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THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD SUBGROUP PRESSURE RELIEF DEVICES

MINUTES

Meeting of July 14, 2020
Louisville, KY

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614)888-8320
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1. **Call to Order**

The meeting was called to order at 8:30 AM on Tuesday July 14, 2020 by Chair Kim Beise
Members and Visitors in attendance can be found on the attendance sheet (Attachments Page 1).

2. **Announcements**

Mr. Beise announced the National Board will be hosting a reception for all committee members and visitors on Wednesday evening at 5:30pm in the Crystal Ballroom.

3. **Adoption of the Agenda**

The agenda dated July 6, 2020 was presented. A motion was made and seconded to adopt the agenda. The motion was unanimously approved.

4. **Approval of Minutes**

It was moved and seconded to approve the January 2020 minutes. The motion was unanimously approved.

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

a. Nominations

- There are no nominations.

b. Reappointments

- Mr. Kim Beise and Mr. Dan Marek have memberships set to expire on July 30, 2020. Both indicated they would like to continue to serve on SG PRD. This is on the SC PRD for vote.

c. Resignations

- There are no resignations.

6. **Interpretations**

- Item 20-19 was changed from an interpretation to action item and can be found under new items.

7. **Action Items**

Item Number: NB12-0901	**NBIC Location: Part 4**	**Attachment pages 2-7**
General Description: Prepare a guide for repair of tank vents **Task Group:** B. Donalson (PM), D. DeMichael, K. Beise, B. Nutter, J. Little, S. Artrip, B. Pittel Item was letter balloted to SC-PRD and had comments and one negative which were responded to. A motion was made and seconded to reaffirm the proposal with no changes. After discussion a vote was taken and the motion unanimously passed.		

Item Number: NB14-0602B	NBIC Location: Part 2	Attachments page 8

General Description: Improve index in Part 2 relating to pressure relief devices

Task Group: D. Marek (PM), B. Donalson, D. DeMichael

Mr. Marek presented a proposal. A motion was made and seconded to accept the attached proposal. After discussion a vote was taken and the motion unanimously passed.

Item Number: NB15-0108B	NBIC Location: Part 1	No Attachment

General Description: Address pressure relief devices in new supplement on high temperature hot water boilers

Task Group: D. Marek (PM), A. Renaldo, D. McHugh, B. Nutter, A. Cox, D. Schirmer

A motion was made and seconded to close this item with no action. After discussion a vote was taken and the motion unanimously passed.

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: NB15-0308	NBIC Location: Part 4	No Attachment

General Description: - Create Guidelines for Installation of Pressure Relief Devices for Organic Fluid Vaporizers.

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

Corresponding ASME item has been approved. Webex to be set up with task group members and chairs of SG/SC PRD and SG/SC Installation to work on item.

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: NB15-0321	**NBIC Location: Part 4, 3.2.5 a) and Part 2, 2.5.7 a)**	**Attachments pages 9-18**

General Description: Review testing requirements for in-service testing of pressure relief devices

Task Group: A. Cox, A. Renaldo (PM), D. Marek, S. Irvin, D. DeMichael, B. Nutter, J. Ball

Item was balloted in Main Committee between meetings, but had some negatives. A motion was made and seconded to accept the revised proposal incorporating comments. After discussion a vote was taken. The motion unanimously passed.

Item Number: 17-115	**NBIC Location: Part 4, Section 2**	**Attachments pages 19-36**

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: 17-128	**NBIC Location: Part 4, 2.4.4.3 and Part 1, 3.9.4.3**	**Attachments Page 37**

General Description: allows Y-base to be used while 2.4.1.6 a) prohibits. This appears to be a conflict.

Task Group: B. Nutter (PM), S. Irvin

Item was letter balloted to Main Committee and received several comments and some negatives. The comments were addressed and no changes were made to the proposal. It will be presented to Main Committee for second consideration.

Item Number: 18-73	**NBIC Location: Part 4, 2.3 and Part 1, S5.7.6**	**Attachments pages 38-44**

General Description: Update installation requirements for Thermal Fluid Heaters

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

Item was revised based on SG/SC Installation's comments and letter balloted SG/SC PRD as well as SG/SC Installation. PRD ballot passed unanimously. Installation ballot did not have quorum. If Installation approves item this will be moved to Main Committee for consideration.

Item Number: 18-80	NBIC Location: Part 4, S4.1, S5.1, S6.1	Attachments Pages 45-46

General Description: Addition of a "Scope" section to Part 4, S4.1, S5.1, and S6.1 to stay consistent with other sections

Task Group: T. Patel (PM), A. Renaldo, P. Dhobi

Item was letter balloted to Main Committee and drew a few negatives. A revised proposal was presented. A motion was made and accepted to accept the attached proposal. After discussion a vote was taken and the motion unanimously passed.

Item Number: 19-1	NBIC Location: Part 4, 4.8.5.4 & 4.8.6.1	No Attachment

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: 19-2	NBIC Location: Part 4, 4.9.1	Attachments page 47

General Description: Review and clarify requirements for documented training program for VR program.

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

Item was letter balloted between meetings and was unanimously approved. This will be forwarded to SC PRD for vote.

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	No Attachment

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: 20-9	NBIC Location: Part 1-4, 9.1 Definitions	Attachments page 48
General Description: Define Verify in NBIC Glossary **Task Group:** N. Carter (PM) A motion was made to accept the attached proposal. After discussion a vote was taken and the motion unanimously passed.		

Item Number: 20-19	NBIC Location: Part 4, 2.3.6 j)	Attachments page 49
General Description: Purpose of NBIC Part 4, 4.8.5.4 n)2) & 3.3.3.4 l)2) system review **Task Group:** None A motion was made to accept the attached proposal. After discussion a vote was taken and the motion unanimously passed.		

9. Presentations

There were no presentations made at this meeting.

10. Future Meetings

January 11th – 14th, 2021 – New Orleans, LA
July 12th-15th , 2020 – Cincinnati, OH

11. Adjournment

A motion was made, seconded, voted on, and unanimously passed to adjourn the meeting at approximately 5:00 PM.

Respectfully Submitted,

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

NBIC Subgroup PRD Attendance - 7/14/2020					
First Last	Email	Company	Phone #	Signature	Attending Reception?
Kim Beise	kbeise@dowcovalve.com	Dowco Valve Company	651 261-1859	Webex	
Marianne Brodeur	Marianne@ivicorp.net	International Valve & Instrument Corp.	413 736-3682	In Person	
J. Alton Cox	alton@jaltoncox.com	JAC Consulting	704 301-8532		
Denis DeMichael	Denis.B.DeMichael@chemours.com	Chemours Co.	302 773-3156	Webex	
Robert Donalson	bob.donalson@emerson.com	Emerson	281 274-4645	Webex	
Daniel Marek	daniel.t.marek@nasa.gov	Mainthia Technologies	216 433-5494	Webex	
Raymond McCaffrey	raymond@qualityvalve.com	Quality Valve	251 476-1045		
David McHugh	mchughd@alliedvalve.com	Allied Valve	312 520-0235	Webex	
Brandon Nutter	Brandon.K.Nutter-1@dupont.com	E.I. Dupont	804 383-3570	Webex	
Thakor Patel	Tpatel@Curtisswright.com	Farris Engineering	440 838-5090	Webex	
Adam Renaldo	adam_renaldo@praxair.com	Praxair	716 879-2928	Webex	
Alfred Donaldson	alfred.donaldson@bhge.com	Baker Hughes	832 360-7892	Webex	
Thomas Beirne	tbeirne@nationalboard.org	The National Board	614 431-3239		
Prakash Dhobi	Prakash.dhobi@lakesidecontrols.com	Lakeside Process Controls	519 823-4251	Webex	
Thomas Tarbay	trtarbay@yahoo.com	TRT Consultants	614 353-0027	In Person	
Jon Wolf	jon.wolf@zurichna.com	Zurich Services Corporation	920 253-8781	Webex	
Delton Schirmer	Del.Schirmer@BoilerProperty.com	XL Insurance	651 666-9824	In Person	
Joe Ball				Webex	
Jay Simms				Webex	

Task Group Item NB12_0901 Repair guidelines for weight-loaded pressure/vacuum vent type pressure relief valve.

S4.1 Introduction

a) 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 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.

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

c) S4.2 contains recommended procedures for the repair of spring-loaded pressure relief valves, and S4.3 contains recommended procedures for the repair of pilot operated types of pressure relief valves, and S4.4 contains recommended procedures for the repair of weight loaded vents. Information on packaging, shipping and transportation is included in ~~as~~ S4.5.

S4.2 SPRING-LOADED PRESSURE RELIEF VALVES (No change)

S4.3 PILOT OPERATED PRESSURE RELIEF VALVES (No change)

S4.4 WEIGHT LOADED VENTS

The procedures provided in S4.4 are general guidelines. The manufacturer's information, when available, should be used for detailed instructions based on the vent type and design.

CAUTION: Weight loaded vents are often exposed to hazardous media. An SDS (safety data sheet) should be provided to the repair organization prior to the commencement of any work. If the vent has been exposed to hazardous media, it should be fully decontaminated prior to inspection and disassembly. If the vent has not been fully decontaminated, safety precautions should be taken to adequately protect repair personnel.

a) External inspection
    1) All external components should be inspected for damage and corrosion.
    2) Record manufacturer's nameplate information, such as model, serial number, set point, flow rate, etc. on the repair traveler.
    3) Record previous repair nameplate information on the repair traveler.

b) Pre-Disassembly Test
    1) Weight loaded vents should be tested prior to disassembly to verify the pressure and/or vacuum setting. . Also, the vents should be inspected for signs of leakage from the pressure and/or vacuum port. The test results should be recorded on the repair traveler.

c) Disassembly
    1) Safety practices and equipment applicable to the work being performed should be considered prior to commencing the repair. Each vent should be disassembled to the extent necessary for thorough examination. Measures should be taken to ensure traceability and segregation between pressure and vacuum components of the vent assembly.

    2) Pressure Side Disassembly (as applicable)
        a. Secure assembly for removal of internal parts.
        b. Remove pressure weather hood and screen or cover as applicable.
        c. Remove weights from pressure side pallet, and place in appropriate bin to maintain traceability and segregation from vacuum side parts. Maintain the order in which the weights are stacked if varying sizes, types and/or thickness of weights are used.
        d. Remove and disassemble pressure pallet assembly, and place in bin to maintain traceability and segregation from vacuum side parts.
        e. Remove pressure seat if applicable and guiding components.

    3) Vacuum Side Disassembly (as applicable)
        a. Secure the vent assembly for removal of internal parts.
        b. Remove vacuum cover and screen as applicable.
        c. Remove weights from vacuum side pallet, and place in appropriate bin to maintain traceability and segregation from pressure side parts. Maintain the order in which the weights are stacked if varying sizes, types and/or thickness of weights are used.
        d. Remove and disassemble vacuum pallet assembly, and place in bin to maintain traceability and segregation from pressure side parts.
        e. Remove vacuum seat if applicable and guiding components.

d) Cleaning

1) Care should be exercised to avoid damage to components (i.e. nameplates, seating/sealing surfaces, delicate components, etc.) caused by the cleaning method used.
2) Cleaning method used for weights is dependent on material of construction.

e) Internal Inspection

1) Vent seats and sealing surfaces should be inspected for signs of corrosion, erosion, pitting, scratches, cuts, or other damage that would create a leak path.

2) Main body, guiding components, and all pressure retaining attachments should be inspected for signs of wear, corrosion, erosion, pitting, cracks, or other damage that could affect proper operation.

3) Nonmetal components including diaphragms, O-rings, and gaskets should be inspected for holes, tears, signs of abnormal wear, or chemical attacks associated with process conditions.

f) Repair

1) Vent seats should be lapped to ensure they are flat.

2) Metal and non-metal components that are damaged should be replaced.

g) Assembly

If applicable, before beginning the reassembly process, weigh the pallet assembly including the weights, for pressure and/or vacuum setting. The manufacturer's weight calculations should be used, and the calculated weight for each setting should be recorded on the repair traveler.

1) Vacuum Side Assembly (as applicable)
   a. Secure the vent assembly for safe assembly of internal parts.
   b. Install vacuum seat and guide as required.
   c. Assemble and install the vacuum pallet assembly into the main vent body.
   d. Install weights on vacuum side pallet assembly. Stack weights from the largest diameter against the pallet.
   e. Install vacuum side cover cap, and screen if applicable.

2) Pressure Side Assembly (as applicable)
   a. Secure the vent for assembly of internal parts.
   b. Install pressure seat if applicable and guides.
   c. Assemble and Install pressure pallet assembly into main body.
   d. Install weights on pressure pallet assembly. Stack weights from the largest diameter against the pallet.

e. Install pressure weather hood and screen or cover as applicable.

h) Testing

1) General Information

a. Test equipment used to perform pressure and/or vacuum testing should be of adequate size to safely secure the vent during testing.

b. All flow meters and pressure/vacuum test gages used should cover the flow rates, and pressure ranges for the vents being tested. Test equipment should be calibrated and traceable to NIST standards.

2) Set Pressure Verification

a. After final assembly, mount the vent on test stand.

b. To check settings, increase pressure or vacuum on the test stand.

1. The pressure setting shall be the test gauge pressure at which an increase in flow rate no longer increases gauge pressure.
2. The vacuum setting shall be the test gauge pressure at which an increase in flow rate no longer decreases gauge pressure.

c. Pallet assembly weight may need to be adjusted to meet pressure/vacuum setting as required.

d. If weight adjustments are made the vent should be retested.

e. Record set pressure/vacuum on repair traveler.

3) Seat Tightness Verification

a. Slowly increase the tank pressure to a minimum of 75% of vent set pressure.

b. While maintaining 75% of set pressure for one minute ensure the test leak rate is in accordance with Table 1. This table applies to seat leakage testing for both pressure and vacuum. If the vent fails to meet leak-rate testing, it must be disassembled and repaired. This table complies with the requirements of API 2000.

c. Record leak rates on the repair traveler for both pressure and vacuum as applicable.

Table 1: Test Flow Rate Specifications

Vent Size mm (in.)	**Test Leak-Rate** m^3/h (scfh)
≤ 150 (6)	0.014 (0.5)
200 – 400 (8 - 16)	0.142 (5.0)
> 400 (16)	0.566 (20)

i) Sealing

Tamper proof seals should be used to prevent tampering of external adjustments after the vent has been serviced and tested.

j) Repair Nameplate

1) Repaired by (organization performing repair)
2) Unique identification number
3) Date of repair
4) Model/Type (if changed)
5) Pressure setting (if applicable)
6) Vacuum setting (if applicable)

~~S4.4~~S4.5 PACKAGING, SHIPPING AND TRANSPORTATION OF PRESSURE RELIEF DEVICES

a) The improper packaging, shipment, and transport of pressure relief devices can have detrimental effects on device operation. Pressure relief devices should be treated with the same precautions as instrumentation, with care taken to avoid rough handling or contamination prior to installation.

b) The following practices are recommended for spring loaded pressure relief valves and pilot operated pressure relief valves:

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 the appropriate standards and/or owner procurement requirements.

c) The following practices are recommended for weight loaded vents:

1) Vents should be securely fastened to pallets in the vertical position to avoid side loads on guiding surfaces, or otherwise securely packaged and cushioned during transport.

2) Weights packaged and shipped separately should be marked or labeled as either pressure, or vacuum prior to shipment. These segregated weights should be installed at the time of field installation, paying close attention as to whether they are pressure or vacuum weights.

3) All shipping blocks, metal bands, protective inserts, and inlet/outlet protective covers that may be used for shipment must be removed prior to placing the vent in service.

NB14-0602B: Improve index in Part 2 relating to pressure relief devices

Suggested updates are in RED:

Blowdown
(2.2.10.3), (2.2.10.6), (2.2.12.2), (2.2.12.3), ~~(2.2.12.7),~~ (S2.4.3), (S2.7.1), ~~(S2.8.1),~~ (S2.9), (S2.11), (S2.13.1.2), (S2.14.7), (S2.14.12), ~~(S8.2),~~ ~~(S8.3),~~ ~~(S8.5)~~

Blowdown – Pressure Relief Devices
(2.2.12.7), (S2.8.1), (S2.11), (S8.2), (S8.3), (S8.5)

Burst Pressure – Rupture Disk
(S6.16.6), (2.5.5.4), (S6.16.9),

Capacity
(2.2.12.2), ~~(2.3.6.2),~~ (2.3.6.7.a), ~~(2.5.2), (2.5.4),~~ ~~(2.5.5.4),~~ ~~(2.5.7),~~ (5.3.4), ~~(S1.6), (S2.8.1), (S2.11),~~ ~~(S2.15),~~ (S5.3.1), (S5.3.3), (S6.8), (S6.13.11.2), (S6.13.11.3), (S6.13.11.4), (S6.15.1), (S6.15.4), ~~(9.1)~~

Capacity – Pressure Relief Devices
(2.3.6.2), (2.3.6.7.b.2), (2.3.6.2.10), (2.5.2), (2.5.4), (2.5.5.4), (2.5.7), (S1.6), (S2.8.1), (S2.11), (S2.14.16), (S2.15), (9.1), Form NB-5, Form NB-6, Form NB-7

Conversion – Units of Measure
(7.2), (7.3), ~~(9.1)~~

Conversion - Pressure Relief Device
(9.1)

Interval

Inspection/Time Interval
(2.5.5.4), (2.5.8), (2.5.8.1), (S6.4.7.5.1), (Index needs to be developed for non-PRD)

Test Interval – Pressure Relief Devices
(2.2.10.6), (2.5.8), (2.5.8.1), (S2.11)

Service Interval – Pressure Relief Devices
(2.5.8.2), (S2.11)

Pressure Relief Device Data
(2.5.1), (2.5.2)

Rupture ~~Discs~~Disks
Both Rupture Disc and Rupture Disk are both used thru out Part 2; Rupture Disk is more prevalent in body text yet not in the index. Spelling preference should be determined and index adjusted to reflect.
(S6.4.7.5.3), (S6.15.1), (S6.15.3.3), (S6.15.3.5)

NB15-0321
Final SG+SC Approved
7-14-20

PART 4

3.2.4.4 ~~RUPTURE DISKS~~NON-RECLOSING PRESSURE RELIEF DEVICES

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

No changes under 3.2.4.4 g)1) through g)10). New text as follows under 3.2.4.4 g)11) through g)14).

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

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

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

3.2.5 GENERAL CONSIDERATIONS FOR TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF DEVICES

a) Pressure relief devices shall be subject to periodic inspection and/or testing based upon the type of device. ~~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~~ is performed at a test facility, the record of this test should be reviewed to ensure the ~~valve~~ device meets the requirements of the original code of construction. ~~Valves~~ Devices 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~~ device shall be disassembled, cleaned, ~~and~~ decontaminated, repaired, and reset.

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

3.2.5.1 TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF VALVES

In addition to 3.2.5, the following apply to testing and operational inspection of pressure relief valves.

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) 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.

~~c~~c) 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.

~~d~~d) 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~~e) 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~~f) Upon completion of set pressure testing, all pressure relief valve gags shall be removed. Any stop valves used to isolate lower set pressure relief devices shall be reopened (and locked, if applicable).

3.2.5.2 TESTING AND OPERATIONAL INSPECTION OF NON-RECLOSING PRESSURE RELIEF DEVICES WITH PINS OR BARS

In addition to 3.2.5, the following apply to testing and operational inspection of non-reclosing PRDs with pins or bars.

a) Periodic set point testing is not required since pins or bars are single use.

b) Periodic inspection shall be per 3.2.4.4.

c) Non-reclosing PRDs shall be periodically inspected by the owner for freedom of motion. Freedom of motion inspection frequency shall be per 3.2.6.

1) Remove pressure from the PRD, or remove the PRD from service, prior to performing this check.

2) Remove the pin or bar.

3) Manually exercise the sealing mechanism to ensure it is capable of its full range of motion.

4) Reinstall the pin or bar or replace with new. Replacement pin or bar shall be per manufacturer recommendation.

5) Restore pressure to the PRD.

6) The PRD should be checked for seat leakage following restoration of pressure.

d) The owner may elect to have a non-reclosing PRD tested periodically in order to determine service life of the device. Such tests should ensure that the PRD is 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 and seat leakage evaluation. Tolerances specified for these operating requirements in the original code of construction should be used to determine the acceptability of test results.

3.2.5.3 TESTING AND OPERATIONAL INSPECTION OF RUPTURE DISKS

In addition to 3.2.5, the following apply to testing and operational inspection of rupture disks.

a) Periodic testing of rupture disks is not required

b) Rupture disks shall be subject to periodic inspection per 3.2.4.4.

c) The owner may elect to have a rupture disks tested periodically in order to determine service life. Such tests should ensure that the disk is free to operate inside its holder and will operate in accordance with the requirements of the original code of construction. Testing should include an evaluation of leakage through the disk (e.g. due to cracks or porosity), followed by device opening or burst pressure at rated temperature. Tolerances specified for these operating requirements in the original code of construction should be used to determine the acceptability of test results.

d) If PRDs are not tested on the system using the system fluid, the following test mediums shall be used:

1) Air and gas service PRDs: air, nitrogen, or other suitable gas;

2) Liquid service PRDs: water or other suitable fluid.

3.2.5.~~1~~ 4 CORRECTIVE ACTION

a) If a ~~valve~~ pressure relief valve or a pin device 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~~ device shall be taken.

b) If a pressure relief device leaks, the owner shall be notified and decide what corrective action (if any) will be taken.

PART 2

2.5.5.4 ~~RUPTURE DISKS~~NON-RECLOSING PRESSURE RELIEF DEVICES

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

No changes under 2.5.5.4 g)1) through g)10). New text as follows under 2.5.5.4 g)11) through g)14).

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

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

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

2.5.7 GENERAL CONSIDERATIONS FOR TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF DEVICES

a) Pressure relief devices shall be subject to periodic inspection and/or testing based upon the type of device. ~~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~~ is performed at a test facility, the record of this test should be reviewed to ensure the ~~valve~~ device meets the requirements of the original code of construction. ~~Valves~~ Devices 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~~ device shall be disassembled, cleaned, ~~and~~ decontaminated, repaired, and reset.

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

2.5.7.1 TESTING AND OPERATIONAL INSPECTION OF PRESSURE RELIEF VALVES

In addition to 2.5.7, the following apply to testing and operational inspection of pressure relief valves.

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) 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.

~~c~~c) 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~~d) 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~~e) 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~~f) Upon completion of set pressure testing, all pressure relief valve gags shall be removed. Any stop valves used to isolate lower set pressure relief devices shall be reopened (and locked, if applicable).

2.5.7.2 TESTING AND OPERATIONAL INSPECTION OF NON-RECLOSING PRESSURE RELIEF DEVICES WITH PINS OR BARS

In addition to 2.5.7, the following apply to testing and operational inspection of non-reclosing PRDs with pins or bars.

a) Periodic set point testing is not required since pins or bars are single use.

b) Periodic inspection shall be per 2.5.5.4.

c) Non-reclosing PRDs shall be periodically inspected by the owner for freedom of motion. Freedom of motion inspection frequency shall be per 2.5.5.4.

1) Remove pressure from the PRD, or remove the PRD from service, prior to performing this check.

2) Remove the pin or bar.

3) Manually exercise the sealing mechanism to ensure it is capable of its full range of motion.

4) Reinstall the pin or bar or replace with new. Replacement pin or bar shall be per manufacturer recommendation.

5) Restore pressure to the PRD.

6) The PRD should be checked for seat leakage following restoration of pressure.

d) The owner may elect to have a non-reclosing PRD tested periodically in order to determine service life of the device. Such tests should ensure that the PRD is 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 and seat leakage evaluation. Tolerances specified for these operating requirements in the original code of construction should be used to determine the acceptability of test results.

2.5.7.3 TESTING AND OPERATIONAL INSPECTION OF RUPTURE DISKS

In addition to 2.5.7, the following apply to testing and operational inspection of rupture disks.

a) Periodic testing of rupture disks is not required

b) Rupture disks shall be subject to periodic inspection per 2.5.5.4.

c) The owner may elect to have a rupture disks tested periodically in order to determine service life. Such tests should ensure that the disk is free to operate inside its holder and will operate in accordance with the requirements of the original code of construction. Testing should include an evaluation of leakage through the disk (e.g. due to cracks or porosity), followed by device opening or burst pressure at rated temperature. Tolerances specified for these operating requirements in the original code of construction should be used to determine the acceptability of test results.

d) If PRDs are not tested on the system using the system fluid, the following test mediums shall be used:

1) Air and gas service PRDs: air, nitrogen, or other suitable gas;

2) Liquid service PRDs: water or other suitable fluid.

2.5.7.~~1~~ 4 CORRECTIVE ACTION

a) If a ~~valve~~ pressure relief valve or a pin device 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~~ device shall be taken.

b) If a pressure relief device leaks, the owner shall be notified and decide what corrective action (if any) will be taken.

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.
i) 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.~~

~~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~~

Comment [AR1]: [this is now covered by a general requirement] 2.1.1.1c Pressure relief devices shall be manufactured in accordance with a national or international standard.

~~valve may be shielded with a cover. The cover shall be properly vented and arranged to permit servicing and normal operation of the valve.~~

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) 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)
Stoker-fired	7 (34)
Oil, gas, or pulverized fuel-fired	8 (39)
Waterwall Heating Surface	

Comment [AR2]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR3]: [this is now covered by a general requirement] 2.1.1.2 a) Pressure relief devices shall be installed directly on, or as close as possible to, the pressure retaining item…

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. 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/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

Comment [AR4]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR5]: [this is now covered in greater detail under general requirements] 2.1.1.2 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.

Comment [AR6]: [this is now covered by a general requirement] 2.1.1.1 a) Pressure retaining items shall be equipped with one or more pressure relief devices…

Comment [AR7]: [this is now covered by a general requirement] 2.1.1.1 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.

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~~The inlet pipe to the pressure relief valve shall ~~be~~ 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 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.~~

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.~~

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 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.~~

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~~

Comment [AR8]: [this is now covered in greater detail under general requirements] 2.1.1.2 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.

Comment [AR9]: [this is now covered in greater detail under general requirements] 2.1.1.2 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).

Comment [AR10]: [this is now covered in greater detail under general requirements] 2.1.1.3 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 o ...

Comment [AR11]: [this is now covered in greater detail under general requirements] **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 fro ...

Comment [AR12]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR13]: [this is now covered by a general requirement] 2.1.1.1 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 ...

Comment [AR14]: [this is now covered by a general requirement] 2.1.1.3 d) Discharge lines from pressure relief devices shall be designed to facilitate drainage and steam venting, or be fitted with 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 ...

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 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). 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.

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.

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.

c) When two or more required pressure relief devices are placed on one connection, the inlet cross-sectional

Comment [AR15]: [this is now covered by a general requirement] 2.1.1.3 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.

Comment [AR16]: [this is now covered by a general requirement] 2.1.1.1 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 ...

Comment [AR17]: [this is now covered by a general requirement] 2.1.1.1 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 ...

Comment [AR18]: [this is now covered by a general requirement] 2.1.1.1 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 ...

Comment [AR19]: [this is now covered in greater detail under general requirements] 2.1.1.3 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 ...

Comment [AR20]: [this is now covered in greater detail under general requirements] 2.1.1.2 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 ...

~~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.~~

~~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.~~

~~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.~~

~~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.~~

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)

Comment [AR21]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR22]: [this is now covered in far greater detail by a general requirement] 2.1.1.2 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.
2.1.1.3 d) Discharge lines from pressure relief devices shall be designed to facilitate drainage and steam venting, or be fitted with 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. There are additional requirements specific to boilers and heaters.

Comment [AR23]: [this is now covered under general requirements] 2.1.1.3 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.

Comment [AR24]: [this is now covered under general requirements] 2.1.1.3 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.

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.~~

~~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.

Comment [AR25]: [this is now covered by a general requirement] 2.1.1.1 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.

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.

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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.

Comment [AR26]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR27]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR28]: [this is now covered by a general requirement] 2.1.1.2 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.

Comment [AR29]: [this is now covered by a general requirement] 2.1.1.2 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.

Comment [AR30]: [this is now covered by a general requirement] 2.1.1.2 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.

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. 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 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

Comment [AR31]: [this is now covered by a general requirement] 2.1.1.2 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.

Comment [AR32]: [this is now covered by a general requirement] 2.1.1.3 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.

Comment [AR33]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR34]: [this is now covered in greater detail by a general requirement] 2.1.1.2 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. ...

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.~~

~~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.~~

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~~

Comment [AR35]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR36]: [this is now covered by a general requirement] 2.1.1.1 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.

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 those 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

Comment [AR37]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR38]: [this is now covered by a general requirement] 2.1.1.2 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 va ...

Comment [AR39]: [this is now covered by a general requirement] 2.1.1.1 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 ...

Comment [AR40]: [this is now covered by a general requirement] 2.1.1.1 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. ...

Comment [AR41]: [this is now covered by a general requirement] 2.1.1.2 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 ...

Comment [AR42]: [this is now covered by a general requirement] 2.1.1.1 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 ...

Comment [AR43]: [this is now covered in greater detail by a general requirement] 2.1.1.2 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 f ...

Comment [AR44]: [this is now covered by a general requirement] 2.1.1.1 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 ...

Comment [AR45]: [this is now covered in far greater detail by a general requirement] 2.1.1.2 h) Unless permitted by the code of construction, the Jurisdiction, and the requirements specific to the type of pressure retaining item found in Section ...

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.

Comment [AR46]: Moved in it's entirety to 2.1.1.4

Comment [AR47]: [this is now covered under general requirements] 2.1.1.3 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.

Comment [AR48]: [this is now covered under general requirements] 2.1.1.3 d) Discharge lines from pressure relief devices shall be designed to facilitate drainage and steam venting, or be fitted with 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. There are additional requirements specific to boilers and heaters.
2.1.1.3 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.

Comment [AR49]: [this is now covered by a general requirement] 2.1.1.1 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.

Comment [AR50]: [this is now covered by a general requirement] 2.1.1.2 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- ...

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1-14-2020

Part 4:

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)~~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.~~

Part 1:

3.9.4.3 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)~~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.~~

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PART 4

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~~VALVES

Thermal fluid heaters shall be equipped with one or more pressure relief ~~devices~~ valves unless the option for overpressure protection by system design is utilized (when permitted by the original code of construction). When pressure relief ~~devices~~ valves 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) A lifting lever shall not be used in pressure relief valve(s). 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.

d) Cast iron fittings shall not be used.

e) Copper and copper alloys shall not be used.

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

2.3.3 LOCATION

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

2.3.4 CAPACITY

The pressure relief ~~device(s)~~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

a) When a single relief ~~device~~ 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 ~~device~~ valve is provided to obtain the required capacity, only one pressure relief ~~device~~ valve set pressure needs to be set at or below the maximum allowable working

pressure. The set pressure of the additional relief ~~devices~~ valves shall be such that the pressure cannot exceed the maximum pressure permitted by the code of construction.

2.3.6 INSTALLATION

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. ~~When a discharge pipe is used, t~~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 ~~devices~~valves. Discharge piping shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief ~~device~~valve.

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

~~b~~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.

~~c~~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.

~~d~~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.

~~e~~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.

~~f~~g) Discharge lines from pressure relief ~~devices~~ valves 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. The possibility of solidification of fluid leakage into the discharge piping system shall be considered.

~~g~~h) The pressure relief discharge ~~should~~ shall be connected to a closed, vented storage tank ~~or blowdown 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. ~~When outdoor discharge is used,~~

~~t~~The following ~~should~~ shall be considered for discharge piping hazards.

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

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

~~W = CKAP √(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 = cp/cv .~~
~~**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 ft3 (m3)~~
~~H = heat of combustion of fuel, Btu/lb (J/kg) or Btu/ft3 (J/m3)~~
~~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.~~

For Liquid
U.S. Customary Units
$W = 2{,}407KA\sqrt{(P - Pd)w}$

SI Units
$W = 5.092\ KA\sqrt{(P - Pd)w}$

Where.
W = Liquid Capacity in lb/hr (kg/hr).
A = Discharge Area of Pressure relief Valve, in^2 (mm^2)
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
Pd = Pressure at discharge of valve, psia (Mpa)
w = Specific weight of liquid at inlet condition
lb/ft^3 (kg/m^3)

To convert lb/hr of water to gal/min, multiply the capacity in lb/hr by 1/500.

!!!!!!! (SEE PART 1 PROPOSAL BEGINNING ON NEXT PAGE) !!!!!!!

PART 1

S5.7 OVERPRESSURE PROTECTION

S5.7.1 GENERAL REQUIREMENTS

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

S5.7.2 PRESSURE RELIEF ~~DEVICES~~VALVES

Thermal fluid heaters shall be equipped with one or more pressure relief ~~devices~~ valves unless the option for overpressure protection by system design is utilized (when permitted by the original code of construction).
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) A lifting lever shall not be used in pressure relief valve(s). 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.

d) Cast iron fittings shall not be used

e) Copper and copper alloys shall not be used

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

S5.7.3 LOCATION

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

S5.7.4 CAPACITY

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

S5.7.5 SET PRESSURE

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

S5.7.6 INSTALLATION

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. ~~When a discharge pipe is used, t~~The cross-sectional area of the discharge piping shall not be less than the full area of the valve outlet. The size of the discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity or adversely affect the operation of the attached pressure vessel relief ~~devices~~valves. Discharge piping shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief ~~device~~valve.

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

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

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

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

~~e~~f) Pressure relief ~~device~~ valve 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.

~~f~~g) Discharge lines from pressure relief ~~devices~~ valves 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. The possibility of solidification of fluid leakage into the discharge piping system shall be considered.

h) The pressure relief valve discharge shall be connected to a closed, 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 (prevent blockage)

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

For Liquid
U.S. Customary Units
$W = 2{,}407KA\sqrt{(P - Pd)w}$

SI Units
$W = 5.092\ KA\sqrt{(P - Pd)w}$

Where.
W = Liquid Capacity in lb/hr (kg/hr).
A = Discharge Area of Pressure relief Valve, in^2 (mm^2)
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
Pd = Pressure at discharge of valve, psia (Mpa)
w = Specific weight of liquid at inlet condition
lb/ft^3 (kg/m^3)

To convert lb/hr of water to gal/min, multiply the capacity in lb/hr by 1/500.

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PART 4

SUPPLEMENT 4
RECOMMENDED PROCEDURES FOR REPAIRING PRESSURE RELIEF VALVES

S4.1 ~~INTRODUCTION~~SCOPE

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, ~~and~~ S4.3 contains recommended procedures for the repair of pilot operated types of pressure relief valves. S4.4 contains ~~I~~information on packaging, shipping and transportation. ~~is included as S4.5.~~

~~a)~~ 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.

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

~~c) S4.2 contains recommended procedures for the repair of spring-loaded pressure relief valves, and S4.3 contains recommended procedures for the repair of pilot operated types of pressure relief valves. Information on packaging, shipping and transportation is included as S4.5.~~

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.

~~S5.2 GENERAL~~

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.~~3~~ 2 describes typical test equipment, and S5.~~4~~ 3 provides data for estimating the size of test vessels required.

S5.~~3~~ 2 TEST SYSTEM DESCRIPTION

a) An optimum configuration, particularly when the test medium source is of small capacity, is shown in Figure S5.~~3~~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.~~3~~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.
(Renumber all remaining sections)

SUPPLEMENT 6
PROCEDURES FOR REPAIRS OF NUCLEAR SAFETY RELATED PRESSURE RELIEF VAVLES

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.

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.

4.9.21 CONTENTS OF TRAINING PROGRAM

The repair organization shall establish a documented in-house training program to ensure the defined skills, knowledge and competencies are achieved. . This program shall establish training objectives and provide a method of evaluating training effectiveness. As a minimum, training objectives for each positionknowledge level shall include:

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

4.9.32 INITIAL EVALUATION AND ACCEPTANCE QUALIFICATION OF PERSONNEL

The Each 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.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.

4.9.43 ANNUAL EVALUATION AND ACCEPTANCE REVIEW OF PERSONNEL QUALIFICATION

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. 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, docu- mented evidence of work performed, and when necessary, monitoring job performance. The review evaluation shall be documented.

Item 20-9: Request for Revision to NBIC Section 9: Glossary of terms

Parts 1, 2, 3 and 4 9.1

Purpose	Define "Verify" and “Witness” in the NBIC Part 1, 2, 3, and 4 to align with the definition in NB-263, RCI-1, Rules for Commissioned Inspectors
Scope	Add “Verify” and “Witness” to the terms defined in Section 9 of Parts 1, 2, 3 and 4
Background	The need for the definition of "verify" and “witness” was initiated from Interpretation Item 18-03, which addresses which Inspector (i.e. “IS” Commissioned or “R” Endorsement) signs the FFSA Form NB-403 when an “R” Certificate Holder is involved with a repair in that region as well as determine what level of review of the Fitness-for-Service the Inspector is expected to complete.
Proposed Revision	Verify – To determine that a particular action has been performed in accordance with the requirements either by witnessing the action or reviewing records. Witness – To be present at an event and have first-hand knowledge of the action and be able to attest that it occurred.

Submitted by: Terry Hellman

Proposed Change:

9.1 DEFINTIONS

Verify – To determine that a particular action has been performed in accordance with the requirements either by witnessing the action or reviewing records.

Witness – To be present at an event and have first-hand knowledge of the action and be able to attest that it occurred.

ITEM 20-19 Proposal

Part 4, Paragraph 3.3.3.4

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 ~~and NBIC~~;

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.