Date Distributed: January 4, 2021

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD SUBGROUP PRESSURE RELIEF DEVICES

AGENDA

Meeting of January 12, 2021
San Antonio, TX

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

1. **Call to Order**

   8:00 AM

2. **Announcements**

   The National Board will be hosting a reception for committee members and their guests at 5:30pm on Wednesday.

3. **Adoption of the Agenda**

4. **Approval of Minutes from the July 14, 2020 Meeting**

5. **Review of the Roster (Attachments Page 1)**

   a. Nominations

   - Mr. Jay Simms is interested in becoming a member of SG PRD.

   b. Reappointments

   c. Resignations

6. **Items from Installation for PRD Consideration**

Item Number: 20-41	**NBIC Location: Part 1**	**Attachment Page 2**
General Description: Safety and Safety Relief Valves for Steam and Hot Water Heating Boilers. **Subgroup:** SG Installation **Task Group:** E. Wiggins (PM), J. Brockman, G. Tompkins **Explanation of Need:** Incorporation of applicable CSD-1 requirements. **July 2020 Meeting Action:** A summary was presented on this item to the SG and SC. A working session was held in the afternoon at the SG level. A proposal was generated in which the SG and SC would like PRD to review. It was also noted that "***3.9 PRESSURE RELIEF VALVES to See NBIC Part 1, 3.2 for the scope of pressure retaining items covered by these requirements"*** is incorrect. If you go to 3.2 it is **"*3.2 DEFINITIONS*"** not the Scope**. It should say to "*See NBIC Part 1, 3.1 SCOPE".*** Extensive discussions were held amongst the SG on this item. The proposal will be forwarded to T. Beirne of PRD for review. This item will be worked on in conjunction with item 20-43.		

Item Number: 20-43	NBIC Location: Part 1	Attachment Page 3

General Description: Safety Relief valve for Hot Water Supply Boilers

Subgroup: SG Installation

Task Group: W. Anderson (PM), E. Wiggins, J. Brockman

Explanation of Need: Incorporation of applicable CSD-1 requirements.

July 2020 Meeting Action: A summary was presented on this item to the SG and SC. A working session was held in the afternoon at the SG level. A proposal was generated in which the SG and SC would like PRD to review. Extensive discussions were held amongst the SG on this item. The proposal will be forwarded to T. Beirne of PRD for review. This item will be worked on in conjunction with item 20-41.

7. Action Items

Item Number: NB15-0305	NBIC Location: Part 4	No Attachment

General Description: Create Guidelines for Installation of Overpressure Protection by System Design.

Task Group: B. Nutter, A. Renaldo, D. Marek (PM), D. DeMichael, J. Wolf

Work continues on this item.

Item Number: NB15-0307	NBIC Location: Part 4	No Attachment

General Description: Create Guidelines for Repair of Pin Devices.

Task Group: D. McHugh (PM), A. Renaldo, T. Tarbay, R. McCaffrey, Jay Simms, C. Beair

A proposal was presented as a progress report. After some input from the committee a revised proposal will be letter balloted between meetings.

Item Number: NB15-0315	NBIC Location: Part 4, 2.5.6 and 2.6.6 and Part 1, 4.5.6 and 5.3.6	No Attachment

General Description: Review isolation Valve Requirements, and reword to allow installation of pressure relief devices in upstream piping.

Task Group: D. DeMichael (PM), B. Nutter, A. Renaldo, D. Marek

Work continues on this item.

Item Number: 17-115	NBIC Location: Part 4, Section 2	Attachments page 4

General Description: Complete rewrite of Section 2 combining common requirements into a general requirements section for all pressure relief devices and look at combining with 2.4.3, 2.4.4.

Task Group: A. Renaldo (PM), D. McHugh, D. Marek

Item was letter balloted to SG PRD and passed with two negatives. However negatives were related to formatting. Document was re-formatted to the satisfaction of the commenters and will be forwarded to SC-PRD for letter ballot.

Item Number: 17-119	NBIC Location: Part 4, 2.2.5 and Part 1, 2.9.1.4	No Attachment

General Description: States pressure setting may exceed 10% range. Clarify by how much.

Task Group: T. Patel (PM), D. Marek, J. Ball, R. Donaldson

ASME closed this item with no action however this committee decided to move forward with a proposal. J. Ball and R. Donaldson were added to the task group.

Item Number: 19-1	NBIC Location: Part 4, 4.8.5.4 & 4.8.6.1	Attachment Page 22

General Description: Develop specific content and scope of annual field audits.

Task Group: A. Donaldson (PM), D. Marek, A. Cox, P. Dhobi, M. Brodeur, T. Patel

Item was letter balloted between meetings and received several comments and negatives. A revised proposal will be letter balloted again between meetings.

Item Number: 19-37	NBIC Location: Part 4, 4.3.1 c) 4)	No Attachment

General Description: Origin of Replacement Parts for Pressure Relief Devices

Task Group: A. Cox (PM), T. Patel, P. Dhobi, J. Simms

Work continues on this item.

Item Number: 19-71	NBIC Location: Part 4, 4.9.2 & 4.9.3	Attachment Page 25

General Description: Use of Personnel from another VR Certificate Holder to perform VR Repairs.

Task Group: A. Donaldson (PM), A. Cox, B. Donaldson, D. Marek, J. Simms

Item will be letter balloted between meetings.

Item Number: 19-83	NBIC Location: Part 4, Part 1	No Attachment

General Description: Address alternate pressure relief valve mounting permitted by ASME CC2887-1.

Task Group: D. Marek (PM), T. Patel, J. Ball

Work continues on this item.

Item Number: 19-85	NBIC Location: Part 4, 2.3.6 j)	No Attachment

General Description: Thermal fluid heaters with no change of phase are not specifically addressed in 2.3.6 j).

Task Group: T. Patel (PM), B. Nutter

Work continues on this item.

8. New Business

Item Number: 20-56	**NBIC Location: Part 4, 2.3.6 j)**	**No Attachment**

General Description: Review and clarify requirements training program for T/O holders

Subgroup: PRD

Task Group: None

Explanation of Need: Need to align the T/O language with the new approved language in Section 4.

Item Number: 20-58	**NBIC Location: Part 4, 3.4 and 3.5**	**No Attachment**

General Description: Correct Paragraph numbers in Section 3 Related to T/O Requirements

Subgroup: PRD

Task Group: None

Explanation of Need: The paragraph hierarchy is incorrect. Section 3 is for all of in-service inspection and Section 3.3 is specifically for the T/O program. Current sections 3.4 and 3.5 are specific to the T/O program and should be a subordinate paragraph in the document.

9. Presentations

10. Future Meetings

July 12th-15th, 2021 – Cincinnati, OH
January 10th-13th, 2022 – TBD

11. Adjournment

Respectfully Submitted,

Thomas P. Beirne, P.E.
Secretary, NBIC Subgroup Pressure Relief Devices
pc: J. Amato
B. Weilgozinski
J. Ellis

Subgroup Pressure Relief Devices

Last Name	First Name	Interest Category	Role	Exp. Date	More
Beise	Kim	National Board Certificate Holders	Chair	07/30/2023	Details
Marek	Daniel	General Interest	Vice Chair	07/30/2023	Details
Beirne	Thomas		Secretary	06/29/2099	Details
Brodeur	Marianne	National Board Certificate Holders	Member	01/30/2023	Details
Cox	J. Alton	General Interest	Member	01/30/2023	Details
DeMichael	Denis	Users	Member	01/30/2023	Details
Dhobi	Prakash	National Board Certificate Holders	Member	10/30/2022	Details
Donaldson	Alfred	Manufacturers	Member	10/30/2022	Details
Donalson	Robert	Manufacturers	Member	01/30/2023	Details
McCaffrey	Raymond	General Interest	Member	01/30/2023	Details
McHugh	David	National Board Certificate Holders	Member	01/30/2023	Details
Nutter	Brandon	National Board Certificate Holders	Member	01/30/2023	Details
Patel	Thakor	Manufacturers	Member	01/30/2023	Details
Renaldo	Adam	Users	Member	01/30/2023	Details
Schirmer	Delton	Authorized Inspection Agencies	Member	01/30/2023	Details
Tarbay	Thomas	General Interest	Member	10/30/2022	Details
Wolf	Jon	Authorized Inspection Agencies	Member	01/30/2023	Details

Item Number: 20-41

ASME CSD-1 2018 Edition

CW-510 Requirements for Steam and Hot-Water Heating Boilers

The safety and safety relief valves of all steam and hot-water heating boilers shall conform to the ASME Boiler and Pressure Vessel Code, Section I or Section IV, as applicable.

NBIC Part I 2019 Edition

2.9.1 (~~c~~b[TB1]) Pressure relief valve shall be manufactured in accordance with a national or international standard and be certified for capacity ~~or flow resistance~~ [TB2]by the National Board.

3.9.2 ~~(a)~~ [TB3]Pressure Relief Valve requirements for steam heating boilers

(a) Pressure relief valve shall be manufactured in accordance with a national or international standard and be certified for capacity ~~or flow resistance~~ [TB4]by the National Board.

(b) The following general requirements pertain to installing, mounting and connecting pressure relief valves on heating boilers.[TB5]

(Note: certified for capacity or flow resistance by the NB is referenced in 4.5.1(a))[TB6]

NBIC Part 4 2019 Edition

2.2.1b) Pressure relief valves shall be manufactured in accordance with a national or international standard and be certified for capacity by the National Board.

2.4.2 a) Pressure relief valves shall be manufactured in accordance with a national or international standard and be certified for capacity by the National Board.

Item Number: 20-43

ASME CSD-1 2018 Edition

CW-510 Requirements for Hot-Water Supply Boilers

The safety and safety relief valves of all hot-water supply boilers shall conform to the ASME Boiler and Pressure Vessel Code, Section I or Section IV, as applicable.

Part 1, 2019 Ed.

3.9.3 (a) Pressure relief valve shall be manufactured in accordance with a national or international standard and be certified for capacity ~~or flow resistance~~ [TB1] by the National Board.

(Note: certified for capacity or flow resistance by the NB is referenced in Part 1, 4.5.1(a)) [TB2]

Part 4, 2019 Ed.

2.4.3 a) Pressure relief valves shall be manufactured in accordance with a national or international standard and be certified for capacity by the National Board.

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.

2.1.1 GENERAL REQUIREMENTS FOR INSTALLATION OF PRESSURE RELIEF DEVICES

2.1.1.1 RELIEF DEVICE DESIGN & NUMBER OF DEVICES

a) Pressure retaining items shall be equipped with one or more pressure relief devices unless the option for overpressure protection by system design is utilized (when permitted by the Jurisdiction and the original code of construction). Multiple isolatable chambers, or system portions with different maximum allowable working pressures, shall have their own pressure relief device(s) to protect the chambers under the most severe coincident conditions.
b) A pressure relief device and its associated piping shall 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. Piping shall be supported in a manner that avoids placing undue stress on the body of the pressure relief device.
c) Pressure relief devices shall be manufactured in accordance with a national or international standard.
d) Pressure relief devices shall have their capacity certified by the National Board unless otherwise permitted by the original code of construction
e) 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 system's contents.
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 properly vented and arranged to permit access for servicing
and normal operation of the valve.
g) A non-reclosing device (rupture disk) may be installed on the inlet and/or outlet of a pressure relief valve when permitted by the original code of construction. The reduction in capacity due to installation of the non-reclosing device shall be determined 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.

h) The effect of inlet pressure drop and discharge back pressure on relief device capacity shall be considered in the system design and relief device selection.
i) Twin pressure relief valves made by placing individual valves on Y-bases or duplex valves having two valves in the same body shall be of equal size.
j) 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.
k) Pressure relief devices 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.

2.1.1.2 DESIGN OF RELIEF DEVICE INLET LINES

a) Pressure relief devices shall be installed directly on, or as close as possible to, the pressure retaining item, and be installed so they are accessible for inspection, repair, or replacement. The opening in the pressure retaining item shall provide unobstructed flow to the pressure relief device. If multiple relief valves are installed on the same connection to the pressure retaining item, the opening 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) Inlet lines shall be as short and straight as possible. Inlet lines shall be properly supported in accordance with 2.1.1.1 b).

c) The opening through all pipes and fittings between a pressure retaining item 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.

d) When a pressure retaining item is fitted with one or more pressure relief devices 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 to have a cross sectional area not less than the combined areas of inlet connections of all the pressure relief devices with which it connects.

e) When a Y-base is used, the inlet area shall be not less than the combined outlet areas.

f) Inlets to pressure relief devices intended for use in compressible fluid or steam 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.

g) 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.

h) Unless permitted by the code of construction, the Jurisdiction, and the requirements specific to the type of pressure retaining item found in Section 2, there shall be no intervening stop valve or changeover valve between the pressure retaining item and its pressure relief device(s),

i) Where an intervening stop valve is permitted and used, it shall comply with 2.1.1.4.

j) Where a changeover valve is permitted and used, it shall comply with 2.1.1.5.

2.1.1.3 DESIGN OF RELIEF DEVICE DISCHARGE LINES

a) Discharge lines shall be as short and straight as possible. Discharge lines shall be properly supported in accordance with 2.1.1.1 b).

b) The opening through all discharge pipes and fittings shall have at least the area of the pressure relief device outlet. The characteristics of this downstream system shall be such that the pressure drop (back pressure) will not reduce the relieving capacity below that required or adversely affect the operation of the pressure relief device.

c) 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.

d) Discharge lines from pressure relief devices shall be designed to facilitate drainage and steam venting, or be fitted with drains (including valve body drains if necessary), to prevent liquid from collecting in the discharge side of a pressure relief device. Drain piping shall discharge to a safe location for the disposal of the fluids being relieved. There are additional requirements specific to boilers and heaters.

e) Where an intervening stop valve is permitted and used, it shall comply with 2.1.1.4.

f) Where a changeover valve is permitted and used, it shall comply with 2.1.1.5.

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 passages due to deposits. Mufflers shall not be used on high temperature water boiler pressure relief valves.

2.1.1.4 REQUIREMENTS FOR PRESSURE RELIEF STOP VALVES (WHERE PERMITTED)

a~~1~~) ~~These s~~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~~b) 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~~c) 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~~d) 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.

2.1.1.5 REQUIREMENTS FOR PRESSURE RELIEF CHANGEOVER VALVES (WHERE PERMITTED)

a) A changeover valve, which allows two redundant pressure relief valves to be installed for the purpose of changing from one pressure relief valve to the other while the pressure retaining item is operating, 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.

b) The changeover valve shall be designed such that there is no intermediate position where both pressure relief valves are isolated from the pressure retaining item.

c) The additional flow restriction caused by a changeover valve shall be considered in the system design.

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

a) Only direct spring loaded pressure relief valves or pilot operated pressure relief valves designed to relieve steam shall be used for steam service.

b) Pressure relief valves are valves designed to relieve either steam or water, depending on the application.

~~c) Pressure relief valves shall be manufactured in accordance with a national or international standard.~~[AR1]

~~d~~c) Deadweight or weighted-lever pressure relief valves shall not be used.

~~e~~d) For high temperature water boilers, pressure relief valves shall have a closed bonnet, and valve bodies
shall not be constructed of cast iron.

~~f~~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.

~~g) 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 properly vented and arranged to permit servicing and normal operation of the valve.~~[AR2]

2.2.2 NUMBER

At least one National Board capacity certified pressure relief valve shall be installed on the boiler in accordance with 2.1.1.1 a. If the boiler has more than 500 ft_2 (46 m_2) of 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.

2.2.3 LOCATION

~~a) Pressure relief valves shall be placed on, or as close as physically possible, to the boiler proper.~~

~~b~~a)[AR3] 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 2.2.4.1, 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 in lbs/hr of the pressure relief valves on a high temperature water boiler shall be determined by dividing the maximum output in Btu at the boiler nozzle obtained by the firing of any fuel for which the unit is designed by one thousand.

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 2.2.4.1

MINIMUM POUNDS OF STEAM PER HOUR PER SQUARE FOOT OF HEATING SURFACE
LB STEAM/HR FT_2 (KG STEAM/HR M_2)

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/ft_3(7.5MJ/m_3), 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/ft_2 (9085 J/cm_2) (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/$ft.^2$ (1136 J/cm_2) above 8000 Btu/$ft.^2$ (9085 J/cm_2) For units less than 7000 Btu/ft_2 (7950 J/cm_2), the factor from the table will be decreased by 1 (4.88).

• For watertube boiler units exceeding 16000 Btu/ft_2 (18170 J/cm_2)(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/$ft.^2$ (1136 J/cm_2) above 16000 Btu/$ft.^2$ (18170 J/cm_2). For units with less than 15000 Btu/$ft.^2$ (17034 J/cm_2), the factor in the table will be decreased by 1 (4.88) for every 1000 Btu/ft.2 (1136 J/cm_2) below 15000 Btu/$ft.^2$ (17034 J/cm_2).

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.~~[AR4] ~~The location shall be suitable for the service intended~~ [AR5]~~and shall provide the overpressure protection required.~~[AR6] ~~The pressure drop upstream of each pressure relief valve shall be considered in determining the set pressure and relieving capacity of that valve.~~[AR7] 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/ft_2 (29 kg steam/hr/m_2) 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

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 t~~T[AR8]he inlet pipe to the pressure relief valve shall be ~~be as short and straight as possible,~~[AR9]
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.~~[AR10]
d) No valves of any type except a changeover valve in accordance with 2.1.1.5 ~~as defined below~~ 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, which allows two redundant pressure relief valves to be installed for the purpose of changing from one pressure relief valve to the other while the boiler is operating, 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. The changeover valve shall be designed such that there is no intermediate position where both pressure relief valves are isolated from the boiler.~~[AR11]
e) When two or more pressure relief valves are used on a boiler, they should be mounted either separately
or as twin valves made by placing individual valves on Y-bases, or duplex valves having two valves in the same body casing. ~~Twin valves made by placing individual valves on Y-bases or duplex valves having two valves in the same body shall be of equal size.~~[AR12]
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.~~[AR13]
h) All pressure relief valves shall be piped to a safe point of discharge so located or piped as to be carried clear from running boards or platforms. 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 ironand 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.~~[AR14]

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. [AR15]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.[AR16]

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 DEVICES

Thermal fluid heaters shall be equipped with one or more pressure relief devices unless the option for overpressure
protection by system design is utilized (when permitted by the original code of construction). [AR17]When pressure relief devices are used, the following shall apply:

a) Pressure relief valve(s) shall be of a totally enclosed type and shall not have a lifting lever. A body drain
is not required.

b) Rupture disks may be installed upstream or downstream of the pressure relief valve(s) in accordance with the original code of construction.

c) Pressure relief valves and rupture disks 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.[AR18]

cd) The inlet connection to the valve shall be not less than NPS ½ (DN 15).

2.3.3 LOCATION

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

2.3.4 CAPACITY

The pressure relief device(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

a) When a single 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 set at or below the maximum allowable working pressure. The set pressure of the additional relief devices shall be such that the pressure cannot exceed the maximum
pressure permitted by the code of construction.

2.3.6 INSTALLATION

a) When a discharge pipe is used, the cross-sectional area 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 devices. Discharge piping shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.[AR19]

b) 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.~~[AR20]
~~c) 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.~~[AR21]
~~d) 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.~~[AR22]
~~e) 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.~~[AR23]
~~f) Discharge lines from pressure relief devices shall be designed to facilitate drainage or be fitted with low point or valve body drains to prevent liquid from collecting in the discharge side of a pressure relief device. Drain piping shall discharge to a safe location for the disposal of the fluids being relieved.~~[AR24]
g) The pressure relief discharge should be connected to a closed, vented storage tank or blowdown tank with solid piping (no drip pan elbow, or other air gap). When outdoor discharge is used, the following should be considered for discharge piping at the point of discharge:
1) Both thermal and chemical reactions (personnel hazard);
2) Combustible materials (fire hazard);
3) Surface drains (pollution and fire hazard);
4) Loop seal or rain cap on the discharge (keep both air and water out of the system);
5) Drip leg near device (prevent liquid collection); and
6) Heat tracing for systems using high freeze point fluids (prevent blockage).
h) A suitable condenser that will condense all the vapors discharged from the pressure relief valve may be
used in lieu of piping the vapors to the atmosphere.
i) In order to minimize the loss by leakage of material through the pressure relief valve, a rupture disk may be installed between the pressure relief valve and the vaporizer, provided the following requirements are met:
1) The cross-sectional area of the connection to a vaporizer shall be not less than the required relief area of the rupture disk.
2) The maximum pressure of the range for which the disk is designed to rupture shall not exceed the opening pressure for which the pressure relief valve is set or the maximum allowable working pressure of the vessel.
3) The opening provided through the rupture disk, after breakage, shall be sufficient to permit a flow equal to the capacity of the attached valve, and there is no chance of interference with the proper functioning of the valve, but in no case shall this area be less than the inlet area of the valve.
4) The space between a rupture disk and the valve shall be provided with a pressure gage, try cock, free vent, or a suitable telltale indicator. This arrangement permits the detection of disk rupture or leakage.

j) Pressure relief valve discharge capacity shall be determined from the following equation:
$W = CKAP \sqrt{(M/T)}$
Where:
A = discharge area of pressure relief valve
C = constant for vapor that is a function of the ratio of specific heats $k = c_p/c_v$.
Note: Where k is not known, k = 1.001.
K = coefficient of discharge for the valve design
M = molecular weight
P = (set pressure × 1.03) + Atmosphere Pressure
T = absolute temperature at inlet, °F + 460 (°C + 273)
W = flow of vapor
The required minimum pressure relief valve relieving capacity shall be determined from the following equation:
W = C x H x 0.75/h

Where:
C = maximum total weight or volume of fuel burned per hour, lb (kg) or ft^3 (m^3)
H = heat of combustion of fuel, Btu/lb (J/kg) or Btu/ft^3 (J/m^3)
h = latent heat of heat transfer fluid at relieving pressure, Btu/lb (J/kg)
W = weight of organic fluid vapor generated per hour
The sum of the pressure relief valve capacities marked on the valves shall be equal to or greater than W.

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

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

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.~~ [AR25]

~~b~~a) 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.

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.

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.

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). The inlet opening shall have an inside diameter equal to, or greater than, the seat diameter.
d) The minimum valve capacity in lbs/hr (kg/hr) shall be the greater of that determined by dividing the maximum Btu/hr (W) output 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 the lbs steam/hr/ft_2 (kg steam/hr/m_2) of boiler heating surface as given in Table 2.2.4.1. 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 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/ft_2 (kg steam/hr/m_2) as given in Table 2.2.4.1. 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 installer or the manufacturer 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, to a fitting connected to the water heater by a short nipple, to a Y-base, or to a valveless

header connecting water outlets on the same heater. 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

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 a Y-base is used, the inlet area shall be not less than the combined outlet areas.
c) 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

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.

NB-23

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.~~[AR26]

~~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.~~[AR27]

~~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 c) 2).~~[AR28]
~~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.~~[AR29]
~~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.~~[AR30]

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.

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.

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.~~[AR31] ~~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.~~[AR32]
~~b) A non-reclosing device installed between a pressure vessel and a pressure relief valve shall meet the requirements of 2.5.6 a).~~[AR33]
~~c) The opening in the pressure vessel wall shall be designed to provide unobstructed flow between the vessel and its pressure relief device.~~[AR34]
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 open, provided it also closes off that vessel from the source of the pressure.
5) 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) 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) 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

a) Each hot water storage tank shall be equipped with an ASME/NB certified temperature and pressure relief device set at a pressure not to exceed the maximum allowable working pressure and 210°F. (99°C).
b) The temperature and pressure relief device 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.~~[AR35]

~~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.~~[AR36]

2.6.3 LOCATION

Pressure relief devices, except those covered by NBIC Part 4, 2.1 through 2.2, may be installed at any location in the system provided the pressure in any portion of the system cannot exceed the maximum overpressure

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~~[AR37]
~~device shall not be isolated from the piping system except as permitted by 2.6.6 e).~~[AR38]

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.~~[AR39]
~~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.~~[AR40]

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.~~[AR41]
~~b) A non-reclosing device installed between a piping system and a pressure relief valve shall meet the requirements of 2.6.6 a).~~[AR42]
~~c) The opening in the pipe shall be designed to provide unobstructed flow between the pipe and its pressure~~
~~relief device.~~[AR43]
~~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).~~[AR44]
~~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:~~[AR45]

~~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.[AR46]

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.[AR47]

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.[AR48]

h) The reaction forces due to discharge of pressure relief devices shall be considered in the design of the inlet and discharge piping.[AR49]

i) Pressure relief devices shall be installed so they are accessible for inspection, repair, or replacement.[AR50]

Item 19-1. Develop specific content and scope of annual field audits.

4.8.6.1 AUDIT REQUIREMENTS

Initial Language

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.

Re-Circulation Ballot Proposal June 2020:

Table 4.8.5.4s addition

Records of audits of the Field Repair program.	The repair organization shall conduct audits of their Field Repair program on an annual basis. The quality manual shall define the audit criteria, scope, frequency and methods to ensure that the requirements of their quality system are met in the field. The exclusions as well as audit results shall be documented.	5 Years

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The repair organization shall conduct audits of their Field Repair program on an annual basis. The quality manual shall define the audit criteria, scope, frequency and methods to ensure that the requirements of their quality system are met in the field. The audit scope shall include, but not be limited to:

a) Performance testing in accordance with 4.6.1 of valve (s) that were repaired in the field to include each applicable ASME Code Section and Test Media defined on the certificate of authorization.

b) Lift assist testing in accordance with 4.6.3 of valve (s) that were repaired in the field.

c) Pressure test of parts in accordance with 4.6.4 of valves (s) that were repaired in the field.

d) Quality system requirements specific to field repair to include, but not limited to:

    a. 4.3.1: Replacement of critical parts including parts received from the owner-user

    b. 4.8.5.4 (i: Spring identification

    c. 4.8.6.2: Use of owner-user personnel

    d. 4.8.5.4 (r: Owner-user measurement and test equipment

e) VR special processes.

Mandatory items included in a), b), c), d), and e) may be excluded if outside the repair organization's scope. The exclusions as well as audit results shall be documented.

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 on an annual basis. The intent of these audits is to ensure work in the field is completed in accordance with the ~~to ensure that the requirements of the~~ Certificate Holder's quality system. ~~are met.~~ The scope and frequency of these audits shall be established in the quality system. 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.~~

a) Performance testing in accordance with 4.6 of valve (s) that were repaired in the field

b) Quality system requirements specific to field repair

c) Certificate Holder's applicable ASME Code sections, VR special process (if applicable in the field), and test medias from the Certificate of Authorization.

d) The audits shall be documented

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) Technicians qualified by ~~Qualified technicians in the employ of~~ the Certificate Holder in accordance with 4.9.2 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.

4.9 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.

4.10 Use of Personnel not in the Certificate Holder's employ

The repair organization may use the services of personnel not in their employ to assist the Certificate Holder's technicians in the performance of repairs provided:

a) The use of such personnel is addressed in the "VR" Certificate Holder's quality system
b) The personnel are qualified in accordance with 4.9.2. Records of this qualification are to be retained in accordance with 4.8.5.4 (s)
c) The personnel work under direct supervision and control of the 'VR" Certificate Holder
d) The "VR" Certificate Holder shall have the authority to assign and remove personnel at its own discretion
e) The names of the personnel utilized are recorded on the documents as required by the quality system

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e) The names of the personnel utilized are recorded on the documents as required by the quality system

4.9 COMPETENCY, TRAINING AND QUALIFICATION OF PERSONNEL

4.9.1 COMPETENCY OF PERSONNEL

The repair organization shall establish the skills, knowledge, competencies, and method to evaluate competencies required for each position within the organization having direct effect on the quality of pressure relief repair performed in accordance with the Certificate of Authorization.

4.9.2 CONTENTS OF TRAINING PROGRAM

The repair organization shall establish a documented training program to ensure the defined skills, knowledge and competencies are achieved. As a minimum, training objectives for each position shall include:

a) Applicable ASME Code requirements;
b) Applicable NBIC requirements;
c) Individual responsibilities of each function described within the organization's quality system;
d) Technical aspects for the applicable position held;
e) Mechanical skills for the applicable position held;
f) Special processes as applicable listed on the Certificate of Authorization.

4.9.3 INITIAL EVALUATION AND ACCEPTANCE OF PERSONNEL

The repair organization shall complete an initial evaluation and acceptance of each individual's skills and competency prior to the individual being assigned to work without direct supervision. This evaluation and acceptance shall be documented.

4.9.4 ANNUAL EVALUATION AND ACCEPTANCE OF PERSONNEL

The repair organization shall complete an annual evaluation and acceptance of each individual's skills and competency to verify proficiency as well as compliance with the certificate Holder's quality system. This evaluation shall include training records, documented evidence of work performed and on-the-job observations to demonstrate competency. The evaluation shall be documented.