality system; however, the requirements for in-process involvement of the Inspector (see Part 3, 2.2.2) 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 quality system.

- 3) PRV part repairs shall be documented on a Form R-1 with a statement under the “Remarks” section “PRV Part 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.
- 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 PRV repair.

4.5 HEAT TREATMENT

4.5.1 PREHEATING

Preheating may be employed during welding to assist in completion of the welded joint in accordance with NBIC Part 3, 2.5.1. The need for and the temperature of preheat are dependent on a number of factors, such as chemical analysis, degree of restraint of the items being joined, material thickness, and mechanical properties. The welding procedure specification for the material being welded shall specify the preheat temperature requirements.

4.5.2 POSTWELD HEAT TREATMENT

Postweld heat treatment shall be performed as required by the original code of construction in accordance with a written procedure. The procedure shall contain the parameters for postweld heat treatment. A time and temperature report or temperature record shall be maintained to document the work performed.

4.6 PRESSURE RELIEF VALVE PERFORMANCE TESTING AND TESTING EQUIPMENT

Each pressure relief valve to which the “VR” repair symbol stamp is to be applied shall be subjected to the following tests by the repair Certificate Holder.

4.6.1 TEST MEDIUM AND TESTING EQUIPMENT

Valves marked for steam service, or having special internal parts for steam service, shall be tested on steam. Valves marked for air, gas, or vapor service shall be tested with air or gas. Valves marked for liquid service shall be tested with water or other suitable liquid. ASME Code, Section IV hot-water valves, shall be tested on water, steam, or air.

- a) Each valve shall be tested to demonstrate the following:
 - 1) Set pressure (as defined by the valve manufacturer and as listed in NB-18, *Pressure Relief Device Certifications*);
 - 2) Response to blowdown, when required by the original code of construction;
 - 3) Seat tightness; and
 - 4) For valves 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 quality system, 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 but not be limited to:
 - a. Schematic of the performance test equipment;
 - b. Size and pressure ranges of valves to be tested and the test fluid to be used;
 - c. Dimensions of test vessels;
 - d. Accuracy of pressure measuring equipment;
 - e. Size and design type of valves used to control flow; and
 - f. Method of qualifying.
- 3) Prior to the implementation of any addition or modification to the testing equipment that would alter the contents of the document required in 4.6.1 b) 2), the Certificate Holder shall re-qualify the performance test equipment in accordance with 4.6.1 b) 2). If the equipment changed was used to satisfy the requirements of verification testing, the Certificate Holder shall notify the National Board and additional verification testing, in accordance with the quality system, may be required.

4.6.2 OWNER-USER ASME CODE SECTION VIII STEAM TESTING

(21)

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

- a) The test pressure using air as the test medium shall be the product of the Manufacturer's correction factor for the differential between steam and air multiplied by the set pressure. If a cold differential test pressure is applicable due to superimposed back pressure and/or service temperature, then the manufacturer's correction factor shall be applied to the cold differential test pressure. The test pressure shall be recorded on the valve repair document described in 4.8.5.4 i).
- b) The correction factor between steam and air shall not be included in the cold differential test pressure marked on the valve repair nameplate per 4.7.2 b) 8).

4.6.3 LIFT ASSIST TESTING

- a) A device may be used to apply an auxiliary lifting load on the spring of a repaired valve to establish the set pressure in lieu of the tests required in 4.6.1 a) 1) when such testing at full pressure:
 - 1) May cause damage to the valve being tested; or
 - 2) Is impractical when system design considerations preclude testing at full pressure.
- b) While actual valve blowdown and valve performance characteristics cannot be verified using this testing technique, valve set pressure may be determined to an acceptable degree of accuracy if, as a minimum:
 - 1) Equipment utilized is calibrated as required in the quality system; including, but not limited to:

- a. System pressure measurement equipment;
 - b. Lifting force measurement equipment; and
 - c. Other measuring elements required by the device manufacturer.
- 2) the device and test procedures that have proved to give accurate results are used and followed;
- 3) A static inlet pressure is applied with the test medium specified in 4.6.1; and
- 4) Adjustments are made in accordance with the valve manufacturer's recommendations to ensure proper lift and blowdown.
- c) Prior to use, all lift assist devices 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 used for verification testing as specified in the quality system or comparisons to field performance. This qualification shall be documented and provisions made to retain such documentation in accordance with Table 4.8.5.4 s). Documentation of this qualification shall include but not be limited to:
 - 1) A description of the lift assist device including model number, serial number and manufacturer;
 - 2) Size and pressure ranges of valves to be tested with the lift assist device and the test fluid to be used;

Note: Maximum set pressure is determined by available lift force and system pressure.

 - 3) Accuracy of pressure measuring equipment; and
 - 4) Method of qualifying.
- d) After initial qualification of the device the device shall be re-qualified if:
 - 1) Modifications or repairs to the device are made which would affect test results; or
 - 2) The manufacturer issues a mandatory recall or modification to the device which will affect test results.

4.6.4 PRESSURE TEST OF PARTS

- a) Parts used in repaired valves shall be pressure tested and documentation 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 as required by the original code of construction.
 - 2) Parts Repaired by Welding

These parts shall be subjected to a pressure test required by the original code of construction. The "VR" Certificate Holder shall be responsible for documentation of such test.
- b) Parts repaired by re-machining within part specifications, lapping, or polishing 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 valves is critical to ensuring acceptance during subsequent inspections, and also provide for traceability and identification of any changes made to the valve. All operations that require the valve's seals to be replaced shall be identified by a nameplate as described in 4.7.2 or 4.7.4.

4.7.2 REPAIR NAMEPLATES

(21)

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

- a) Prior to attachment of the repair nameplate, the previous repair nameplate, if applicable, shall be removed from the repaired valve.
- b) As a minimum, the information on the valve repair nameplate (see Figure 4.7.2-a) shall include:
 - 1) The name of the repair organization preceded by the words "repaired by";
 - 2) The "VR" repair symbol stamp and the "VR" certificate number;
 - 3) Unique identifier (e.g., repair serial number, shop order number, etc.);
 - 4) Date of repair;
 - 5) Set pressure;
 - 6) Capacity and capacity units (if changed from original nameplate due to set pressure or service fluid change);
 - 7) Type/Model number (if changed from original nameplate by a conversion. See 4.2); and
 - 8) When an adjustment is made to correct for service conditions of superimposed back pressure and/or temperature, the information on the valve repair nameplate shall include the:
 - a. Cold Differential Test Pressure (CDTP); and
 - b. Superimposed Back Pressure (BP) (only when applicable).

(21) **FIGURE 4.7.2-a****EXAMPLE LAYOUT OF REQUIRED MARKINGS FOR REPAIR OF ASME/NATIONAL BOARD “V,” “UV,” AND “HV”-STAMPED PRESSURE RELIEF VALVES**

REPAIRED BY	_____	CERTIFICATE HOLDER
	_____	(1) TYPE/MODEL NUMBER
	_____	(1) SET PRESSURE CAPACITY
	_____	(1) (1) CDTP BP
	_____	REPAIR IDENTIFICATION
	_____	DATE REPAIRED

NATIONAL BOARD “VR”
CERTIFICATE NUMBER

Note: To be indicated only when changed

4.7.3 CHANGES TO ORIGINAL PRESSURE RELIEF VALVE NAMEPLATE INFORMATION

- If the set pressure is changed, the set pressure, capacity, and blowdown, if applicable, on the original nameplate or stamping shall be marked out but left legible. The new capacity shall be based on that for which the valve was originally certified.
- If the service fluid is changed, the capacity, including units, on the original nameplate or stamping shall be marked out but left legible. The new capacity shall be based on that for which the valve was originally certified, or if a conversion has been made, as described in 4.2 on the capacity certification for the valve as converted.
- If the Type/Model number is changed, the Type/Model number on the original nameplate or stamping shall be marked out but left legible.
- If the blowdown is changed, the blowdown, if shown on the original nameplate or stamping, shall be marked out but left legible. The new blowdown may be based on the current ASME Code requirements.
- 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. 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 quality system.

(21) **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) that cannot be positively identified by the manufacturer or through in-house sources. Such identification shall include the verification of the original ASME Stamping. Pressure relief valves that have missing or illegible nameplates and can be positively identified shall be equipped with a nameplate marked “DUPLICATE”, which contains all original nameplate data. The duplicate nameplate shall not bear the “NB” Mark or the ASME Certification Mark with the “V”, “HV”, or “UV” Designator or the supplanted “V”, “HV”, or “UV” Symbol. Instead, the nameplate shall be stamped “Sec. I”, “Sec. IV”, or “Sec. VIII”, as applicable, to indicate the original stamping. Illegible nameplates, if applicable, shall not be removed.

4.8 ACCREDITATION OF “VR” REPAIR ORGANIZATIONS

4.8.1 SCOPE

- a) This section provides requirements that must be met for an organization to obtain a National Board *Certificate of Authorization* to use the “VR” Symbol Stamp for repair activities of pressure relief devices constructed in accordance with the requirements of the ASME Code.
- b) For administrative requirements to obtain or renew a National Board “VR” *Certificate of Authorization* and “VR” Symbol Stamp, refer to NB-514, *Accreditation of “VR” Repair Organizations*.

4.8.2 JURISDICTIONAL PARTICIPATION

The National Board member Jurisdiction in which the “VR” organization is located is encouraged to participate in the review and demonstration of the applicant’s quality system. The Jurisdiction may require participation in the review of the repair organization and the demonstration and acceptance of the repair organization’s quality system manual.

4.8.3 ISSUANCE AND RENEWAL OF THE “VR” *CERTIFICATE OF AUTHORIZATION*

4.8.3.1 GENERAL

Authorization to use the stamp bearing the official National Board “VR” symbol as shown in Figure 4.7.2-a, will be granted by the National Board pursuant to the provisions of the following administrative rules and procedures.

4.8.3.2 ISSUANCE OF CERTIFICATE

Repair organizations, manufacturers, assemblers, or users that make repairs to the ASME Code symbol stamped or marked pressure relief valves and National Board capacity certified pressure relief valves may apply to the National Board for a *Certificate of Authorization* to use the “VR” symbol.

4.8.4 USE OF THE “VR” *CERTIFICATE OF AUTHORIZATION*

4.8.4.1 TECHNICAL REQUIREMENTS

The administrative requirements of 4.8 for use of the “VR” stamp shall be used in conjunction with the technical requirements for valve repair as described in sections 4.1 through 4.7. Those requirements shall be mandatory when a “VR” repair is performed.

4.8.4.2 STAMP USE

Each “VR” symbol stamp shall be used only by the repair firm within the scope, limitations, and restrictions under which it was issued.

4.8.5 QUALITY SYSTEM

4.8.5.1 GENERAL

Each applicant for a new or renewed “VR” *Certificate of Authorization* shall have and maintain a quality system which shall establish that all of these rules and administrative procedures and applicable ASME

Code requirements, including material control, fabrication, machining, welding, examination, setting, testing, inspection, sealing, and stamping will be met.

4.8.5.2 WRITTEN DESCRIPTION

A written description, in the English language, of the system the applicant will use shall be available for review and shall contain, as a minimum, the features set forth in 4.8.5.4. This description may be brief or voluminous, depending upon the projected scope of work, and shall be treated confidentially. In general, the quality system shall describe and explain what documents and procedures the repair firm will use to validate a valve repair.

4.8.5.3 MAINTENANCE OF CONTROLLED COPY

Each applicant to whom a "VR" *Certificate of Authorization* is issued shall maintain thereafter a controlled copy of the accepted quality system manual with the National Board. Except for changes that do not affect the quality system, revisions to the quality system manual shall not be implemented until such revisions are accepted by the National Board.

(21) 4.8.5.4 OUTLINE OF REQUIREMENTS FOR A QUALITY SYSTEM

The following establishes the minimum requirements of the written description of the quality system. It is required that each valve repair organization develop its own quality system that meets the requirements of its organization. For this reason it is not possible to develop one quality system 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 quality system 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 list and reference, by paragraph 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" stamp shall be applied only to pressure relief valves that meet both of the following conditions:
 - a. Are marked with the ASME Certification Mark and the "V", "UV", "HV", or "NV" Designator or the supplanted ASME "V", "UV", "HV" or "NV" Code symbol and have been capacity certified by the National Board; and
 - b. Have been disassembled, inspected, and repaired by the Certificate Holder such that the valves' condition and performance are equivalent to the standards for new valves.

- 2) The title of the individual responsible to ensure that the quality system is followed and who has authority and freedom to effect the responsibility;
- 3) A statement that if there is a disagreement in the implementation of the written quality system, the matter is to 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 quality system and the method by which such revisions are to be submitted to the National Board for acceptance 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 actual organization in place.

f) Scope of Work

- 1) The scope of work section shall indicate the scope and type of valve repairs, including conversions the organization is capable of and intends to perform. The location of repairs (shop, shop and field, or field only), ASME Code Section(s) to which the repairs apply, the test medium (air, gas, liquid, or steam, or combinations thereof), and special processes (machining, welding, postweld heat treatment, or nondestructive examination, or combinations thereof) shall be specifically addressed.
- 2) The types and sizes of valves 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 assuring that the latest applicable drawings, specifications, and instructions required are used for valve repair, including conversions, inspection, and testing.

h) Material and Part Control

The material and part control section shall describe purchasing, receiving, storage, 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 quality system.

i) Repair and Inspection Program

The repair and inspection program section shall include reference to a document (such as a report, traveler, or checklist) that outlines the specific repair and inspection procedures used in the repair of pressure relief valves. Repair procedures shall require verification that the critical parts meet the valve manufacturer's specification. Supplement 4 outlines recommended procedures covering some specific items. This document shall be retained in accordance with Table 4.8.5.4 s).

- 1) Each valve or group of valves shall be accompanied by the document referred to above for processing through the plant. Each valve shall have a unique identifier (i.e., repair serial number, shop order number, etc.) appearing on the repair documentation and repair nameplate such that traceability is established.
- 2) The document referred to above shall describe the original nameplate information, including the ASME Code symbol stamping and the repair nameplate information, if applicable. In addition, it

shall include material checks, replacement parts, conversion parts (or both), reference to items such as the welding procedure specifications (WPS), fitup, NDE technique, heat treatment, and pressure test methods to be used. Application of the “VR” stamp to the repair nameplate shall be recorded in this document. Specific conversions performed with the new Type/Model number shall be recorded on the document. There shall be a space for “signoffs” at each operation to verify that each step has been properly performed.

- 3) The system shall include a method of controlling the repair or replacement of critical valve parts. The method of identifying each spring shall be indicated on the repair document described in 4.8.5.4 i). Such identification shall be based on the Manufacturer’s spring chart current at the time of the repair, except that the spring removed from the valve during the repair bearing different identification 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 system shall also describe the controls used to ensure that any personnel engaged in the repair of pressure relief valves are trained and qualified in accordance with this section.

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

The quality system manual shall indicate the title of the person(s) responsible for and describe the system used in the selection, development, approval, and qualification of welding procedure specifications, and the qualification of welders and welding operators in accordance with the provisions of 4.4.

- 1) The quality system manual may include controls for the “VR” Certificate Holder to have the pressure relief valve part repaired by a National Board “R” Certificate Holder, per 4.4.7.
- 2) The completed Form R-1 shall be noted on and attached to the “VR” Certificate Holder’s document required in 4.8.5.4 i). Similarly, NDE and heat treatment techniques must be covered in the quality system manual. When outside services are used for NDE and heat treatment, the quality system manual shall describe the system whereby the use of such services meet the requirements of the applicable section of the ASME Code.

k) Valve Testing, Setting, and Sealing

The system shall include provisions that each valve shall be tested, set, and all external adjustments sealed according to the requirements of the applicable ASME Code Section and the National Board. The seal shall identify the “VR” Certificate Holder making the repair. Abbreviations or initials shall be permitted, provided such identification is acceptable to the National Board.

l) Valve Repair Nameplates

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

m) Calibration

- 1) The 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) Manual Control

The quality system shall include:

- 1) Measures to control the issuance of and revisions to the quality system manual;
- 2) Provisions for a review of the system in order to maintain the manual current with these rules and the applicable sections of the ASME Code;
- 3) The title(s) of the individual(s) responsible for control, revisions, and review of the manual;
- 4) Provision of a controlled copy of the written quality system manual to be submitted to the National Board; and
- 5) Revisions shall be submitted to and accepted by the National Board prior to being implemented.

o) Nonconformities

The system 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. These may include, but are not limited to, data discrepancies, procedural and/or documentation deficiencies, or material defects. Also, the title(s) of the individual(s) involved in this process shall be included.

p) Exhibits

Forms used in the quality system shall be included in the manual with a written description. Forms exhibited should be marked SAMPLE and completed in a manner typical of actual valve repair procedures.

q) Testing Equipment

The system 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.

(See Supplement 5 for a guide on the sizing of pressure vessels used as part of pressure relief valve test equipment)

r) Field Repairs

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

- 1) Provisions for annual audits of field activities shall be included;
- 2) Provisions for receipt and inspection of replacement parts, including parts received from the owner-user, shall be addressed;
- 3) If owner-user personnel will assist with repairs, provisions for the use of owner user personnel shall be included; and
- 4) Provisions for use of owner-user measurement and test equipment, if applicable, shall be addressed.

s) Records Retention

The quality manual shall describe a system for filing, maintaining, and easily retrieving records supporting or substantiating the administration of the Quality System within the scope of the "VR" *Certificate of Authorization*. The record retention schedule described in the Quality System Manual is to 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 that required welding as part of the repair	Record retention shall be in accordance with Part 3, Table 1.5.1	Refer to Part 3, Table 1.5.1
Record of repair or inspection	The repair and inspection program section shall include reference to a document (such as a report, traveler, or checklist) that outlines the specific repair and inspection procedures used in the repair of pressure relief valves.	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 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 quality system, or comparisons to field performance.	5 years after the subject piece of equipment or instrument is retired.
Record of lift assist device qualification	Prior to use, all lift assist devices 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 used for verification testing as specified in the quality system or 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 those positions within the organization as they directly relate to pressure relief valve 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.

4.8.6 FIELD REPAIR

Repair organizations may obtain a “VR” *Certificate of Authorization* for field repair, either as an extension to their in-shop/plant scope, or as a field-only scope, provided that:

- a) Qualified technicians in the employ of the Certificate Holder perform such repairs;
- b) An acceptable quality system covering field repairs, including field audits, is maintained; and
- c) Functions affecting the quality of the repaired valves are supervised from the address of record where the “VR” certification is issued.

4.8.6.1 AUDIT REQUIREMENTS

Upon issuance of a *Certificate of Authorization*, provided field repairs are performed, annual audits of the work carried out in the field shall be performed to ensure that the requirements of the Certificate Holder’s quality system are met. The audit shall include, but not be limited to performance testing in accordance with 4.6 of valve(s) that were repaired in the field. The audits shall be documented.

4.8.6.2 USE OF OWNER OR USER PERSONNEL

For the repair of pressure relief valves at an owner or user’s facility for the owner or user’s own use, the “VR” Certificate Holder may utilize owner or user personnel to assist Certificate Holder technician(s) in the performance of repairs provided:

- a) The use of such personnel is addressed in the “VR” Certificate Holder’s quality system;
- b) The owner or user personnel are trained and qualified;
- c) Owner or user personnel work under direct supervision and control of the “VR” Certificate Holder’s technician(s) during any stage of the repair when they are utilized;
- d) The “VR” Certificate Holder shall have the authority to assign and remove owner or user personnel at its own discretion; and
- e) The names of the owner or user personnel utilized are recorded on the document as required for a quality system.

4.9 TRAINING AND QUALIFICATION OF PERSONNEL

4.9.1 CONTENTS OF TRAINING PROGRAM

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

- a) Applicable ASME Code and NBIC requirements;
- b) Responsibilities within the organization’s quality system; and
- c) Knowledge of the technical aspects and mechanical skills for the applicable position held.

4.9.2 QUALIFICATION OF PERSONNEL

Each repair organization shall establish minimum qualification requirements for those positions within the organization as they directly relate to pressure relief valve repair. Each repair organization shall document the evaluation and acceptance of an individual's qualification for the applicable position.

4.9.3 ANNUAL REVIEW OF QUALIFICATION

The repair organization shall annually review the qualifications of repair personnel to verify proficiency as well as compliance with the Certificate Holder's quality system. This review shall include training records, documented evidence of work performed, and when necessary, monitoring job performance. The review shall be documented.

PART 4, SECTION 5 PRESSURE RELIEF VALVES

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PART 4, SECTION 6

PRESSURE RELIEF DEVICES — SUPPLEMENTS

SUPPLEMENT 1

PRESSURE RELIEF VALVES ON THE LOW PRESSURE SIDE OF STEAM PRESSURE REDUCING VALVES

S1.1 SCOPE

This supplement provides requirements and guidelines for the installation of safety valves on the low-pressure side of steam pressure reducing valves.

- a) The subject of protection of vessels in steam service connected to the low-pressure side of a steam-pressure-reducing valve is of considerable importance to proper operation of auxiliary equipment such as pressure cookers, hot-water heating systems, etc., operating at pressures below that which the primary boiler generating unit is operating.
- b) To automatically reduce the primary boiler pressure for such processing equipment, pressure reducing valves are used. The manufacturers of such equipment have data available listing the volume of flow through reducing valves manufactured by them, but such data are not compiled in a form that the results can be deduced readily. To protect the equipment operating on the low pressure side of a pressure reducing valve, pressure relief valves of a relieving capacity sufficient to prevent an unsafe pressure rise in case of failure of the pressure reducing valve, should be installed.
- c) The pressure reducing valve is a throttling device, the design of which is based on certain diaphragm pressures opposed by spring pressure which, in turn, controls the opening through the valve. If the spring, the diaphragm, or any part of the pressure reducing valve fails, steam will flow directly through the valve and the low pressure equipment will be subjected to the boiler pressure. To protect the equipment operating on the low pressure side of the pressure reducing valve, pressure relief valve(s) should be installed on the low pressure side of the pressure reducing valve, which will provide a relieving capacity sufficient to prevent the pressure from rising above the system design pressure.
- d) In most cases pressure reducing valves used for the reduction of steam pressures have the same pipe size on the inlet and outlet. In case of failure of a pressure reducing valve, the pressure relief valve on the low-pressure side must have a capacity to take care of the volume of steam determined by the high pressure side and the area of the pipe.

S1.2 PRESSURE RELIEF VALVE CAPACITY

- a) The capacity of the pressure relief valve(s) on the low-pressure side of the pressure reducing valve should be based on the capacity of the pressure reducing valve when wide open or under maximum flow conditions or the flow capacity through the bypass valve.
- b) By using the formula in S1.3 below, Inspectors may calculate the required relieving capacities of the pressure relief valve(s) installed on the low-pressure side of the pressure reducing valve.
- c) Usually a pressure reducing valve has a bypass arrangement so that in case of failure of the pressure reducing valve the boiler pressure may be short circuited into the low-pressure line without passing through the pressure reducing valve. When determining the required relieving capacity of pressure relief valves for the low-pressure side of the pressure reducing valve, the steam flow through the bypass must be taken into consideration.

S1.3 CALCULATION OF PRESSURE RELIEF VALVE RELIEVING CAPACITY

- a) When a pressure reducing valve is installed, there are two possibilities of introducing boiler pressure into the low-pressure system:
- 1) The failure of the pressure reducing valve so that it remains wide open; and
 - 2) The possibility of the bypass valve being open.
- b) It is necessary therefore, to determine the flow under both circumstances in paragraph a) above and check that the size of the pressure relief valve under either condition will be adequate. The following formulas should be used:

- 1) W = steam flow in lbs/hr (kg/hr) through the pressure reducing valve

$$W = AKC$$

where,

A = internal area in in.² (mm²) of the inlet pipe size of the pressure reducing valve (see Table S1.5)

K = flow coefficient for the pressure reducing valve (see S1.4)

C = flow capacity of saturated steam through a pipe in lbs/hr/in² (kg/hr/mm²) at various pressure differentials from Tables S1.3-a, S1.3-b, or S1.3-c. (for U.S. Customary units) or Tables S1.3M-a, S1.3M-b, or S1.3M-c (for metric units).

- 2) W = steam flow in lbs/hr (kg/hr) through the by-pass valve

$$W = A_1 K_1 C_1$$

where,

A_1 = internal area in in.² (mm²) of the pipe size of the bypass around the pressure reducing valve

K_1 = flow coefficient for the bypass valves (see S1.4)

C_1 = flow capacity of saturated steam through a pipe in lbs/hr/in² (kg/hr/mm²) at various pressure differentials from Tables S1.3-a, S1.3-b, or S1.3-c. (for U.S. Customary units) or Tables S1.3M-a, S1.3M-b, or S1.3M-c (for metric units).

TABLE S1.3-a

CAPACITY OF SATURATED STEAM, IN LBS/HR, PER IN.2 OF PIPE AREA

Outlet Pressure, psi	Pressure-reducing valve inlet pressure, psi												
	1,500	1,450	1,400	1,350	1,300	1,250	1,200	1,150	1,100	1,050	1,000	950	900
1,000	76,560	72,970	69,170	64,950	60,540	55,570	49,930	43,930	35,230	25,500	.....	.....	.....
950	77,430	74,180	70,760	63,100	63,100	58,770	53,920	48,610	42,380	34,890	24,910	.....	.....
900	77,750	74,810	71,720	68,340	64,870	61,040	56,820	52,260	47,050	41,050	33,490	23,960	.....
850	77,830	74,950	72,160	69,130	66,020	62,610	58,900	54,930	50,480	45,470	39,660	29,080	23,190
800		75,070	72,330	69,490	66,700	63,680	60,390	56,910	53,060	48,800	43,980	38,340	31,610
750				69,610	66,880	64,270	61,260	58,200	54,840	51,170	47,080	42,420	37,110
700					66,900	64,270	61,520	58,820	55,870	52,670	49,170	45,230	40,860
650							61,550	58,860	56,260	53,480	50,440	47,070	43,400
600								58,980	56,270	53,660	51,020	48,470	45,010
550										53,810	51,040	48,470	45,800
500													45,850
450													45,870
400													
350													
300													
250													
200													
175													
150													
110													
100													
85													
75													
60													
50													
40													
30													
25													
15													
10													
5													
Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.													

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE S1.3M-a

CAPACITY OF SATURATED STEAM, IN KG/HR, PER MM². OF PIPE AREA

Outlet Pressure, MPa	Pressure-reducing valve inlet pressure, MPa															
	10.25	10.00	9.75	9.5	9.25	9.00	8.75	8.5	8.25	8.00	7.75	7.50	7.25	7.00	6.75	6.50
6.75	53.44	51.68	49.82	47.85	45.77	43.63	41.28	38.73	36.01	33.09	29.47	25.37	20.89	.....	.....	6.25
6.50	53.87	52.23	50.52	48.69	46.79	44.83	42.69	40.40	37.95	35.30	32.33	29.02	25.31	20.46	.....	6.50
6.25	54.07	52.55	50.96	49.27	47.51	45.71	43.75	41.67	39.46	37.08	34.46	31.59	28.43	24.45	19.36	6.75
6.00	54.15	52.67	51.19	49.62	47.99	46.33	44.53	42.63	40.62	38.74	36.12	33.59	30.83	27.53	23.13	7.00
5.75	54.19	52.74	51.32	49.85	48.33	45.80	45.14	43.40	41.56	39.62	37.51	35.25	32.82	30.04	26.20	7.25
5.50	54.20	52.78	49.97	49.610	48.53	47.11	45.60	44.00	42.32	40.55	38.56	36.63	34.48	32.05	29.37	7.50
5.25	.....	.....	.....	50.00	48.60	47.20	45.82	44.35	42.78	41.17	39.44	37.62	35.68	33.52	31.16	7.75
5.00	.....	.....	.....	50.01	48.62	47.23	45.89	44.49	43.02	41.55	39.98	38.33	36.57	34.64	32.56	8.00
4.75	.....	.....	.....	.....	.....	47.24	.....	44.52	43.13	41.75	40.31	38.81	37.22	35.50	33.64	8.25
4.50	.....	.....	.....	.....	.....	.....	.....	44.53	43.14	41.77	40.43	39.08	37.63	36.07	34.41	8.5
4.25	.....	.....	.....	.....	.....	.....	.....	.....	43.15	41.82	40.46	39.10	37.74	36.33	34.90	8.75
4.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	41.84	40.48	39.12	37.82	36.45	35.12	9.00
3.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.14	37.88	36.48	35.13	9.25
3.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.5
3.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.75
3.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.00

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE S1.3-b

CAPACITY OF SATURATED STEAM, IN LBS/HR, PER IN² OF PIPE AREA

Outlet Pressure, psi	Pressure-reducing valve inlet pressure, psi												
	850	800	750	700	650	600	550	500	450	400	350	300	250
1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
950	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
850	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
800	22,550	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
750	30,600	21,800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
700	35,730	29,420	21,020	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
650	39,200	34,250	28,260	20,190	.....	.....	.....	.....	.....	.....	.....	.....	.....
600	41,500	37,470	32,800	27,090	19,480	.....	.....	.....	.....	.....	.....	.....	.....
550	42,480	39,850	35,730	31,310	25,940	18,620	.....	.....	.....	.....	.....	.....	.....
500	43,330	40,530	37,610	33,880	29,760	24,630	17,720	.....	.....	.....	.....	.....	.....
450	43,330	40,730	38,150	35,260	31,980	28,080	23,290	16,680	.....	.....	.....	.....	.....
400	.....	40,760	38,220	35,680	33,050	29,980	26,380	21,870	15,760	.....	.....	.....	.....
350	.....	.....	.....	.....	33,120	30,690	27,910	24,570	20,460	14,790	.....	.....	.....
300	.....	.....	.....	.....	33,240	.....	28,140	25,610	22,620	18,860	13,630	.....	.....
250	.....	.....	.....	.....	.....	.....	28,150	25,650	23,200	21,000	17,100	10,800	.....
200	.....	.....	.....	.....	.....	.....	.....	.....	.....	21,350	18,250	15,350	10,900
175	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18,250	16,000	12,600
150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18,250	16,200	13,400
110	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18,780	.....	13,600
100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,630
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE S1.3M-b

CAPACITY OF SATURATED STEAM, IN KG/HR. PER MM² OF PIPE AREA

Outlet Pressure, MPa	Pressure-reducing valve inlet pressure, MPa															
	6.00	5.75	5.50	5.25	5.00	4.75	4.50	4.25	4.00	3.75	3.50	3.25	3.00	2.75	2.50	2.25
5.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5.50	18.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5.25	22.24	17.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5.00	24.96	21.60	17.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4.75	27.06	24.31	21.18	17.17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4.50	28.64	26.30	23.70	20.58	16.54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4.25	29.71	27.67	25.44	22.83	19.75	15.63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4.00	30.49	28.74	26.86	24.59	22.06	19.18	15.75	.....	.....	.....	.....	.....	.....	.....	.....	.....
3.75	30.99	29.49	27.95	25.92	23.77	21.42	18.76	15.23	.....	.....	.....	.....	.....	.....	.....	.....
3.50	31.15	29.77	28.32	26.74	24.90	22.87	20.68	17.93	14.24	.....	.....	.....	.....	.....	.....	.....
3.25	31.18	29.86	28.49	27.10	25.53	23.81	21.95	19.73	17.12	13.72	.....	.....	.....	.....	.....	.....
3.00	31.19	29.88	28.56	27.25	25.86	24.40	22.82	20.98	18.90	16.51	13.46	.....	.....	.....	.....	.....
2.75	.....	.....	28.58	27.28	25.98	24.68	23.34	21.79	20.09	18.19	15.90	12.98	.....	.....	.....	.....
2.50	.....	.....	.....	.....	.....	.....	23.37	22.05	20.62	19.04	17.19	14.94	11.83	.....	.....	.....
2.25	.....	.....	.....	.....	.....	.....	23.42	22.15	20.83	19.45	17.94	16.18	14.11	11.59	.....	.....
2.00	.....	.....	.....	.....	.....	.....	23.46	22.17	20.87	19.57	18.28	16.85	15.26	13.48	10.95	.....
1.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	19.58	18.30	17.03	15.79	14.59	12.54	9.55
1.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.05	15.90	14.84	12.12	10.46
1.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15.92	14.95	12.98	11.75
1.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.96	13.44	12.19
0.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.97	13.60	12.30
0.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.66	12.35
0.70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
0.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE S1.3-c

CAPACITY OF SATURATED STEAM, IN LBS/HR, PER IN.² OF THE PIPE AREA

Outlet pres., psi	Pressure-Reducing Valve Inlet Pressure											
	200	175	150	125	100	85	75	60	50	40	30	25
1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
950	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
850	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
650	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
550	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
450	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
350	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
300	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
250	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
175	7,250	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
150	9,540	6,750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
125	10,800	8,780	6,220	.....	.....	.....	.....	.....	.....	.....	.....	.....
110	11,000	9,460	7,420	4,550	.....	.....	.....	.....	.....	.....	.....	.....
100	11,000	9,760	7,970	5,630	.....	.....	.....	.....	.....	.....	.....	.....
85	11,000	.....	8,480	6,640	4,070	.....	.....	.....	.....	.....	.....	.....
75	11,000	.....	.....	7,050	4,980	3,150	.....	.....	.....	.....	.....	.....
60	11,000	.....	.....	7,200	5,750	4,540	3,520	.....	.....	.....	.....	.....
50	11,000	.....	.....	.....	5,920	5,000	4,230	2,680	.....	.....	.....	.....
40	11,000	.....	.....	.....	.....	5,140	4,630	3,480	2,470	.....	.....	.....
30	11,050	.....	.....	.....	.....	.....	.....	3,860	3,140	2,210	.....	.....
25	.....	.....	.....	.....	.....	.....	.....	.....	3,340	2,580	1,485	.....
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,830	2,320	1,800
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,060
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE S1.3M-c

CAPACITY OF SATURATED STEAM, IN KG/HR, PER MM² OF PIPE AREA

Outlet Pressure, kPa	Pressure-reducing valve inlet pressure, kPa										
	1,500.00	1,250.00	1,000.00	900.00	800.00	700.00	600.00	500.00	400.00	300.00	200.00
1,250.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1,000.00	7.78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
900.00	8.15	6.25	.....	.....	.....	.....	.....	.....	.....	.....	.....
800.00	8.34	6.77	4.29	.....	.....	.....	.....	.....	.....	.....	.....
700.00	8.38	7.06	5.21	4.22	.....	.....	.....	.....	.....	.....	.....
600.00	8.38	7.08	5.65	4.87	3.82	.....	.....	.....	.....	.....	.....
500.00	8.38	.....	5.77	5.19	4.48	3.68	.....	.....	.....	.....	.....
400.00	8.38	.....	5.78	5.26	4.71	4.13	3.37	.....	.....	.....	.....
300.00	8.38	.....	.....	.....	4.74	4.22	3.66	3.01	.....	.....	.....
200.00	8.41	.....	.....	.....	.....	.....	3.69	3.71	2.62	1.83	.....
100.00	.....	.....	.....	.....	.....	.....	.....	.....	2.64	2.12	1.56
80.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.58
60.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.60
40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

S1.4 STEAM FLOW WHEN FLOW COEFFICIENTS ARE NOT KNOWN

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

The formulas in S1.3 then become:

$W = 1/3 \cdot A \cdot C$ for the capacity through the pressure reducing valve; and

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

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

S1.5 TWO-STAGE PRESSURE REDUCING VALVE STATIONS

The pressure relief valve for two-stage pressure reducing valve stations shall be sized on the basis of the highside pressure and the inlet size of the first pressure reducing valve in the line. If an intermediate pressure line is taken off between the pressure reducing valves, then this line and the final low side shall be protected by pressure relief valves sized on the basis of the high-side pressure and the inlet size of the first pressure reducing valve. (See Table S1.5)

TABLE S1.5
PIPE DATA

Nominal Pipe Size (US Customary)	Nominal Pipe Size (SI Metric)	Average Outside Diameter (D)		Nominal Wall Thickness Standard Weight Pipe (t)		Approximate Internal Area (Note 1)	
ASME B36.10M							
Unitless	Unitless	in.	mm	in.	mm	in²	mm²
NPS 3/8	DN 10	0.675	17.1	0.091	2.31	0.191	122
NPS 1/2	DN 15	0.840	21.3	0.109	2.77	0.304	195
NPS 3/4	DN 20	1.050	26.7	0.113	2.87	0.533	345
NPS 1	DN 25	1.315	33.4	0.133	3.38	0.864	557
NPS 1-1/4	DN 32	1.660	42.2	0.140	3.56	1.496	967
NPS 1-1/2	DN 40	1.900	48.3	0.145	3.68	2.036	1,316
NPS 2	DN 50	2.375	60.3	0.154	3.91	3.356	2,163
NPS 2-1/2	DN 65	2.875	73.0	0.203	5.16	4.788	3,086
NPS 3	DN 80	3.500	88.9	0.216	5.49	7.393	4,769
NPS 3-1/2	DN 90	4.000	101.6	0.226	5.74	9.887	6,379
NPS 4	DN 100	4.500	114.3	0.237	6.02	12.73	8,213
NPS 5	DN 125	5.563	141.3	0.258	6.55	20.00	12,908
NPS 6	DN 150	6.625	168.3	0.280	7.11	28.89	18,646
NPS 8	DN 200	8.625	219.1	0.332	8.18	49.78	32,283
NPS 10	DN 250	10.750	273.0	0.365	9.27	78.85	50,854
NPS 12	DN 300	12.750	323.8	0.375	9.53	113.1	72,937

Note:

In applying these rules, the area of the pipe is always based upon standard weight pipe and the inlet size of the pressure-reducing valve.

SUPPLEMENT 2**PRESSURE DIFFERENTIAL BETWEEN PRESSURE RELIEF VALVE SETTING AND BOILER OR PRESSURE VESSEL OPERATING PRESSURE****S2.1 SCOPE**

If a pressure relief valve is subjected to pressure at or near its set pressure, it will tend to weep or simmer, and deposits may accumulate in the seat and disk area. Eventually, this can cause the valve to freeze closed and thereafter the valve could fail to open at the set pressure. Unless the source of pressure to the boiler or pressure vessel is interrupted, the pressure could exceed the rupture pressure of the vessel. It is important that the pressure differential between the valve set pressure and the boiler or pressure vessel operating pressure is sufficiently large to prevent the valve from weeping or simmering.

S2.2 HOT WATER HEATING BOILERS

For hot-water heating boilers, the recommended pressure differential between the pressure relief valve set pressure and the boiler operating pressure should be at least 10 psi (70 kPa), or 25% of the boiler operating pressure, whichever is greater. Two examples follow:

- a) If the pressure relief valve of a hot-water heating boiler is set to open at 30 psi (200 kPa), the boiler operating pressure should not exceed 20 psi (140 kPa).
- b) If the pressure relief valve of a hot water heating boiler is set to open at 100 psi (700 kPa), the boiler operating pressure should not exceed 80 psi (550 kPa).

Section IV of the ASME Code does not require that pressure relief valves used on hot water heating boilers have a specified blowdown. Therefore, to help ensure that the pressure relief valve will close tightly after opening and when the boiler pressure is reduced to the normal operating pressure, the pressure at which the valve closes should be well above the operating pressure of the boiler.

S2.3 STEAM HEATING BOILERS

For steam heating boilers, the recommended pressure differential between the pressure relief valve set pressure and boiler operating pressure should be at least 5 psi (35 kPa), i.e., the boiler operating pressure should not exceed 10 psi (70 kPa).

Since some absorption-type refrigeration systems use the steam heating boiler for their operation, the boiler operating pressure may exceed 10 psi (70 kPa). If the boiler operating pressure is greater than 10 psi (70 kPa), it should not exceed 15 psi (100 kPa), minus the blowdown pressure of the pressure relief valve.

This recommendation can be verified by increasing the steam pressure in the boiler until the pressure relief valve pops, then slowly reducing the pressure until it closes, to ensure that this closing pressure is above the operating pressure.

S2.4 POWER BOILERS

For steam power boilers, the recommended pressure differentials between the pressure relief valve set pressure and the boiler operating pressure are as follows:

Boiler Design Pressure	Minimum Pressure Differential
over 15 psi to 300 psi (100 kPa to 2.10 MPa)	10% but not less than 7 psi (50 kPa)
over 300 psi to 1000 psi (2.14 MPa to 6.89 MPa)	7% but not less than 30 psi (200 kPa)
over 1000 psi to 2000 psi (6.89 MPa to 13.8 MPa)	5% but not less than 70 psi (480 kPa)
over 2000 psi (13.8 MPa)	per designer's judgment

Notes:

- 1) Above 2000 psi (13.8 MPa) the pressure differential between operating pressure and the maximum allowable working pressure is a matter for the designer's judgment, taking into consideration such factors as satisfactory operating experience and the intended service conditions.
- 2) Pressure relief valves in hot water service are more susceptible to damage and subsequent leakage, than pressure relief valves relieving steam. It is recommended that the maximum allowable working pressure of the boiler and pressure relief valve setting for high-temperature hot-water boilers be selected substantially higher than the desired operating pressure, so as to minimize the time the pressure relief valve must lift.
- 3) For organic fluid vaporizers a pressure differential of 40 psi (280 kPa) is recommended.

S2.5 PRESSURE VESSELS

Due to the variety of service conditions and the various designs of pressure relief valves, only general guidelines can be given regarding differentials between the set pressure of the valve and the operating pressure of the vessel. Operating difficulty will be minimized by providing an adequate differential for the application. The following is general advisory information on the characteristics of the intended service and of the pressure relief valves that may bear on the proper pressure differential selection for a given application. These considerations should be reviewed early in the system design since they may dictate the maximum allowable working pressure of the system.

To minimize operational problems it is imperative that the user consider not only normal operating conditions of the fluids (liquids or gases), pressures, and temperatures, but also start-up and shutdown conditions, process upsets, anticipated ambient conditions, instrument response time, and pressure surges due to quick-closing valves, etc. When such conditions are not considered, the pressure relief devices may become, in effect, a pressure controller, a duty for which they were not designed. Additional consideration should be given to the hazard and pollution associated with the release of the fluid. Larger differentials may be appropriate for fluids which are toxic, corrosive, or exceptionally valuable.

The blowdown characteristics and capabilities are the first consideration in selecting a compatible valve and operating margin. After a self-actuated release of pressure, the valve must be capable of reclosing above the normal operating pressure. For example: if the valve is set at 100 psi (700 kPa) with a 7% blowdown, it will close at 93 psi (640 kPa). The operating pressure must be maintained below 93 psi (640 kPa) in order to prevent leakage or flow from a partially open valve. Users should exercise caution regarding the blowdown adjustment of large, spring-loaded valves. Test facilities, whether owned by the manufacturer, repair house, or user, may not have sufficient capacity to accurately verify the blowdown setting. The setting cannot be considered accurate unless made in the field on an actual installation.

Pilot operated valves represent a special case from the standpoint of both blowdown and tightness. The pilot portion of some pilot operated valves can be set at blowdowns as short as 2%. This characteristic is not, however, reflected in the operation of the main valve in all cases. The main valve can vary considerably from the pilot depending on the location of the two components in the system. If the pilot is installed remotely from the main valve, significant time and pressure lags can occur, but reseating of the pilot ensures reseating of the main valve. The pressure drop in connecting piping between the pilot and the main valve must not be excessive, otherwise the operation of the main valve will be adversely affected.

Tightness capability is another factor affecting valve selection, whether spring-loaded or pilot operated. Tightness varies somewhat depending on whether metal or resilient seats are specified and also on such factors as corrosion and temperature. The required tightness and test method should be specified to comply at a pressure not lower than the normal operating pressure of the process. It should be remembered that any degree of tightness obtained should not be considered permanent. Service operation of a valve almost invariably reduces the degree of tightness.

The following minimum pressure differentials are recommended unless the pressure relief valve has been designed or tested in a specific or similar service and a smaller differential has been recommended by the manufacturer:

Set Pressure	Recommended Pressure Differential
up to 70 psi (480 kPa)	5 psi (35 kPa)
70 – 1000 psi (480 kPa – 6.89 MPa)	10% of set pressure
Above 1000 psi (6.89 MPa)	7% of set pressure

SUPPLEMENT 3

(21)

PRESSURE RELIEF AND PILOT VALVE STORAGE & SHELF LIFE**S3.1 SCOPE**

This supplement provides guidance for proper conditions and duration of pressure relief valve storage. This guidance applies to pressure relief valves, temperature & pressure relief valves, and pilot operated pressure relief valves (including the main body valve and the pilot valve).

S3.2 PRESSURE RELIEF VALVE STORAGE

Pressure relief valve set pressure and/or seat tightness can deviate during storage. The manufacturer's recommendations should be followed regarding shelf life. In some cases, it may be necessary to retest the relief valve prior to installation or reduce maintenance interval if the relief valve was in storage for an extended period. When storing relief valves, a first in / first out policy should be followed.

S3.3 PRESSURE RELIEF VALVE STORAGE CONDITIONS

Relief valves should be stored per manufacturer recommendations. Storage temperature should be within the operating or storage temperature range provided by the manufacturer. Where the manufacturer has no recommendations, the following guidelines should be followed.

- a) Storage temperature should be between 40 and 72 °F, where practical.
- b) Ideal relative humidity in the storage area should be 70 percent or less. For relief valves with soft seats, relative humidity should be kept between 30 and 70 percent. Some soft materials require a minimum humidity level to prevent material degradation.
- c) Storage area should have a non-corrosive atmosphere. Otherwise, stored relief valves should be protected from the atmosphere.
- d) Relief valves that utilize spindles or weights should be stored in a vertical position.
- e) Temperature and pressure relief valves should have their probes supported to prevent bending or detachment.
- f) All ports should be plugged, blanked, or capped.
- g) Relief valves that have been cleaned for oxidizing gas or other specialty service should be sealed in a plastic bag. Plastic wrapping may be acceptable for larger relief valves.
- h) Storage should be off the ground (e.g. on a shelf or pallet).
- i) Storage area should limit exposure to direct sunlight
- j) Relief valves constructed of materials subject to corrosion (such as carbon steel) should be painted or otherwise protected against the environment prior to storage.

S3.4 PRESSURE RELIEF VALVE SHELF LIFE

Pressure Relief valve shelf life shall be determined based upon manufacturer's recommendations and performance history. Shelf life may increase or decrease based upon storage conditions and performance history. In the absence of manufacturer or service provider recommendations, and performance history, the shelf life recommendations per table S3.4 should be used when stored in accordance with S3.3. Shelf life may be increased or decreased, from the recommended values, once performance history is established.

TABLE S3.4

RECOMMENDED RELIEF VALVE SHELF LIFE (IF NOT PROVIDED BY MANUFACTURER)

Pressure Relief Valve Description	Recommended Shelf Life (years)
Temperature and pressure relief valve	2
Pressure relief valve with metal-to-metal seat	5
Pressure relief valve with nonmetal seat	2

S3.4.1 EXCEEDING SHELF LIFE

If shelf life is exceeded, the valve shall either be tested prior to installation or tested using its lift lever (if applicable) following installation. Storage for a length of time less than the shelf life of the pressure relief valve does not reduce the time before the first regularly scheduled retest. If performance history shows that time in storage less than shelf life causes the device to function outside of acceptable tolerance, then the shelf life shall be reduced.

SUPPLEMENT 4**RECOMMENDED PROCEDURES FOR REPAIRING PRESSURE RELIEF VALVES****S4.1 SCOPE**

(21)

This supplement contains recommended procedures for the repair, packaging, shipping and transportation of pressure relief valves. S4.2 contains recommended procedures for the repair of spring-loaded pressure relief valves. S4.3 contains recommended procedures for the repair of pilot operated types of pressure relief valves. S4.4 contains information on packaging, shipping and transportation.

It is essential that the repair organization establish basic, specific procedures for the repair of pressure relief valves. 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 there are many types of valves and conditions under which they are repaired and, for this reason, the specific items in these recommended procedures may not apply, or they may be inadequate for each of those types or to the detailed repairs that may be required for each valve.

Prior to removal, repair, or disassembly of a pressure relief valve ensure that all sources of pressure have been removed.

S4.2 SPRING-LOADED PRESSURE RELIEF VALVES**a) Visual inspection as received**

- 1) This information is to be recorded:
 - a. Record user (customer) identification number;
 - b. Complete original PRV nameplate data, previous repair nameplate data, plus any important information received from customer;
 - c. Check external adjustment seals for warranty repair;
 - d. Check bonnet for venting on bellows type valves; and
 - e. Check appearance for any unusual damage, missing, or misapplied parts.
- 2) If sufficient damage or other unusual conditions are detected that may pose a safety risk during preliminary testing, then proceed directly to S4.2 c).
- 3) Valves that are to be repaired in place proceed to S4.2 c) unless preliminary testing has been authorized by the owner.

b) Preliminary test as received

- 1) Information from the recommended preliminary performance test and subsequent disassembly and inspections will provide a basis for any repair interval change that should be necessary to ensure that the valve will function as intended.
- 2) Determine set pressure or Cold Differential Test Pressure (CDTP) in accordance with manufacturer's recommendations and appropriate ASME Code 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.
- 3) If results do not correlate with field performance, then steps to duplicate field conditions (fluid and temperature) may be necessary.

- 4) Record preliminary test results and test bench identification data.
- c) Disassembly
 - 1) Remove cap and lever assembly, if applicable.
 - 2) Remove release nut assembly, if applicable.
 - 3) Loosen jam nut on adjusting (compression) screw.
 - 4) Record measurement and remove adjusting (compression) screw.
 - 5) Remove bonnet or yoke.
 - 6) Remove spring and washers, and tag (identify) including upper and lower washers, as appropriate.
 - 7) Remove spindle and disk assembly.
 - 8) Remove ring pins.
 - 9) Record measurement and remove adjusting rings, nozzle, and guide, as applicable.
- d) Cleaning
 - 1) Wire all small parts together and clean. (Caution: do not use a cleaning method that will damage the parts.)
 - 2) Do not clean in a chemical solution except under acceptable circumstances.
 - 3) Protect seating surfaces and nameplates prior to cleaning.
- e) Inspection
 - 1) Check spring for correct range, damage such as erosion, corrosion, cracking, or compression below free height.
 - 2) Check nozzle for cracks (NDE as applicable) or unusual wear.
 - 3) Check disk assembly for cracks (NDE as applicable) or unusual wear.
 - 4) Check spindle for trueness, bearing areas, and thread condition.
 - 5) Check guide for wear and galling.
 - 6) Check adjusting ring(s) for worn threads and wear.
 - 7) Check ring pins for bent or broken pin and thread condition.
 - 8) Check bellows, if provided, for pinholes and corrosion.
 - 9) Check flange gasket facings for wear and cuts.
- f) Machining

Machine nozzle and disk as necessary to the manufacturer's critical dimension charts.
- g) Lapping
 - 1) Machine or hand lap disk and nozzle to be sure of flatness.
 - 2) Lap bevel seats to a grey finish; then re-machine disk or plug to the manufacturer's critical dimension.

h) Bearing Points

Grind all bearing areas with grinding compound to make sure they are round and true.

i) Assembly

- 1) Install nozzle;
- 2) Install lower ring and guide ring to the measurement from c) 9) above or to manufacturer's specifications;
- 3) Install guide;
- 4) Install disc and holder;
- 5) Install spindle;
- 6) Install spring washers;
- 7) Install bonnet;
- 8) Install bonnet bolting;
- 9) Install adjusting screw and lock nut to the measurement from c) 4) above;
- 10) Install release nut and lock nut, and cap and lever assembly; and
- 11) Document installation of replacement parts.

j) Testing

Test data shall be recorded. Testing will be done in accordance with manufacturer's recommendations and appropriate ASME Code section. To preclude unsafe and unstable valve operations or erroneous performance test results, it is recommended that low volume testing equipment (e.g., gas cylinders without a test vessel, hand pumps, tubing) should be avoided.

k) Sealing

After final adjusting and acceptance by quality control inspection, all external adjustments shall be sealed with a safety seal providing a means of identification of the organization performing the repair.

l) Nameplate

The repairer will place a repair nameplate on each repaired valve. The nameplate shall, as a minimum, meet the requirements of 4.7.1.

S4.3 PILOT OPERATED PRESSURE RELIEF VALVES

a) Visual Inspection as Received

- 1) This information is to be recorded:
 - a. Complete nameplate data, plus any other important information received from the customer;
 - b. User identification number, if applicable;
 - c. Seals on external adjustments (ensure seals are intact);
 - d. Identification on seal; and
 - e. Obvious damage and external condition including missing or misapplied parts.

b) Disassembly

- 1) Remove pilot and disassemble per manufacturer's maintenance instruction.
- 2) Disassemble main valve. Where lift adjustments are provided, do not remove the locking device or change the lift unless it is required as part of conversion.
- 3) Remove the nozzle if recommended by the manufacturer's maintenance instructions and/or when required as part of conversion.

c) Cleaning

- 1) Pilot — Components of pilot are small and must be handled carefully to prevent damage or loss. Clean parts and nameplates with solvents that will not affect the parent metal and/or polish with 500 grit paper.
- 2) Main Valve — Clean by appropriate means such as abrasive blast. Finishes of machined surfaces must not be affected. (Caution: Do not use a cleaning method that will damage the parts or nameplates.)

d) Inspection

1) Pilot

- a. Check spring for damage such as corrosion, cracks, out of square ends, etc.
- b. Inspect all parts for damage. Small burrs or scratches may be removed by polishing. Severely damaged parts should be replaced. (Internal components or pilots should not be repaired by machining as the functions of the pilot could easily be impaired.)
- c. Check strainers and filters on inlet and outlet lines.
- d. Replace all soft goods per manufacturer's recommendation.

2) Main Valve

- a. Check nozzle seating surface for nicks. These can be removed by machining or lapping as required.
- b. Check the piston and liner (or other moving member) for galling or excessive wear. The piston should move freely in the liner.
- c. Replace soft goods or re-lap disk as required.
- d. Where lift adjustments are provided, measure the lift per the manufacturer's specifications.

e) Testing

Test data shall be recorded. Testing will be done in accordance with the manufacturer's recommendation and in accordance with the applicable ASME Code section. To preclude unsafe and unstable valve operations or erroneous performance test results, it is recommended that low volume testing equipment (e.g., gas cylinders without a test vessel, hand pumps, tubing) should be avoided.

f) Sealing

After final adjustment and acceptance by quality control, all external adjustments shall be sealed by means assuring positive identification of the organization performing the repair.

g) Nameplate

The repairer will place a repair nameplate on each repaired valve. The nameplate, as a minimum, shall meet the requirements of 4.7.1.

S4.4 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:
 - 1) Valves should be securely fastened to pallets in the vertical position to avoid side loads on guiding surfaces except threaded and socket-weld valves up to NPS 2 (DN 50) may be securely packaged and cushioned during transport.
 - 2) Valve inlet and outlet connection, drain connections, and bonnet vents should be protected during shipment and storage to avoid internal contamination of the valve. Ensure all covers and/or plugs are removed prior to installation.
 - 3) The valve 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 and/or breakage.
 - 5) Valves for special services, including but not limited to oxygen, chlorine, and hydrogen peroxide, should be packaged in accordance with appropriate standards and/or owner procurement requirements.

SUPPLEMENT 5**RECOMMENDED GUIDE FOR THE DESIGN OF A TEST SYSTEM FOR PRESSURE RELIEF DEVICES IN COMPRESSIBLE FLUID SERVICE****S5.1 SCOPE**

This supplement provides guidance for the design of a test system using compressible fluids (e.g., steam or air/gas) and permits the determination of pressure relief valve set pressure and valve operating characteristics such as blowdown.

The size of the test vessel needed depends on the size of the valve, its set pressure, the design of the test system, and whether blowdown must be demonstrated. A repair organization may use the information provided in this supplement to determine the minimum size test vessel needed so that the measured performance is characteristic of the valve and not the test system.

- a) The National Board administrative rules and procedures for the “VR” *Certificate of Authorization* and symbol stamp require that pressure relief valves, after repair, be tested in accordance with the manufacturer’s recommendations and the applicable ASME Code. The purpose of this testing is to provide reasonable assurance that valves will perform according to design when they are returned to service.
- b) It is recognized that a full evaluation of the performance of some pressure relief valve designs requires testing at maximum allowable overpressure. However, it is beyond the scope of this supplement to define test equipment or facilities for such testing.
- c) Section 6 of this part provides a glossary, S5.2 describes typical test equipment, and S5.3 provides data for estimating the size of test vessels required.

(21) S5.2 TEST SYSTEM DESCRIPTION

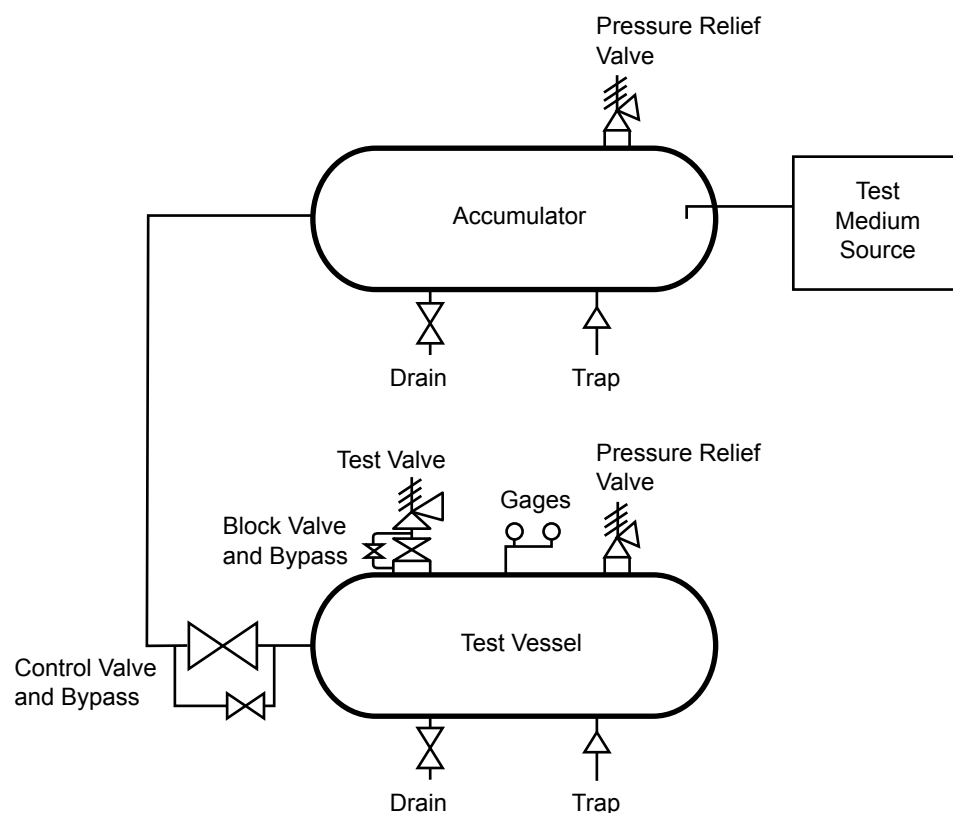
- a) An optimum configuration, particularly when the test medium source is of small capacity, is shown in Figure S5.2-a. The test medium flows from the pressure source, usually a compressor or boiler, to an accumulator. It then flows through a pressure-controlling valve into the test vessel, from which it is discharged, through the pressure relief valve installed on the test vessel. The pressure-controlling valve is usually a globe valve, although any throttling valve is acceptable. If the pressure-controlling valve is of adequate size and can open quickly, large transient flows can be generated, increasing the pressure above the pressure relief valve set pressure, causing it to lift, and be sustained in its lifted condition.
- b) Figure S5.2-b shows a simpler test system in which the test vessel is pressurized directly from the pressure source without the use of an accumulator. In this configuration, flow-rates through the pressure relief valve and any consequent over-pressure are dependent on the flow generating capacity of the pressure source.
- c) In a test facility, the pressure relief valve is usually installed on an isolating valve that should be of sufficient size that it will not choke flow to the pressure relief valve. There should be no intervening piping between the two valves to avoid any significant pressure drop between the test vessel and the pressure relief valve.
- d) The isolating valve and any adapter flanges or valve test nozzles must be designed to sustain pressure relief valve discharge forces, and so secured that these forces are not transmitted to the test vessel. This is especially important for larger valves set at pressures greater than 100 psig (700 kPa).
- e) The vessel should have a length-to-diameter ratio as low as is practical, and should be suitably anchored.
- f) Pressure sensing lines should be connected to the test vessel well away from any inlet or outlet connections where pressure distortions due to transient changes in flow velocity during testing could cause

erroneous pressure readings. When testing with steam, any water head that develops in the gage line must be taken into consideration.

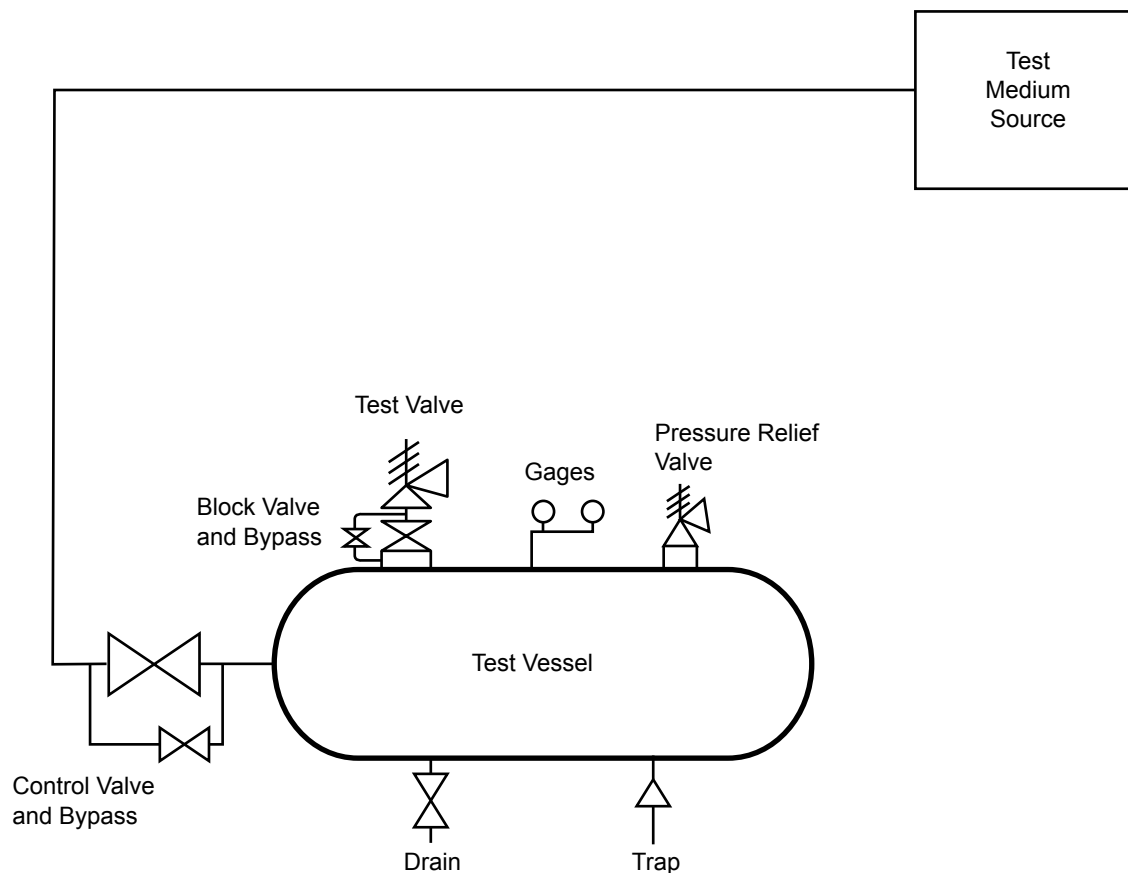
- g) Any intervening piping between the test vessel and the pressure relief valve should be as short and as straight as possible and be of adequate size to minimize inlet pressure drop.
- h) In the case of steam, the equipment should be insulated and steam traps should be installed, as appropriate, to ensure that the test steam is dry, saturated steam with a minimum quality of 98%.
- i) Pressure relief valves shall be used to protect the test vessel and the accumulator.

FIGURE S5.2-a
SCHEMATIC OF TEST EQUIPMENT WITH ACCUMULATOR

(21)



(21) **FIGURE S5.2-b**
SCHEMATIC OF TEST EQUIPMENT WITHOUT ACCUMULATOR



(21) **S5.3 TEST VESSEL SIZING DATA**

- a) Recommended test vessel sizes are given in Figures S5.3-a and S5.3-b for a configuration using one vessel fed directly from the source of the test medium. Figure S5.2-a gives the test vessel size in ft^3 (m^3) vs. the valve orifice area in in.^2 (cm^2) for dry, saturated steam. Curves are shown for set pressures up to 500 psig (3.45MPa) for three different blowdowns: 4%, 7%, and 10%. The source is assumed to be capable of feeding the test vessel at 2500 lbs/hr. (1135 kg/hr). Figure S5.3-b gives similar curves for air with a source capable of feeding the test vessel at 200 ft^3/min (5.66 m^3/min).
- b) For valves, with effective orifices less than 1.28 in.^2 (826 mm^2), the size of the test vessel needed becomes less dependent on the flow capacity of the source. For these valves, a 15 ft.^3 (.425 m^3) minimum size test vessel is recommended. This should allow the accurate measurement and setting of blowdown for small valves. This minimum size should also be adequate for determining set pressures of larger valves; however, larger test vessels must be used if blowdown is to be set accurately. It is recognized that there are practical limits on the size and maximum pressure of a test vessel used to demonstrate pressure relief valve operational characteristics. In such cases, determination of valve set pressure remains the only viable production and repair test option. The recommended minimum size test vessel (15 ft.^3 [0.425 m^3]) is normally adequate for this purpose.

FIGURE S5.3-a

(21)

RECOMMENDED TEST VESSEL SIZE, TEST MEDIUM: STEAM

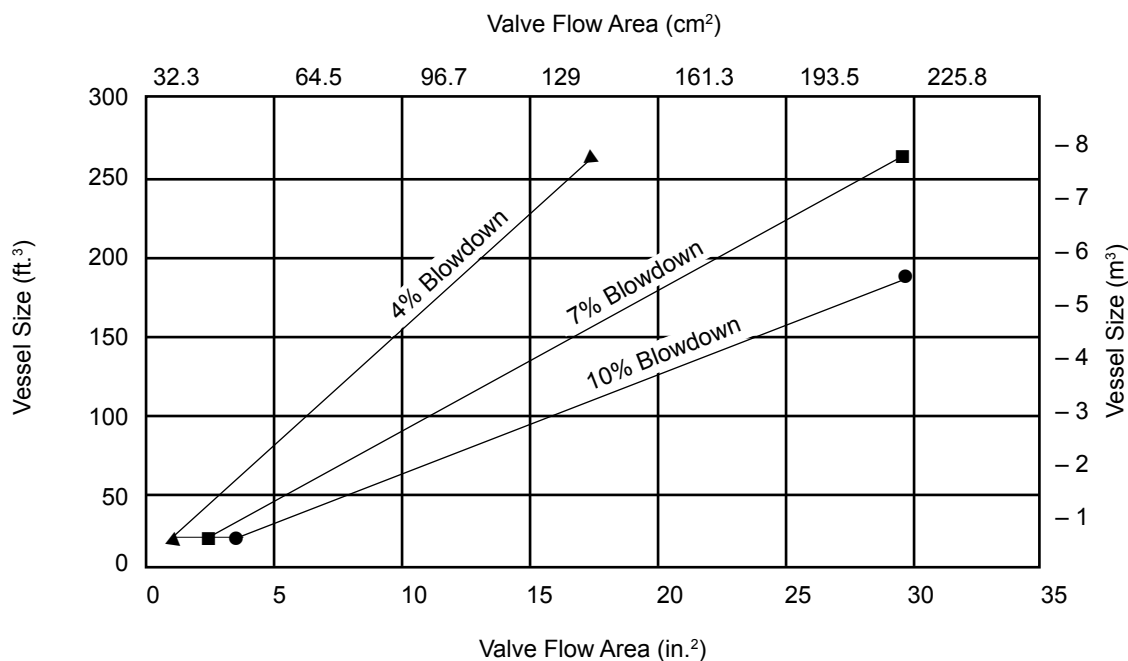
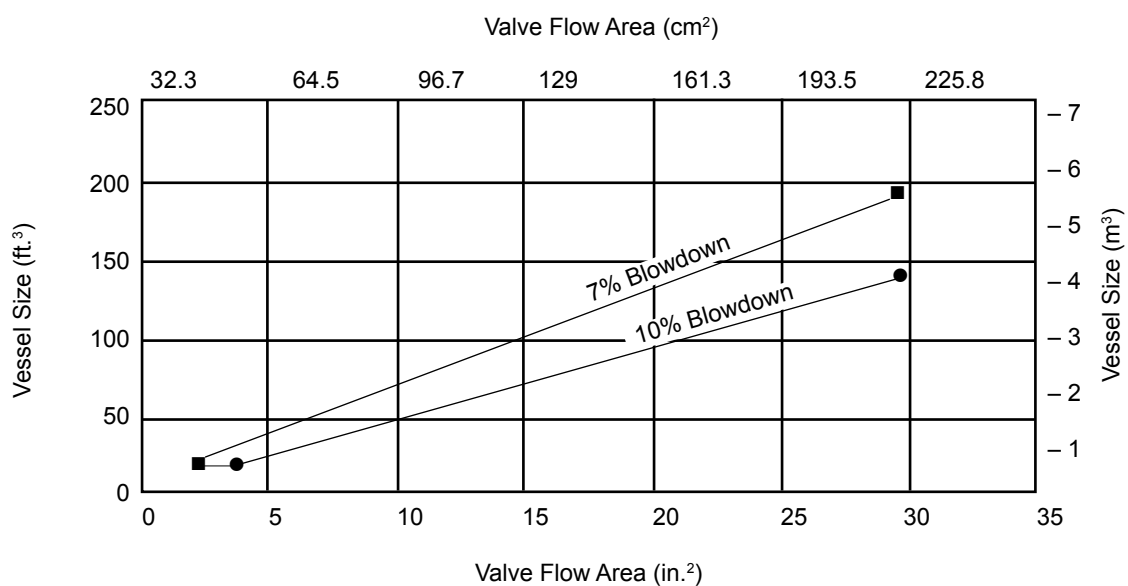


FIGURE S5.3-b

(21)

RECOMMENDED TEST VESSEL SIZE, TEST MEDIUM: AIR OR GAS



SUPPLEMENT 6**PROCEDURES FOR REPAIRS OF NUCLEAR SAFETY RELATED PRESSURE RELIEF VALVES****(21) S6.1 SCOPE**

This supplement provides procedures and requirements for the repair of nuclear safety related pressure relief valves and power actuated pressure relief valves.

Nuclear safety related pressure relief valves and power actuated pressure relief valves may be repaired provided the following requirements are met. Valves being repaired under these provisions are intended to be those protecting the nuclear pressure boundary. Other pressure relief valves in the nuclear power plant (such as pressure relief valves on air compressors and auxiliary boilers) shall be repaired as required by the applicable Jurisdiction.

S6.2 DEFINITIONS

Safety Related – As used in this supplement and when applied to nuclear power plants, safety related means a structure, system, or component or part thereof that affects its safety function necessary to assure:

- a) The integrity of the reactor coolant pressure boundary;
- b) The capability to shut down the reactor and maintain it in a safe shutdown condition; or
- c) The capability to prevent or mitigate the consequence of accidents which could result in potential offsite exposures.

S6.3 NUCLEAR SAFETY RELATED VALVE GROUPS

These rules classify nuclear safety related pressure relief valves into three groups based upon the original code of construction and capacity certification status.

Group 1: ASME Section I and Section VIII pressure relief valves accepted by the Jurisdiction for use in nuclear safety related service with National Board capacity certification.

Group 2: ASME Section III "NV" stamped Class 1, 2, or 3 pressure relief valves with National Board capacity certification.

Group 3: Pressure relief valves not addressed in Group 1 or Group 2. This group shall include pressure relief valves without National Board capacity certification and/or pressure relief valves constructed to codes or standards other than ASME (see NBIC Part 3, Category 3).

The term pressure relief valve includes power actuated pressure relief valves. Replacement of rupture disks in rupture disk holders or in systems is not considered a repair activity under the scope of this supplement.

(21) S6.4 ADMINISTRATIVE PROCEDURES

- a) The repair organization shall obtain a "VR" *Certificate of Authorization*.
- b) The repair organization shall obtain a National Board "NR" *Certificate of Authorization*. The requirements for said certificate include, but is not limited to, the following. The repair organization shall:
 - 1) Maintain a documented quality assurance program that meets the applicable requirements of NBIC Part 3, 1.6. This program shall also include all the applicable requirements for the use of the "VR" stamp;

- 2) Have a contract or agreement with an Authorized Inspection Agency that is accredited in accordance with the requirements of ASME QAI-1, "Qualifications for Authorized Inspection" to provide nuclear inspection services;
 - 3) Successfully complete a survey of the quality assurance program and its implementation. This survey shall be conducted by representatives of the National Board, the Jurisdiction wherein the applicant's repair facilities are located, and the applicant's Authorized Inspection Agency. Further verification of such implementation by the survey team may not be necessary if the applicant holds a valid ASME "NV" certificate and can verify by documentation the capability of implementing the quality assurance program for repair of "NV"-stamped pressure relief valves, covered by the applicant's ASME "NV" certificate.
- c) The application of the "NR" *Certificate of Authorization* and stamp shall clearly define the scope of intended activities with respect to the repair of nuclear pressure relief valves.
 - d) Revisions to the quality assurance program shall be acceptable to the Authorized Nuclear Inspector Supervisor and the National Board before being implemented.
 - e) The scope of the "VR" *Certificate of Authorization* shall include repair of nuclear pressure relief valves (denoted on the "VR" Certificate as Section III).
 - f) Verification testing of valves repaired by the applicant shall not be required provided such testing has been successfully completed under the applicant's "VR" certification program for the applicable test fluids.
 - g) A survey of the applicant for the "VR" *Certificate of Authorization* and endorsement of the repair of nuclear pressure relief valves may be made concurrently.

S6.5 GENERAL RULES

(21)

- a) Group 1 and Group 2 pressure relief valves which have been repaired in accordance with these rules, shall be stamped with both the "VR" and "NR" stamps. They shall be classified as either "NR" Category 1 or Category 2 as applicable. Group 3 pressure relief valves which have been repaired in accordance with these rules shall be stamped with the "NR" stamp. They shall be classified as either "NR" Category 2 or Category 3 as applicable.
- b) The "VR" and "NR" stamps shall be applied only to nuclear safety related pressure relief valves that have been disassembled, inspected, and repaired as necessary, such that the valves' condition and performance are equivalent to the standards for new valves. As a minimum, the information on the valve repair nameplate (see Figure S6.5-a) shall include:
 - 1) The name of the certificate holder;
 - 2) The "VR" and "NR" symbol stamps and certificate numbers;
 - 3) Unique identifier (e.g., repair serial number, shop order number, etc.);
 - 4) Date of repair;
 - 5) Set pressure;
 - 6) Capacity and capacity units (if changed from the original nameplate due to set pressure)
- c) All measuring and test equipment used in the repair of pressure relief valves shall be calibrated against certified equipment having known valid relationships to nationally recognized standards.

- d) Documentation of the repair of nuclear safety related pressure relief valves shall be recorded on the National Board Form NVR-1, *Report of Repair/ Replacement Activities for Nuclear Pressure Relief Devices*, in accordance with the requirements of NBIC Part 3, 1.6. The original code of construction and capacity certification status shall be identified on the NVR-1 form.
- e) When an ASME “V”, “UV” or “NV” stamped pressure relief device requires a duplicate nameplate because the original nameplate is illegible or missing, it may be applied using the procedures of NBIC Part 4, 4.7.4 provided concurrence is obtained from the Authorized Nuclear Inspector and Jurisdiction. In this case the nameplate shall be marked “SEC. I”, “SEC. III”, or “SEC. VIII” to indicate original ASME Code stamping.
- f) Repair activities for pressure relief valves shall not include rerating of the device. Set pressure changes within the range of the valve manufacturer’s capacity certification and the design pressure of the valve (see NBIC Part 4, 4.7.3) are permitted, provided the new set pressure and capacity rating are reconciled with the design of the system where the device will be used. These changes are not considered to be rerating.
- g) Conversions of pressure relief valves as described in NBIC Part 4, 4.2 b) are permitted as part of repair activities.
- h) Set pressure changes or conversions of pressure relief valves shall be described in the “Remarks” section of Form NVR-1.

(21) **FIGURE S6.5-a.**

EXAMPLE LAYOUT OF REQUIRED MARKINGS FOR REPAIR OF NUCLEAR PRESSURE RELIEF VALVES

 	_____	
	CERTIFICATE HOLDER	
NATIONAL BOARD CERTIFICATE NOS.	_____	
	UNIQUE IDENTIFIER	
"NR" "VR"	_____	_____
	SET PRESSURE	CAPACITY (IF CHANGE IN SET PRESSURE)

DATE OF REPAIR		

SUPPLEMENT 7**RECOMMENDED PROCEDURES FOR TEST ONLY OF PRESSURE RELIEF VALVES****S7.1 INTRODUCTION**

- a) It is essential that the test only organization establish basic, specific procedures for the testing of pressure relief valves. The purpose of these recommended procedures is to provide the test only organization with guidelines for this important aspect of valve testing. It is realized that there are many types of valves and conditions under which they are tested and, for this reason, the specific items in these recommended procedures may not apply, or they may be inadequate for each of those types or for the detailed test procedures that may be required for each valve.
- b) If the valve is to be bench tested, ensure that all sources of pressure have been removed from the valve prior to removal from service. If the valve is to be field tested using system pressure, ensure that all sources of pressure are under the control of the person performing the test.
- c) S7.2 contains recommended procedures for the test only of spring-loaded and pilot operated pressure relief valves.

S7.2 PRESSURE RELIEF VALVES

(21)

a) Visual inspection

- 1) This information is to be recorded
 - a. User (customer) identification number;
 - b. Complete original pressure relief valve nameplate data, previous "VR" repair nameplate data, previous "T/O" test only nameplate data plus any important information received from customer.
 - c. If nameplate is missing, illegible or has incorrect information, the pressure relief valve shall not be tested. The pressure relief valve should be sent to "VR" repair shop per paragraph 4.7.4
- 2) Verify external adjustment seals are installed and match manufacturer and/or "VR" - "T/O" nameplate.
- 3) Check bonnet for venting on bellows type valves.
- 4) Check appearance for any unusual damage, missing, or misapplied parts. If sufficient damage or other unusual conditions are detected that may pose a safety risk during testing, set aside for review by the Quality Department.

b) Existing Nameplate

- 1) An existing "VR" Nameplate, if applicable, shall not be removed from the relief valve.
- 2) An existing "T/O" Nameplate shall be removed from the relief valve.

c) Relief Valve Data

- 1) "Set Pressure Definition" shall be obtained from National Board Document # NB-18.
- 2) Manufacturer's steam to air correction factor, if applicable, shall be obtained from Manufacturer.

d) Set Pressure Test

- 1) If set pressure test indicates the valve opens within the requirements of the original code of construction, then proceed to Seat Tightness.
- 2) If set pressure test indicates the valve does not open within the requirements of the original code of construction, but opens within twice the set pressure tolerance allowed per the requirements of the original code of construction and is otherwise in acceptable condition, set pressure restoration (defined as no more than twice the permitted set pressure tolerance) shall be made. Proceed to Seat Tightness.
- 3) If set pressure test indicates the valve does not open within twice the set pressure tolerance allowed per the requirements of the original code of construction, valve should be sent to a "VR" shop for repair or scrapped.

e) Seat Tightness

- 1) Seat tightness must be tested at a level which meets the requirements of the end user.

f) Sealing

- 1) After completion of set pressure test, set pressure restoration (if applicable) and seat tightness testing, any seals removed by the "T/O" Certificate Holder for testing and/or adjustment shall be resealed in accordance with the original code of construction with a seal providing a means of identification of the organization performing the set pressure test.

g) "T/O" Nameplate

- 1) The tester shall prepare a "T/O" nameplate for each valve tested.
- 2) The nameplate shall, as a minimum, meet the requirements of 3.5.2 a).
- 3) Nameplate shall be installed independent of sealing used for external adjustments and/or "VR" nameplate attachment.
- 4) Nameplate shall receive a safety seal providing a means of identification of the organization performing the set pressure testing.

PART 4, SECTION 7

PRESSURE RELIEF DEVICES — NBIC POLICY FOR METRICATION

7.1 GENERAL

This policy provides guidance for the use of US customary units and metric units. Throughout the NBIC, metric units are identified and placed in parentheses after the US customary units referenced in the text and associated tables. For each repair or alteration performed, selection of units shall be based on the units used in the original code of construction. For example, items constructed using US customary units shall be repaired or altered using US customary units. The same example applies to items constructed using metric units. Whichever units are selected, those units are to be used consistently throughout each repair or alteration. Consistent use of units includes all aspects of work required for repairs or alterations (i.e. materials, design, procedures, testing, documentation, stamping, etc.).

7.2 EQUIVALENT RATIONALE

The rationale taken to convert metric units and US customary units involves knowing the difference between a *soft* conversion and a *hard* conversion. A soft conversion is an exact conversion. A hard conversion is simply performing a soft conversion and then rounding off within a range of intended precision. When values specified in the NBIC are intended to be approximate values, a hard conversion is provided. If an exact value is needed to maintain safety or required based on using good engineering judgment, then a soft conversion will be used. In general, approximate accuracy is acceptable for most repairs or alterations performed using the requirements of the NBIC. Therefore, within the NBIC, metric equivalent units are primarily hard conversions.

The following examples are provided for further clarification and understanding of soft conversions versus hard conversions:

Example 1: Using 1 in. = 25.4 mm;
12 in. = 304.8 mm (soft conversion)

Example 2: Using the above conversion, a hard conversion may be 300 mm or 305 mm depending on the degree of precision needed.

7.3 PROCEDURE FOR CONVERSION

The following guidelines shall be used to convert between US customary units and metric units within the text of the NBIC:

- a) All US customary units will be converted using a soft conversion;
- b) Soft conversion calculations will be reviewed for accuracy;
- c) Based on specified value in the NBIC, an appropriate degree of precision shall be identified;
- d) Once the degree of precision is decided, rounding up or down may be applied to each soft conversion in order to obtain a hard conversion; and
- e) Use of hard conversion units shall be used consistently throughout the NBIC wherever soft conversions are not required.

Note:

Care shall be taken to minimize percentage difference between units.

7.4 REFERENCING TABLES

The following tables are provided for guidance and convenience when converting between US customary units and metric units. (See NBIC Part 1, 2, 3, 4, Tables 7.4-a through 7.4-j)

TABLE 7.4-a

SOFT CONVERSION FACTORS (US X FACTOR = METRIC)

US Customary	Metric	Factor
in.	mm	25.4
ft.	m	0.3048
in. ²	mm ²	645.16
ft. ²	m ²	0.09290304
in. ³	mm ³	16,387.064
ft. ³	m ³	0.02831685
US gal.	m ³	0.003785412
US gal.	liters	3.785412
psi	MPa	0.0068948
psi	kPa	6.894757
ft.-lb	J	1.355818
°F	°C	5/9 x (°F–32)
R	K	5/9
lbm	kg	0.4535924
lbf	N	4.448222
in.-lb	N-mm	112.98484
ft.-lb	N-m	1.3558181
ksiVin	MPaVm	1.0988434
Btu/hr	W	0.2930711
lb/ft ³	kg/m ³	16.018463
in.-wc	kPa	0.249089

Note:

The actual pressure corresponding to the height of a vertical column of fluid depends on the local gravitational field and the density of the fluid, which in turn depends upon the temperature. This conversion factor is the conventional value adopted by ISO. The conversion assumes a standard gravitational field ($g_n = 9.80665 \text{ N/kg}$) and a density of water equal to $1,000 \text{ kg/m}^3$. 7.4-a through 7.4-j.

Temperature shall be converted to within 1°C as shown in NBIC Part 1, 2, 3, 4, Table 7.4-b.

TABLE 7.4-b
TEMPERATURE EQUIVALENTS

Temperature °F	Temperature °C
60	16
70	21
100	38
120	49
350	177
400	204
450	232
800	427
1,150	621

Fractions of an inch shall be converted according to NBIC Part 1, 2, 3, Table 7.4-c. Even increments of inches are in even multiples of 25 mm. For example, 40 inches is equivalent to 1,000 mm. Intermediate values may be interpolated rather than converting and rounding to the nearest mm.

TABLE 7.4-c
US FRACTIONS/METRIC EQUIVALENTS

Inches	Millimeters
1/32	0.8
3/64	1.2
1/16	1.5
3/32	2.5
1/8	3
5/32	4
3/16	5
7/32	5.5
1/4	6
5/16	8
3/8	10
7/16	11
1/2	13
9/16	14
5/8	16
11/16	17
3/4	19
7/8	22
1	25

For nominal pipe sizes, the following relationships were used as shown in NBIC Parts 1, 2 or 3, Table 7.4-d.

TABLE 7.4-d
PIPE SIZES/EQUIVALENT

US Customary Practice	Metric Practice
NPS 1/8	DN 6
NPS 1/4	DN 8
NPS 3/8	DN 10
NPS 1/2	DN 15
NPS 3/4	DN 20
NPS 1	DN 25
NPS 1-1/4	DN 32
NPS 1-1/2	DN 40
NPS 2	DN 50
NPS 2-1/2	DN 65
NPS 3	DN 80
NPS 3-1/2	DN 90
NPS 4	DN 100
NPS 5	DN 125
NPS 6	DN 150
NPS 8	DN 200
NPS 10	DN 250
NPS 12	DN 300
NPS 14	DN 350
NPS 16	DN 400
NPS 18	DN 450
NPS 20	DN 500
NPS 22	DN 550
NPS 24	DN 600
NPS 26	DN 650
NPS 28	DN 700
NPS 30	DN 750
NPS 32	DN 800
NPS 34	DN 850
NPS 36	DN 900
NPS 38	DN 950
NPS 40	DN 1000
NPS 42	DN 1050
NPS 44	DN 1100
NPS 46	DN 1150
NPS 48	DN 1200
NPS 50	DN 1250
NPS 52	DN 1300
NPS 54	DN 1350
NPS 56	DN 1400
NPS 58	DN 1450
NPS 60	DN 1500

Areas in square inches (in²) were converted to square mm (mm²) and areas in square feet (ft²) were converted to square meters (m²). See examples in NBIC Parts 1, 2 or 3, Tables 7.4-e and 7.4-f.

TABLE 7.4-e

Area (US Customary)	Area (Metric)
3 in ²	650 mm ²
6 in ²	3,900 mm ²
10 in ²	6,500 mm ²

TABLE 7.4-f

Area (US Customary)	Area (Metric)
5 ft ²	0.46 m ²

Volumes in cubic inches (in.³) were converted to cubic mm (mm³) and volumes in cubic feet (ft³) were converted to cubic meters (m³). See examples in NBIC Parts 1, 2 or 3, Tables 7.4-g and 7.4-h.

TABLE 7.4-g

Volume (US Customary)	Volume (Metric)
1 in ³	16,000 mm ³
6 in ³	96,000 mm ³
10 in ³	160,000 mm ³

TABLE 7.4-h

Volume (US Customary)	Volume (Metric)
5 ft ³	0.14 m ³

Although the pressure should always be in MPa for calculations, there are cases where other units are used in the text. For example, kPa is used for small pressures. Also, rounding was to two significant figures. See examples in Table 7.4-i. (Note that 14.7 psi converts to 101 kPa, while 15 psi converts to 100 kPa. While this may seem at first glance to be an anomaly, it is consistent with the rounding philosophy.)

TABLE 7.4-i
PRESSURE/EQUIVALENTS

Pressure (US Customary)	Pressure (Metric)
0.5 psi	3 kPa
2 psi	15 kPa
3 psi	20 kPa
10 psi	70 kPa
15 psi	100 kPa
30 psi	200 kPa
50 psi	350 kPa
100 psi	700 kPa
150 psi	1.03 MPa
200 psi	1.38 MPa
250 psi	1.72 MPa
300 psi	2.10 MPa
350 psi	2.40 MPa
400 psi	2.8 MPa
500 psi	3.45 MPa
600 psi	4.14 MPa
1,200 psi	8.27 MPa
1,500 psi	10.34 MPa

TABLE 7.4-j

Strength (US Customary)	Strength (Metric)
95,000 psi	655 MPa

Material properties that are expressed in psi or ksi (e.g., allowable stress, yield and tensile strength, elastic modulus) were generally converted to MPa to three significant figures. See example in NBIC Parts 1, 2, 3 or 4, Table 7.4-h.

PART 4, SECTION 8

PRESSURE RELIEF DEVICES — PREPARATION OF TECHNICAL INQUIRIES TO THE *NATIONAL BOARD INSPECTION CODE* COMMITTEE

8.1 INTRODUCTION

The NBIC Committee meets regularly to consider written requests for interpretations and revisions to the code rules. This section provides guidance to code users for submitting technical inquiries to the Committee. Technical inquiries include requests for additions to the code rules and requests for code Interpretations, as described below.

a) Code Revisions

Code revisions are considered to accommodate technological developments, address administrative requirements, or to clarify code intent.

b) Code Interpretations

Code Interpretations provide clarification of the meaning of existing rules in the code, and are also presented in question and reply format. Interpretations do not introduce new requirements. In cases where existing code text does not fully convey the meaning that was intended, and revision of the rules is required to support an Interpretation, an intent Interpretation will be issued and the code will be revised. As a matter of published policy, the National Board does not approve, certify, or endorse any item, construction, propriety device or activity and, accordingly, inquiries requiring such consideration will be returned. Moreover, the National Board does not act as a consultant on specific engineering problems or on the general application or understanding of the code rules.

Inquiries that do not comply with the provisions of this section or that do not provide sufficient information for the Committee's full understanding may result in the request being returned to the inquirer with no action.

8.2 INQUIRY FORMAT

Inquiries submitted to the Committee shall include:

a) Purpose

Specify one of the following:

- 1) Revision of present code rules;
- 2) New or additional code rules; or
- 3) Code Interpretation.

b) Background

Provide concisely the information needed for the Committee's understanding of the inquiry, being sure to include reference to the applicable Code Edition, Addenda, paragraphs, figures, and tables. Provide a copy of the specific referenced portions of the code.

c) Presentations

The inquirer may attend a meeting of the Committee to make a formal presentation or to answer questions from the Committee members with regard to the inquiry. Attendance at a Committee meeting shall

be at the expense of the inquirer. The inquirer's attendance or lack of attendance at a meeting shall not be a basis for acceptance or rejection of the inquiry by the Committee.

8.3 CODE REVISIONS OR ADDITIONS

Request for code revisions or additions shall provide the following:

a) Proposed Revisions or Additions

For revisions, identify the rules of the code that require revision and submit a copy of the appropriate rules as they appear in the code, marked up with the proposed revision. For additions, provide the recommended wording referenced to the existing code rules.

b) Statement of Need

Provide a brief explanation of the need for the revision or addition.

c) Background Information

Provide background information to support the revision or addition, including any data or changes in technology that form the basis for the request that will allow the Committee to adequately evaluate the proposed revision or addition. Sketches, tables, figures, and graphs should be submitted as appropriate. When applicable, identify any pertinent paragraph in the code that would be affected by the revision or addition and identify paragraphs in the code that reference the paragraphs that are to be revised or added.

8.4 CODE INTERPRETATIONS

Requests for code Interpretations shall provide the following:

a) Inquiry

Provide a condensed and precise question, omitting superfluous background information and, when possible, composed in such a way that a "yes" or a "no" reply, with brief provisos if needed, is acceptable. The question should be technically and editorially correct.

b) Reply

Provide a proposed reply that will clearly and concisely answer the inquiry question. Preferably the reply should be "yes" or "no" with brief provisos, if needed.

c) Background Information

Provide any background information that will assist the committee in understanding the proposed Inquiry and Reply Requests for Code Interpretations must be limited to an interpretation of the particular requirement in the code. The Committee cannot consider consulting type requests such as:

- 1) A review of calculations, design drawings, welding qualifications, or descriptions of equipment or parts to determine compliance with code requirements;
- 2) A request for assistance in performing any code-prescribed functions relating to, but not limited to, material selection, designs, calculations, fabrication, inspection, pressure testing, or installation; or
- 3) A request seeking the rationale for code requirements.

8.5 SUBMITTALS

Submittals to and responses from the Committee shall meet the following criteria:

a) Submittal

Inquiries from code users shall be in English and preferably be submitted in typewritten form; however, legible handwritten inquiries will be considered. They shall include the name, address, telephone number, fax number, and email address, if available, of the inquirer and be mailed to the following address:

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

As an alternative, inquiries may be submitted via fax or email to:

Secretary NBIC Committee
Fax: 614.847.1828
Email: NBICinquiry@nationalboard.org

b) Response

The Secretary of the NBIC Committee shall acknowledge receipt of each properly prepared inquiry and shall provide a written response to the inquirer upon completion of the requested action by the NBIC Committee.

PART 4, SECTION 9

PRESSURE RELIEF DEVICES — GLOSSARY OF TERMS

9.1 DEFINITIONS

For the purpose of applying the rules of the NBIC, the following terms and definitions shall be used herein as applicable to each part:

Additional terms and definitions specific to DOT Transport Tanks are defined in NBIC Part 2, Supplement 6.

Accumulator — A vessel in which the test medium is stored or accumulated prior to its use for testing.

Alteration — A change in the item described on the original Manufacturer's Data Report which affects the pressure containing capability of the pressure-retaining item. (See NBIC Part 3, 3.4.3, *Examples of Alteration*) Nonphysical changes such as an increase in the maximum allowable working pressure (internal or external), increase in design temperature, or a reduction in minimum temperature of a pressure-retaining item shall be considered an alteration.

ANSI — The American National Standards Institute.

Appliance — A piece of equipment that includes all controls, safety devices, piping, fittings, and vessel(s) within a common frame or enclosure that is listed and labeled by a nationally recognized testing agency for its intended use.

ASME — The American Society of Mechanical Engineers.

ASME Code — The American Society of Mechanical Engineers Boiler and Pressure Vessel Code published by that Society, including addenda and Code Cases, approved by the associated ASME Board.

Assembler — An organization who purchases or receives from a manufacturer the necessary component parts of valves and assemblies, adjusts, tests, seals, and ships safety or safety relief valves at a geographical location, and using facilities other than those used by the manufacturer.

Authorized Inspection Agency (AIA)

Inservice: An Authorized Inspection Agency is either:

- a) a Jurisdictional authority as defined in the National Board Constitution; or
- b) an entity that is accredited by the National Board meeting NB-369, *Accreditation of Authorized Inspection Agencies Performing Inservice Inspection Activities*; NB-371, *Accreditation of Owner-User Inspection Organizations (OUIO)*; or NB-390, *Accreditation of Federal Inspection Agencies (FIA)*.

New Construction: An Authorized Inspection Agency is one that is accredited by the National Board meeting the qualification and duties of NB-360, *National Board Acceptance of Authorized Inspection Agencies (AIA) Accredited by the American Society of Mechanical Engineers (ASME)*.

Authorized Nuclear Inspection Agency — An Authorized Inspection Agency intending to perform nuclear inspection activities and employing nuclear Inspectors / Supervisors.

Biomass — Fuels which result from biological sources requiring a relatively short time for replenishment: Wood and bagasse are typical examples.

Biomass Fired Boiler — A boiler which fires biomass as its primary fuel.

- (21) **Brazing** — A group of metal joining processes which produce coalescence of materials by heating them to a suitable temperature, and by using a filler metal having a liquidus above 840°F (450°C) and below the solidus of the base materials. The filler metal is distributed between the closely fitted surfaces of the joint by capillary action.

Boiler — A boiler is a closed vessel in which water or other liquid is heated, steam or vapor generated, steam or vapor is superheated, or any combination thereof, under pressure for use external to itself, by the direct application of energy from the combustion of fuels or from electricity or solar energy. The term boiler also shall include the apparatus used to generate heat and all controls and safety devices associated with such apparatus or the closed vessel.

High-Temperature Water Boiler — A power boiler in which water is heated and operates at a pressure in excess of 160 psig (1.1 MPa) and/or temperature in excess of 250°F (121°C).

Hot-Water Heating Boiler — A hot water boiler installed to operate at pressures not exceeding 160 psig (1,100 kPa) and/or temperatures not exceeding 250°F (121°C), at or near the boiler outlet.

Hot-Water Supply Boiler — A boiler that furnishes hot water to be used externally to itself at a pressure less than or equal to 160 psig (1,100 kPa gage) or a temperature less than or equal to 250°F (120°C) at or near the boiler outlet.

Power Boiler — A boiler in which steam or other vapor is generated at a pressure in excess of 15 psig (100 kPa) for use external to itself. The term power boiler includes fired units for vaporizing liquids other than water, but does not include fired process heaters and systems. (See also High-Temperature Water Boiler).

Steam Heating Boiler — A steam boiler installed to operate at pressures not exceeding 15 psig (100 kPa).

Capacity Certification — The verification by the National Board that a particular valve design or model has successfully completed all capacity testing as required by the ASME Code.

Carbons Recycle — See Flyash Recycle.

CGA – Compressed Gas Association

Changeover Valve – A three-way stop (or diverter) valve with one inlet port and two outlet ports designed to isolate either one of the two outlet ports from the inlet port, but not both simultaneously during any mode of operation.

Chimney or Stack — A device or means for providing the venting or escape of combustion gases from the operating unit.

Confined Space — Work locations considered “confined” because their configurations hinder the activities of employees who must enter, work in and exit them. A confined space has limited or restricted means for entry or exit, and it is not designed for continuous employee occupancy. Confined spaces include, but are not limited to, underground vaults, tanks, storage bins, manholes, pits, silos, process vessels, and pipelines. Regulatory Organizations often use the term “permit-required confined space” (permit space) to describe a confined space that has one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress. Confined space entry requirements may differ in many locations and the Inspector is cautioned of the need to comply with local or site- specific confined space entry requirements.

Conversion

Pressure Relief Devices — The change of a pressure relief valve from one capacity-certified configuration to another by use of manufacturer’s instructions.

Units of Measure — Changing the numeric value of a parameter from one system of units to another.

Conveyor System(s) — A fuel transport system utilized on biomass boilers that drops fuel onto a moving belt, bucket elevator, drag link conveyor, or a screw or auger mechanism. (The speed of the conveyor may be varied to meet fuel demand.)

Covered Piping Systems (CPS) — not to be confused with insulated piping, ASME B31.1 pressure piping systems or other piping systems where safety risks to personnel and equipment may exist during facility operations.

Cryogenic — Products stored at or below -238°F (-150°C)

Demonstration — A program of making evident by illustration, explanation, and completion of tasks documenting evaluation of an applicant's ability to perform code activities, including the adequacy of the applicant's quality program, and by a review of the implementation of that program at the address of record and/or work location.

Dense Phase Pneumatic System(s) — A batch feed transport system used on solid fuel fired boilers for both fuel delivery and/or ash removal. In this system the material to be transported is dropped through a valve in a pressure vessel. When the vessel is filled the valve closes and air at a pressure from 30 to 100 psig (200 to 700 kPa) is admitted and the material leaves the vessel in the form of a "slug". The sequence then repeats.

Dutchman — Generally limited to tube or pipe cross-section replacement. The work necessary to remove a compromised section of material and replace the section with material meeting the service requirements and installation procedures acceptable to the Inspector. Also recognized as piecing.

Emissions — The discharge of various Federal or State defined air pollutants into the surrounding atmosphere during a given time period.

Emissions Control System — An arrangement of devices, usually in series, used to capture various air pollutants and thereby reduce the amount of these materials, or gases, being admitted to the surrounding atmosphere, below Federal or State defined standards.

Examination — In process work denoting the act of performing or completing a task of interrogation of compliance. Visual observations, radiography, liquid penetrant, magnetic particle, and ultrasonic methods are recognized examples of examination techniques.

Existing Material — The actual material of the pressure retaining item at the location where the repair or alteration is to be performed.

Exit — A doorway, hallway, or similar passage that will allow free, normally upright unencumbered egress from an area.

Field — A temporary location, under the control of the Certificate Holder, that is used for repairs and/or alterations to pressure-retaining items at an address different from that shown on the Certificate Holder's *Certificate of Authorization*.

Fluidized Bed — A process in which a bed of granulated particles are maintained in a mobile suspension by an upward flow of air or gas.

Fluidized Bed (Bubbling) — A fluidized bed in which the fluidizing velocity is less than the terminal velocity of individual bed particles where part of the fluidizing gas passes through as bubbles.

Fluidized Bed (Circulating) — A fluidized bed in which the fluidizing velocities exceed the terminal velocity of the individual bed particles.

Flyash — Suspended ash particles carried in the flue gas.

Flyash Collector — A device designed to remove flyash in the dry form from the flue gas.

Flyash Recycle — The reintroduction of flyash/unburned carbon from the flyash collector into the combustion zone, in order to complete the combustion of unburned fuel, thereby improving efficiency.

Forced-Flow Steam Generator — A steam generator with no fixed steamline and waterline.

Fuel Transport Fan — A fan which generates airflow capable of moving fuel particles, in suspension, from a metering device to the combustion zone.

Fusing — The coalescence of two plastic members by the combination of controlled heating and the application of pressure approximately normal to the interface between them.

Grate — The surface on which fuel is supported and burned and through which air is passed for combustion.

Hydrostatic Test — A liquid pressure test which is conducted using water as the test medium.

Inspection — A process of review to ensure engineering design, materials, assembly, examination, and testing requirements have been met and are compliant with the code.

Induced Draft Fan — A fan exhausting hot gases from the heat absorbing equipment.

Inspector — See National Board Commissioned Inspector and National Board Owner-User Commissioned Inspector.

Intervening — Coming between or inserted between, as between the test vessel and the valve being tested.

Jurisdiction — A governmental entity with the power, right, or authority to interpret and enforce law, rules, or ordinances pertaining to boilers, pressure vessels, or other pressure-retaining items where the pressure retaining item is installed. It includes National Board member Jurisdictions defined as “Jurisdictional Authorities.” Where there is no National Board Member Jurisdiction, the National Board shall act on behalf of the Jurisdiction.

Jurisdictional Authority — A member of the National Board, as defined in the *National Board Constitution*.

Lean Phase Pneumatic System(s) — A fuel transport system utilized on biomass boilers that drops fuel into a moving airstream, mixes with the air, and travels through a pipe at a velocity in the region of 5,000 ft/min (1,525 m/min). Air pressures are in the region of 25 inches (635 mm) water column.

Lift Assist Device — A device used to apply an auxiliary load to a pressure relief valve stem or spindle, used to determine the valve set pressure as an alternative to a full pressure test.

Liquid Pressure Test — A pressure test using water or other incompressible fluid as a test medium.

Manufacturer’s Documentation — The documentation that includes technical information and certification required by the original code of construction.

Mechanical Assembly — The work necessary to establish or restore a pressure retaining boundary, under supplementary materials, whereby pressure-retaining capability is established through a mechanical, chemical, or physical interface, as defined under the rules of the NBIC.

Mechanical Repair Method — A method of repair, which restores a pressure retaining boundary to a safe and satisfactory operating condition, where the pressure retaining boundary is established by a method other than welding or brazing, as defined under the rules of the NBIC.

Metering Device — A method of controlling the amount of fuel, or air, flowing into the combustion zone.

“NR” Certificate Holder — An organization in possession of a valid “NR” *Certificate of Authorization* issued by the National Board.

National Board — The National Board of Boiler and Pressure Vessel Inspectors.

National Board Commissioned Inspector — An individual who holds a valid and current National Board Commission.

NBIC — The *National Board Inspection Code* published by The National Board of Boiler and Pressure Vessel Inspectors.

Nuclear Items — Items constructed in accordance with recognized standards to be used in nuclear power plants or fuel processing facilities.

Original Code of Construction — Documents promulgated by recognized national standards writing bodies that contain technical requirements for construction of pressure-retaining items or equivalent to which the pressure-retaining item was certified by the original manufacturer.

Overfire Air — Air admitted to the furnace above the grate surface /fuel bed. Used to complete the combustion of fine particles, in suspension. Also aids in reducing NOx formation.

Owner or User — As referenced in lower case letters means any person, firm, or corporation legally responsible for the safe operation of any pressure-retaining item.

Owner-User Inspection Organization — An owner or user of pressure-retaining items that maintains an established inspection program, whose organization and inspection procedures meet the requirements of the National Board rules and are acceptable to the Jurisdiction or Jurisdictional Authority wherein the owner or user is located.

Owner-User Inspector — An individual who holds a valid and current National Board Owner-User Commission.

Piecing — A repair method used to remove and replace a portion of piping or tubing material with a suitable material and installation procedure.

Pilot Operated Pressure Relief Valve — A pressure relief valve in which the disk is held closed by system pressure, and the holding pressure is controlled by a pilot valve actuated by system pressure.

Plate Heat Exchanger (PHE) — An assembly of components consisting of heat transfer plates and their supporting frame. The frame provides structural support and pressure containment and may consist of fixed endplates, moveable endplates, an upper carrying bar and lower guide bar which provide plate alignment, and frame compression bolts.

Pneumatic Test — A pressure test which uses air or another compressible gas as the test medium.

Potable Water Heaters — A corrosion resistant appliance that includes the controls and safety devices to supply potable hot water at pressure not exceeding 160 psig (1,100 kPa) and temperature not in excess of 210°F (99°C).

Fired Storage Water Heater — A potable water heater in which water is heated by electricity, the combustion of solid, liquid, or gaseous fuels and stores water within the same appliance.

Indirect Fired Water Heater — A potable water heater in which water is heated by an internal coil or heat exchanger that receives its heat from an external source. Indirect fired water heaters provide water directly to the system or store water within the same appliance.

Circulating Water Heater — A potable water heater which furnishes water directly to the system or to a separate storage tank. Circulating water heaters may be either natural or forced flow.

Potable Water Storage Tank — an unfired pressure vessel used to store potable hot water at temperatures not exceeding 210°F (99°C).

Pressure Relief Device — 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.

Pressure Relief Valve (PRV) — A pressure relief device designed to actuate on inlet static pressure and reclose after normal conditions have been restored.

Pressure Relief Valve Shelf Life — For a pressure relief valve or pilot valve, the length of time for which the device can be stored, after it has been set and tested or repaired, prior to installation, without requiring a retest or reduced service interval.

Pressure-Retaining Items (PRI) — Any boiler, pressure vessel, piping, or material used for the containment of pressure, either internal or external. The pressure may be obtained from an external source, or by the application of heat from a direct source, or any combination thereof.

Pressure Roll Load — The terms line load, and nip load are used interchangeably to refer to the interaction between the pressure roll(s) and the Yankee dryer. It is called “nip” load because the pressure roll is rubber-covered and is pressed up against the Yankee dryer with enough force to create a nip (or pinch) that forces the paper into line contact between the rolls and provides some mechanical dewatering. The paper then sticks onto the Yankee surface and follows the Yankee dryer for thermal dewatering by the steam-heated Yankee surface. This “nip load” is called a “line load” because the units are load (force) per length of line contact. The units are pounds per linear inch (PLI) and kilonewtons per meter (kN/m).

Pressure Test — A test that is conducted using a fluid (liquid or gas) contained inside a pressure-retaining item.

Pressure Vessel — A pressure vessel is a container other than a boiler or piping used for the containment of pressure.

“R” Certificate Holder — An organization in possession of a valid “R” *Certificate of Authorization* issued by the National Board.

Re-ending — A method used to join original code of construction piping or tubing with replacement piping or tubing material for the purpose of restoring a required dimension, configuration or pressure-retaining capacity.

Relief Valve — A pressure relief valve characterized by gradual opening that is generally proportional to the increase in pressure. It is normally used for incompressible fluids.

Repair — The work necessary to restore pressure-retaining items to a safe and satisfactory operating condition.

Re-rating (re-rate) — See alteration. Re-rate does not apply to pressure relief devices.

Regulatory Authority — A government agency, such as the United States Nuclear Regulatory Commission, empowered to issue and enforce regulations concerning the design, construction, and operation of nuclear power plants.

Safe Point of Discharge — A location that will not cause property damage, equipment damage, or create a health or safety threat to personnel in the event of discharge.

Safety Relief Valve — A pressure relief valve characterized by rapid opening or by gradual opening that is generally proportional to the increase in pressure. It can be used for compressible or incompressible fluids.

Safety Valve — A pressure relief valve characterized by rapid opening and normally used to relieve compressible fluids.

Seal Weld — Any weld designed primarily to provide a specific degree of tightness against leakage. A seal weld is not intended to provide structural integrity to a pressure retaining item.

Settings — Those components and accessories required to provide support for the component during operation and during any related maintenance activity.

Shop — A permanent location, the address that is shown on the *Certificate of Authorization*, from which a Certificate Holder controls the repair and/or alteration of pressure-retaining items.

Suspension Burner — A combustion system in which the fuel is in the form of relatively small particles. Their buoyancy is maintained in the transport airstream and the fuel/air mixture flow stream, until combustion is completed.

Testing Laboratory — National Board accepted laboratory that performs functional and capacity tests of pressure relief devices.

Thermal Fluid Heater — A thermal fluid heater is a closed vessel in which a fluid other than water is heated by the direct application of heat from a thermal energy source. Depending on the process heating requirements, the fluid may be vaporized with normal circulation but, more often, the fluid is heated and circulated by a pump.

Transient — An occurrence that is maintained only for a short interval as opposed to a steady state condition.

Underfire Air — A method of introducing air beneath the grate surface/fuel bed.

“VR” Certificate Holder — An organization in possession of a valid “VR” *Certificate of Authorization* issued by the National Board.

Velocity Distortion — The pressure decrease that occurs when fluid flows past the opening of a pressure sensing line. This is a distortion of the pressure that would be measured under the same conditions for a non or slowly moving fluid.

- (21) **Verify** — To determine that a particular action has been performed in accordance with the requirements either by witnessing the action or reviewing records.
- (21) **Volumetric NDE** — A method capable of detecting imperfections that may be located anywhere within the examined volume. Volumetric NDE is limited to radiographic (RT) and ultrasonic (UT) examination methods.
- (21) **Water Head** — The pressure adjustment that must be taken into account due to the weight of test media (in this case, water) that is 0.433 psi/ft (10 kPa/m) added (subtracted) from the gage pressure for each foot the gage is below (above) the point at which the pressure is to be measured.
- (21) **Welding** — A group of processes which produce a localized coalescence of metallic or nonmetallic materials by heating the materials to the suitable temperature, with or without the application of pressure, and with or without the use of filler material.
- (21) **Witness** — To be present at an event and have first-hand knowledge of the action and be able to attest that it occurred.

PART 4, SECTION 10

PRESSURE RELIEF DEVICES — NBIC APPROVED INTERPRETATIONS

10.1 SCOPE

- a) This section provides a list of all approved interpretations for previous editions and addenda of the NBIC. A complete list of interpretations including approved interpretations for this edition is provided on the National Board website.
- b) Each interpretation references the edition and addenda applicable to the committee response and approval. Use of interpretations, for other than the approved edition and addenda, may not be appropriate for reference.
- c) Technical inquiries (also known as “request for interpretation”) may be submitted to the NBIC committee to clarify the meaning or intent of existing rules to the NBIC. The requirements for submitting technical inquiries are described in NBIC Parts 1, 2, and 3 (Section 8), Preparation of Technical Inquiries to the NBIC Committee.

2019 INTERPRETATIONS

(21)

Interpretation	Edition	Part	Section	Subject
19-23	2019	3	3.3.2 e) 1)	Mechanical replacement of valves, fittings, tubes, and/or pipes
19-22	2019	3	3.3.2 e)	Repair of a Stiffening Ring
19-21	2019	3	1.4.1	Accreditation Process/Certification of Scope
19-20	2019	3	4.4.1 & 4.4.2	Liquid Pressure Test Examination Methods Applicable to Alterations
19-19	2019	3	1.3.2	Authorization of Repair/Alteration Activities
19-18	2019	3	3.3.2 e)	Addition of Non-Load Bearing Attachments
19-17	2019	3	3.3.3	Scope of Repairs
19-16	2019	3	4.4.2 c)	Alternative Method in lieu of Pressure Testing or Examination
19-15	2019	3	3.4.4	PV Cycles of operations change as an alteration
19-14	2019	3	3.4.5.1 b)	Alteration of ASME Section VIII Div.2 vessels
19-13	2019	3	4.4.1 e)	Nondestructive Examination
19-12	2019	3	3.3.3 & 3.3.4.3	Weld build of wasted areas with different material
19-11	2019	3	3.2.2, 3.3.3, & 5.12.4.1	Mechanical Installation of Replacement Parts in ASME Section VIII Division 3 Pressure Vessels
19-10	2019	3	2.2.6 & S6.9.6	Continuity of qualified personnel
19-09	2019	3	Table 2.3	Acceptance of latest AWS SWPS for use in the 2019 NBIC
19-08	2019	3	3.3.2	Routine Repairs for ASME B31.3 Normal Fluid Service and Severe Cyclic piping
19-07	2019	3	5.6	Form Registration Log
19-06	2019	3	2.2 & 2.2.1	National Certified Pipe Welding Bureau (NCPWB) welding procedure specifications
19-05	2019	3	1.5.1 d) 1)	Clarification of Part 3, 1.5.1 d) 1)
19-04	2019	3	2.5.3.6	Welding Method 6 on Grade 92 steel

(21) 2019 INTERPRETATIONS

Interpretation	Edition	Part	Section	Subject
19-03	2019	3	1.6.6.2 m), 1.6.7.2 m), & 1.6.8.2 m)	ISO/IEC 17025 edition reference in NBIC Part 3, 1.6.6.2, 1.6.7.2, and 1.6.8.2
19-02	2019	3	3.3.4.3-a	Wastage/Wasted Areas
19-01	2019	3	3.3.2	"R" Certificate Holder manufacturing parts and subassemblies

(21) 2017 INTERPRETATIONS

Interpretation	Edition	Part	Section	Subject
17-22	2017	3	3.3.2, 3.3.5	Repair of Section VIII Div. 2 and Div. 3 Pressure Vessels
17-21	2017	3	3.3.2 e)	Determining the Pressure Used for Hydrostatic Test
17-20	2017	3	3 4.4.2 c)	NDE methods in lieu of a hydrostatic test
17-19	2017	All Parts	8.1 b)	Interpretations issued to earlier NBIC editions
17-18	2017	3	3.2.6	Reference to Other Codes and Standards
17-17	2017	3	3.3.5, 3.4.5	Repair and alteration of Section VIII Division 2 items
17-16	2017	3	3.4.1	Certifying engineer of UDS for re-rating of pressure vessel
17-15	2017	3	2.5.3.2, 2.5.3.3, 2.5.3.4	Alternative Welding Methods
17-14	2017	1, 4	Part 1, 2.9.6 h) and Part 4, 2.2.10 h)	Plugging a Valve Casing Drain
17-13	2017	3	2.5.3 e)	Alternative NDE methods acceptable to the Inspector and the Jurisdiction
17-12	2017	3	3.3.4	Reducing a pressure vessel's overall shell length
17-11	2017	3	2.5.3.6 e)	Changing of Welding Consumables
17-10	2017	3	3.4.5	ASME Section VIII, Division 2, Class 1 Vessels.
17-09	2017	3	2.5.2	Post-Weld Heat Treatment of full penetration groove weld
17-08	2017	3	3.3.5.2.a and 3.4.5.1.a	Repair/Alteration Plans for ASME VIII, Division 2, Class 1 Pressure Vessels
17-07	2017	3	2.5.3	Omission of PWHT by an R Certificate holder
17-06	2017	3	2.5.3.6	Part 3, Section 2.5.3.6, Welding Method 6
17-05	2017	3	3	Repairs to a Pressure Retaining Part
17-04	2017	2	All	Evaluation of existing equipment with minimal documentation
17-03	2017	3	3, Figure 3.3.4.3- b and 3, 3.3.2(e)(5)	Adding Handhole Ring on Pressure Side of Pressure Retaining Item
17-02	2017	3	1.5.1	Continuity Records Retention
17-01	2017	3	All	Application of Term "Practicable"

2015 INTERPRETATIONS

Interpretation	Edition	Part	Section	Subject
15-15	2015	1	2.10, 3.10	Installation Pressure Test
15-14	2017	3	1.5.1	Continuity Records Retention
15-13	2015	3	5.7.2	Routine Repair Stamping Requirements
15-12	2015t	3	3.3.2	Surface Repair of Corrugating Rolls
15-11	2013	3	3	Repair/Replacement of Bolting Material
15-10	2017	3	All	Application of Term “Practicable”
15-09	2015	3	3	Use of Backing Strips to Install Flush Patches
15-08	2015	3	5.7	Alteration to One Side of Shell/Tube Heat Exchanger
15-07	2015	3	3.4.3	Local Stress from Bracket Loading
15-06	2015	3	3.4.3	Change in Boiler Heat Input from HRSG
15-05	2015	3	1.3.2 c)	Verification of Installation of Repair Nameplate
15-04	2015	3	3	Explosive Weld Plugs Tube Repair
15-03	2015	3	3.2.6	Fillet Welded Patches
15-02	2015	3	5.12.2	Valve Repair Nameplate Field Labels
15-01	2015	1	3.3.4	Boiler Clearance Less than Recommended

2013 INTERPRETATIONS

Interpretation	Edition	Part	Section	Subject
13-11	2013	3	3	Repair/Replacement of Bolting Material
13-10	2013	3	3	Use of Backing Strips to Install Flush Patches
13-09	2013	3	4	Penetrant Examination in Lieu of Hydrostatic Test
13-08	2013	3	1.6.1	Quality Control System Responsibilities
13-07	2013	3	3.2	Weld Buildup of Wasted Areas
13-06	2013	3	2.5.2	Postweld Heat Treatment Requirements
13-05	2013	1	3.8.2.3	Operating Limit Control Location on Hot Water Supply Boilers
13-04	2013	3	3.3.2 e)	Seal Welding of Inspection Opening Covers
13-03	2011	3	3.3.2 d) 1)	Standard Threaded Fitting Welded through ASME VIII, Div. 1 Vessel
13-02	2011	3	5.7.5	Stamping Requirements for Alterations
13-01	2013	3	1.8.5 q)	Personnel Qualified IAW ANSI/ASME N45.2.23

2011 INTERPRETATIONS

Interpretation	Edition	Part	Section	Subject
11-06	2011	3	3.2.5	Calculations / Start of Work
11-05	2011	2	5.2.2 – 5.2.3	Replacement of Stamped Data on Corrugator Rolls
11-04	2011	3	1.7	Application of “VR” Stamp

2011 INTERPRETATIONS

Interpretation	Edition	Part	Section	Subject
11-03	2011	2	2.5.8	Test Frequencies
11-02	2011	3	4.4.2 a)	Liquid Pressure Test Requirements
11-01	2011	3	3.3.2	Routine Repair Considerations

2007 INTERPRETATIONS

Interpretation	Edition	Addenda	Part	Section	Subject
07-16	2007		3	3.3.5.2	Requirement for Repair / Alteration Plan
07-15	2007	2008	2	S2.10.6	Average Pitch
07-14	2007	2009	3	3.3.3	Replacement of Pressure Retaining Parts
07-13	2007	2009	All		The Original Code of Construction
07-12	2007	2009	3	3.4.3	Replacement of Heads with Different Types
07-11	2007	2010	3	3.2.2 a)	Replacement Parts
07-10	2007	2009	3	3.3.2–3.3.3	Routine Repairs
07-09	2007	2008	2	S2.9 b) & S2.11 b) 7) b)	Schedule 80 Pipe in External Piping
07-08	2007	2009	3	3.4.3 c)	Handhole Replacement with Flush Patch
07-07	2007	2009	3	3.3.4.3 e) & 3.3.2 d) 3)	Weld Buildup of Wasted Area / Routine Repair
07-06	2007		3		Replacement Parts for Repairs and Alterations
07-05	2007	2008	1	2.9.5.1 c)	Change-Over Valve Permitted in ASME Code Case-2254 Use
07-04	2007		1	4.5.1 a)	Installation of New Rupture Disc in an Existing Holder
07-03	2007		3	2.5.3	Use of Alternative Welding Method 2 on P-No 4 and P-No 5A Base Material
07-02	2007		3	1.6.2, 1.7.5.4, & 1.8.2	NBIC Manual Requirements for “R”, “VR”, and “NR” Stamp Holders
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04-22	2004		RC-1130	Inspector Verification of NDE Performed
04-21	2004	2005	RC-1130	Inspector Involvement in NDE in Lieu of Pressure Test

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04-19	2004	2005	RD-2020	Repair of Threaded Bolt Holes
04-18	2004	2005	RD-3010	Re-rating Using a Later Edition/Addenda of The Original Code of Construction
04-17	2001	2003	RD-2020(c)	Procedures for Repairing Cracks and Crack Classification
04-16	2004		RA-2370	“NR” Certificate Interface with Owner’s Repair/Replacement Program
04-15	2004		RD-2060	Utilizing a Flush Patch to Gain Access Window in Pressure Retaining Items
04-14	2004		RC-1000 & RC-3000	Replacement Safety Valves with Different Capacities and Set Pressures than Boiler Data Report
04-13	2004		RC-1020, RC-1030, Appendix 4, & RC-3022	Replacement of a Cast Iron Section
04-12	2001	2003	RD-1030, RC-1050(c)	Post Weld Heat Treatment of Parts
04-11	2001	2003	RC-1050(c), RC-2050, & RC-2051	Requirements for Testing Replacement Parts
04-10	2004		RC-2031	Flush Patches in Pipes and Tubes NPS 5 or less
04-09	2004		RC-2031	Routine Repairs
04-08	2004		RE-1050	Fabricated Replacement Critical Parts
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04-06	2004		RC-1050(c), RC-2050, RC-2051, & RC-1110	Written Procedure Requirements for Non-Destructive Examinations
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04-04	2004		RC-3022(b) & (d)	Re-rating of Pressure-Retaining Items for Lethal Service/Removal of Insulation
04-03	2004		RC-3022(b) & (d)	Re-rating of Pressure-Retaining Items/Removal of Insulation
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01-40	2001	2003	RC-2051(e), RC-3031(c), RC-2050, & RC-3030(c)	Use of VT when Pressure Test Is Not Practicable

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01-38	2001	2003	RD-3022(d)	Design Only "R" Stamp Holders Pressure Testing and Form R-2
01-37	2001	2003	RC-1140 & RC-3040	Construction Phase & Stamping when Re-rating without Physical Changes
01-36	2001	2002	RC-1020(b)	Application of "R" Stamp on Non-Code Pressure Retaining Items
01-35	2001	2002	RC-1040	Is Pre-Assembly of a Part Considered Fabrication
01-34	2001	2002	RD-1060(h)(2)	Butter Layers Using the SMAW Process
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01-32	2001	2002	Introduction	Are Reference Codes and Standards Acceptable
01-31	2001	2002	RB-3238	Determination of Remaining Life Applicable to Boilers and Pressure Vessels
01-30	2001	2002	RC-1050(c)	Fabrication and Installation by "R" Stamp Holder
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01-26	2001	2002	RB-3238(f)	Criteria for Determining Actual Thickness and Maximum Deterioration
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01-24	2001		RC-1110(a)	NDE of Tack Welds by Welders and Welder Operators
01-23	2001		RC-2031(a)(1)	Routine Repairs
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01-20	2001		RC-2031(a)(1)	Routine Repairs
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01-14	2001		RC-2082(b)	Repair Plan (Sec. VIII, Div. 2) AIA Acceptance
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01-11	2001		RC-3022	Re-rating Based on Joint Efficiency
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