



PART 4

PRESSURE RELIEF DEVICES

2025 **NBIC**

NATIONAL BOARD INSPECTION CODE

ANSI/NB23

AN AMERICAN NATIONAL STANDARD,
RECOGNIZED INTERNATIONALLY



Documents

Document Sharing Hub

NATIONAL BOARD INSPECTION CODE

2025 EDITION

DATE OF ISSUE — JULY 1, 2025

This code was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code was balanced to ensure that individuals from competent and concerned interests had an opportunity to participate. The proposed code was made available for public review and comment, which provided an opportunity for additional public input from industry, academia, regulatory and Jurisdictional agencies, and the public-at-large.

The National Board does not “approve,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

The National Board does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable Letters Patent, nor assume any such liability. Users of a code are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code.

The National Board accepts responsibility for only those interpretations issued in accordance with governing National Board procedures and policies that preclude the issuance of interpretations by individual committee members.



The above National Board symbols are registered with the US Patent Office.

“National Board” is the abbreviation for The National Board of Boiler and Pressure Vessel Inspectors.

No part of this document may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

All charts, graphs, tables, and other criteria that have been reprinted from the *ASME Boiler and Pressure Vessel Code*, Sections I, IV, VIII, and X are used with the permission of the American Society of Mechanical Engineers. All Rights Reserved.

Library of Congress Catalog Card No. 52-44738
 Printed in the United States of America
 All Rights Reserved

www.NBBI.org

Copyright © 2025 by
 THE NATIONAL BOARD OF BOILER & PRESSURE VESSEL INSPECTORS
 All rights reserved
 Printed in U.S.A.

PART 4 — PRESSURE RELIEF DEVICES

TABLE OF CONTENTS

Introduction	VII
Foreword	XI
Personnel	XIII
Section 1	General and Administrative Requirements 1
1.1	Scope 1
1.2	Construction Standards for Pressure-Relief Devices 1
1.3	Pressure Relief Devices—Definitions 1
1.3.1	Additional Definitions Related to Pressure Relief Devices 1
1.4	Accreditation 1
1.4.1	Accreditation Process 2
Section 2	Installation of Pressure Relief Devices 3
2.1	Scope 3
2.2	Pressure Relief Valves for Power Boilers 3
2.2.1	General Requirements 3
2.2.2	Number 3
2.2.3	Location 4
2.2.4	Capacity 4
2.2.5	Set Pressure 5
2.2.6	Forced-Flow Steam Generators 6
2.2.7	Superheaters 6
2.2.8	Economizers 7
2.2.9	Pressure Reducing Valves 7
2.2.10	Installation and Discharge Requirements 7
2.2.11	Supports, Foundations, and Settings 8
2.3	Overpressure Protection for Thermal Fluid Heaters 8
2.3.1	General Requirements 8
2.3.2	Pressure Relief Valves 9
2.3.3	Location 9
2.3.4	Capacity 9
2.3.5	Set Pressure 9
2.3.6	Installation 9
2.4	Overpressure Protection for Organic Fluid Vaporizers 11
2.4.1	General Requirements 11
2.4.2	Pressure Relief Devices 11
2.4.3	Location 11
2.4.4	Capacity 11
2.4.5	Set Pressure 11
2.4.6	Installation 11
2.5	Pressure Relief Valves for Steam Heating, Hot Water Heating, and Hot Water Supply Boilers 14
2.5.1	General Requirements 14
2.5.1.1	Installation of Pressure Relief Valves for Heating Boilers 14
2.5.1.1.1	Permissible Installation 14
2.5.1.1.2	Requirements for Common Connections for Two or More Valves 14
2.5.1.2	Threaded Connections 14
2.5.1.3	Prohibited Installations 14
2.5.1.4	Use of Shutoff Valves Prohibited 14
2.5.1.5	Pressure Relief Valve Discharge Piping 15
2.5.1.6	Temperature and Pressure Relief Valves 15
2.5.2	Pressure Relief Valve Requirements for Steam Heating Boilers 15
2.5.3	Pressure Relief Valve Requirements for Hot Water Heating or Hot Water Supply Boilers 16
2.5.4	Pressure Relief Valve Requirements for Potable Water Heaters 17
2.5.4.1	Installation 18

2.5.4.2	Permissible Installations	18
2.5.4.3	Requirements for Common Connection for Two or More Valves	18
2.5.4.4	Threaded Connections	18
2.5.4.5	Prohibited Installations	18
2.5.4.6	Use of Shutoff Valves Prohibited	18
2.5.4.7	Temperature and Pressure Relief Valve Discharge Piping	18
2.5.5	Pressure Relief Valves for Tanks and Heat Exchangers	19
2.5.5.1	Steam to Hot-Water Supply	19
2.5.5.2	High Temperature Water to Water Heat Exchanger	19
2.5.5.3	High Temperature Water to Steam Heat Exchanger	19
2.6	Pressure Vessel Pressure Relief Devices	20
2.6.1	Device Requirements	20
2.6.2	Number of Devices	20
2.6.3	Location	20
2.6.4	Capacity	20
2.6.5	Set Pressure	21
2.6.6	Installation and Discharge Piping Requirements	21
2.6.7	Temperature and Pressure Relief Devices for Hot Water Storage Tanks/Potable Hot Water Storage Tank	22
2.7	Piping System Pressure Relief Devices	23
2.7.1	Device Requirements	23
2.7.2	Number of Devices	23
2.7.3	Location	23
2.7.4	Capacity	23
2.7.5	Set Pressure	24
2.7.6	Inlet and Discharge Piping Requirements	24
Section 3	In-service Inspection of Pressure Relief Devices	26
3.1	Scope	26
3.2	General	26
3.2.1	Pressure Relief Device Data	26
3.2.2	Inspection Requirements for Device Condition	27
3.2.3	Inspection Requirements for Installation Condition	27
3.2.4	Additional Inspection Requirements	28
3.2.4.1	Power Boilers	28
3.2.4.2	Hot-Water Heating Boilers, Hot Water Supply Boilers, and Water Heaters	28
3.2.4.3	Pressure Vessels and Piping	28
3.2.4.4	Non-Reclosing Pressure Relief Devices	28
3.2.5	General Considerations for Testing and Operational Inspection of Pressure Relief Devices	30
3.2.5.1	Testing and Operational Inspection of Pressure Relief Devices	31
3.2.5.2	Testing and Operational Inspection of Non-Reclosing Pressure Relief Devices (PRD) with Pins or Bars	32
3.2.5.3	Testing and Operational Inspection of Rupture Disks	32
3.2.5.4	Corrective Action	32
3.2.5.5	Valve Adjustments	33
3.2.6	Recommended Inspection and Testing Frequencies for Pressure Relief Devices	33
3.2.6.1	Establishment of Inspection and Test Intervals	35
3.2.6.2	Establishment of Service Intervals	35
3.3	Accreditation of "T/O" Test Only Organizations	36
3.3.1	Scope	36
3.3.2	Jurisdictional Participation	36
3.3.3	Quality System	36
3.3.3.1	General	36
3.3.3.2	Written Description	36
3.3.3.3	Maintenance of a Controlled Copy	36
3.3.3.4	Outline of Requirements for a Quality System	36
3.3.4	Testing & Adjustment	40
3.3.5	Competency, Training and Qualification of Personnel	41
3.3.5.1	Competency of Personnel	41

3.3.5.2	Contents of Training Program	41
3.3.5.3	Initial Evaluation and Acceptance of Personnel	41
3.3.5.4	Annual Evaluation and Acceptance of Personnel	41
3.3.6	Marking Requirements for Valves Tested Under the "T/O" Program	41
3.3.6.1	Nameplates	41
3.3.6.2	Test Only Nameplate & Valve Sealing	42
3.4	Annual Audits	43
Section 4	Repair of Pressure Relief Valves	44
4.1	Scope	44
4.2	General Requirements	44
4.2.1	"VR" Repair	44
4.2.2	Construction Standards for the Repair of Pressure Relief Devices	45
4.2.3	Installation of Pressure Relief Devices	45
4.2.4	Initial Adjustments to Pressure Relief Valves	45
4.3	Materials for Pressure Relief Valve Repair	45
4.3.1	Replacement Parts for Pressure Relief Devices	46
4.4	Welding for Pressure Relief Valves	46
4.4.1	Welding Procedure Specifications	47
4.4.2	Standard Welding Procedure Specifications	47
4.4.3	Performance Qualification	47
4.4.4	Welding Records	47
4.4.5	Welder's Identification	47
4.4.6	Welder's Continuity	47
4.4.7	Weld Repairs to Pressure Relief Valve Parts by an "R" Stamp Holder	47
4.5	Heat Treatment	48
4.5.1	Preheating	48
4.5.2	Postweld Heat Treatment	48
4.6	Pressure Relief Valve Performance Testing and Testing Equipment	48
4.6.1	Test Medium and Testing Equipment	48
4.6.2	Owner-User ASME Code Section VIII Steam Testing	49
4.6.3	Lift Assist Testing	50
4.6.4	Pressure Test of Parts	50
4.7	Stamping Requirements for Pressure Relief Devices	51
4.7.1	Nameplates	51
4.7.2	Repair Nameplates	51
4.7.3	Changes to Original Pressure Relief Valve Nameplate Information	52
4.7.4	Illegible or Missing Nameplates	52
4.8	Accreditation of "VR" Repair Organizations	52
4.8.1	Scope	52
4.8.2	Jurisdictional Participation	53
4.8.3	Issuance and Renewal of the "VR" <i>Certificate of Authorization</i>	53
4.8.3.1	General	53
4.8.3.2	Issuance of Certificate	53
4.8.4	Use of the "VR" <i>Certificate of Authorization</i>	53
4.8.4.1	Technical Requirements	53
4.8.4.2	Stamp Use	53
4.8.5	Quality System	53
4.8.5.1	General	53
4.8.5.2	Written Description	53
4.8.5.3	Maintenance of Controlled Copy	54
4.8.5.4	Outline of Requirements for a Quality System	54
4.8.6	Field Repair	59
4.9	Competency, Training and Qualification of Personnel	59
4.9.1	Competency of Personnel	59
4.9.2	Contents of Training Program	59
4.9.3	Initial Evaluation and Acceptance of Personnel	59
4.9.4	Annual Evaluation and Acceptance of Personnel	59
4.10	Use of Personnel not in the Certificate Holder's Employ	59
4.11	Annual Audits	59

Section 5	INTENTIONALLY LEFT BLANK	61
Section 6	Supplements	62
Supplement 1	Pressure Relief Valves on the Low Pressure Side of Steam Pressure Reducing Valves	62
S1.1	Scope	62
S1.2	Pressure Relief Valve Capacity	62
S1.3	Calculation of Pressure Relief Valve Relieving Capacity	63
S1.4	Steam Flow When Flow Coefficients are not Known	70
S1.5	Two-Stage Pressure Reducing Valve Stations	70
Supplement 2	Pressure Differential Between Pressure Relief Valve Setting and Boiler or Pressure Vessel Operating Pressure	72
S2.1	Scope	72
S2.2	Hot Water Heating Boilers	72
S2.3	Steam Heating Boilers	72
S2.4	Power Boilers	72
S2.5	Pressure Vessels	73
Supplement 3	Pressure Relief and Pilot Valve Storage & Shelf Life	75
S3.1	Scope	75
S3.2	Pressure Relief Valve Storage	75
S3.3	Pressure Relief Valve Storage Conditions	75
S3.4	Pressure Relief Valve Shelf Life	75
S3.4.1	Exceeding Shelf Life	76
Supplement 4	Recommended Procedures for Repairing Pressure Relief Valves	77
S4.1	Scope	77
S4.2	Spring-Loaded Pressure Relief Valves	77
S4.3	Pilot Operated Pressure Relief Valves	79
S4.4	Weight Loaded Vents	81
S4.5	Packaging, Shipping and Transportation of Pressure Relief Devices	84
Supplement 5	Recommended Guide for the Design of a Test System for Pressure Relief Devices in Compressible Fluid Service	85
S5.1	Scope	85
S5.2	Test System Description	85
S5.3	Test Vessel Sizing Data	87
Supplement 6	Procedures for Repairs of Nuclear Safety Related Pressure Relief Valves	89
S6.1	Scope	89
S6.2	Definitions	89
S6.3	Nuclear Safety Related Valve Groups	89
S6.4	Administrative Procedures	89
S6.5	General Rules	90
Supplement 7	Recommended Procedures for Test Only of Pressure Relief Valves	92
S7.1	Introduction	92
S7.2	Pressure Relief Valves	92
Section 7	NBIC Policy for Metrication	94
7.1	General	94
7.2	Equivalent Rationale	94
7.3	Procedure for Conversion	94
7.4	Referencing Tables	95

Section 8	Preparation of Technical Inquiries to the <i>National Board Inspection Code</i> Committee	100
Section 9	Glossary of Terms	101
9.1	Definitions	101
Section 10	NBIC Approved Interpretations	109
10.1	Scope	109
Section 11	Index	122

INTRODUCTION

It is the purpose of the *National Board Inspection Code* (NBIC) to maintain the integrity of pressure-retaining items and pressure relief devices by providing rules for post-construction activities. In providing these rules, the NBIC helps to ensure the safety of the pressure-retaining items' and pressure relief devices' continued use.

The NBIC is intended to provide rules, information, and guidance to manufacturers, jurisdictions, Inspectors, owner-users, installers, contractors, and other individuals and organizations performing or involved in post-construction activities, thereby encouraging the uniform administration of rules pertaining to pressure-retaining items and pressure relief devices. A thorough understanding of the NBIC's information and conformity to its requirements will promote personal and public safety.

SCOPE

The NBIC recognizes four important areas of post-construction activities for pressure-retaining items and pressure relief devices:

- Installation
- Inspection
- Repairs and Alterations
- Testing of Pressure Relief Devices

The NBIC provides rules, information, and guidance for post-construction activities involving pressure-retaining items and pressure relief devices; however, such rules, information, and guidance is not all-encompassing. Where complete details are not provided in this Code, the Code user is advised to seek guidance from the applicable jurisdiction or other technical sources.

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

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

ORGANIZATION

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

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

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

TEXT IDENTIFICATION AND NUMBERING

Each page in the text displays the publication name and publication year in the header; the footer of each page displays the designated section and page number. The numbering sequence for each section begins with the section number followed by a period to further designate major sections (e.g., 1.1, 1.2, 1.3). Major sections are subdivided using periods to designate subsections within that major section (e.g., 1.1.1, 1.2.1, 1.3.1). Subsections can be further divided as necessary. Paragraphs under sections or subsections shall be designated with a small letter followed by a parenthesis (e.g., a), b), c)) and are further subdivided using a number followed by a parenthesis (e.g., 1), 2), 3)).

Subdivisions of paragraphs beyond this point will be designated using a hierarchical sequence of numbers and letters, each of which is followed by a period.

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

Each part of the NBIC typically contains tables, charts, and figures within or after each major section. Tables, charts, and figures provide relevant illustrations or supporting information for text passages and are designated with numbers corresponding to the paragraph they illustrate or support within each section or subsection. Multiple tables, charts, or figures referenced by the same paragraph are marked with additional letters sequentially arranged to reflect the order of reference.

SUPPLEMENTS

Supplements are contained in each part of the NBIC to provide requirements and guidance pertaining only to a specific type of pressure-retaining item (e.g., locomotive boilers, historical boilers, graphite pressure vessels) or to a specific subject (e.g., report forms, alternative repair methods, etc.). Supplements follow the same numbering system used for the main text but are preceded by the letter “S.” Each page of the supplement is tabbed to identify the supplement number.

EDITIONS

Editions of the NBIC are published every two years. Editions are permissive on the date issued; however, they become mandatory six months after the date of issue. Substantive revisions or additions that have been incorporated into the NBIC since the last edition are noted with the two-digit publication year, enclosed in parentheses in the margin next to the section, or subsection containing the revisions and/or additions.

CODE STAMPING

American Society of Mechanical Engineers (ASME) Code “stamping” referenced throughout the NBIC includes the ASME Boiler and Pressure Vessel Code Symbol Stamps used for conformity assessment prior to the 2010 edition/2011 addenda; it also includes the ASME Single Certification Mark with applicable ASME Designator required to meet the later editions of the ASME Boiler and Pressure Vessel Code sections. When

other construction codes or standards are utilized for repairs or alterations, stamping shall refer to the identification symbol stamp required by that code or standard.

INTERPRETATIONS, CODE ADDITIONS, AND CODE REVISIONS

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

The NBIC Committee does not act as a consultant for specific issues with pressure relief devices or for issues with installation, inspection, repair, or alteration activities; nor does the NBIC Committee act as a consultant for the general application or understanding of Code requirements. After reviewing the inquiry, the committee may recommend the inquirer seek assistance from another source. In this case, the request will be returned with a statement that consulting questions are not the responsibility of the committee, and the committee recommends the inquirer seek assistance from a competent source.

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

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

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

PRESENTATION REQUESTS

From time to time someone requests to give a presentation to specific NBIC committees (e.g., subgroups, subcommittees, NBIC Main Committee). Requests to give a presentation to any committee shall be submitted in writing to the NBIC Committee Secretary at least one month prior to the scheduled NBIC meetings. The written request shall specify the subject and committee(s) to which you are requesting to provide the presentation. All requests shall contain a copy of the presentation in a format that is acceptable to the NBIC Secretary, such as Microsoft PowerPoint. Requests should be emailed to the NBIC Secretary at NBICSecretary@nbbi.org.

Commercial promotion is not permitted.

All requests for presentations are subject to the approval of The National Board and the Chair(s) of the specific committee(s).

JURISDICTIONAL PRECEDENCE

The NBIC references the requirements of the “jurisdiction.” Where any provision herein presents a direct or implied conflict with any jurisdictional regulation, the jurisdictional regulation shall govern. Where the requirements of the jurisdiction do not meet the minimum requirements of the NBIC Part 3, the National Board “R” or “NR” Symbol stamp shall not be applied, and the applicable “R” reports shall not be signed by the “R” or “NR” Certificate Holder or the Inspector.

UNITS OF MEASUREMENT

Both United States (U.S.) customary units and metric units (or International System [SI] units) are used in the NBIC. The values stated in U.S. customary units or SI/metric units are to be regarded separately as the standard. Throughout the NBIC, whenever a U.S. customary unit is referenced, the equivalent SI/metric unit follows in parentheses. In NBIC Part 2, Supplement 6 and NBIC Part 3, Supplement 6, regarding United States Department of Transportation (DOT) Transport Tanks, the U.S. customary unit is noted in parentheses following each metric unit reference.

U.S. customary units or metric units may be used with this edition of the NBIC, but one system of units shall be used consistently throughout a repair or alteration of a pressure-retaining item. National Board-accredited repair organizations shall ensure the appropriate units are used consistently throughout all phases of work. This includes materials, design, procedures, testing, documentation, and stamping. The NBIC policy for metrification is outlined in Section 7 of each part of the NBIC.

ACCREDITATION PROGRAMS

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

- “R” Repairs and alterations to pressure-retaining items (NB-415)
- “VR” Repairs to pressure relief valves (NB-514)
- “NR” Repair and replacement activities for nuclear items (NB-417)
- “T/O” Testing of pressure relief valves (NB-528)

The administrative requirements for these accreditation programs can be viewed on the National Board’s website at www.nbbi.org.

The National Board also administers four specific accreditation/acceptance programs for inspection agencies as shown below:

New Construction

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

Inservice

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

Owner-User

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

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

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

CERTIFICATES OF AUTHORIZATION FOR ACCREDITATION PROGRAMS

Any organization seeking accreditation for a National Board program(s) shall apply to the National Board to obtain a *Certificate of Authorization* for the requested scope of activities. A confidential review shall be conducted to evaluate the organization’s quality management system and its implementation of the same. Upon completion of the evaluation, a recommendation regarding the applicable *Certificate of Authorization* will be sent to the National Board.

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

FOREWORD

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

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

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

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

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

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

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

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

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

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

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

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

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

COLOR IMAGES

Color images of certain figures and photographs found in the NBIC are available to view on the National Board's website, on the NBIC Publication Information page under the NBIC tab. For those using a digital copy of the NBIC, you may click the link below to directly access that page. For those using a physical copy of the NBIC, you may scan the QR code to access the page on a mobile device.

[NBIC Publication Information Page](#)



PERSONNEL

The National Board of Boiler and Pressure Vessel Inspectors

Board of Trustees

R. Troutt
Chairman

J. Burpee
First Vice Chairman

R. Sturm
Second Vice Chairman

E. Creaser
Member at Large

T. Seime
Member at Large

M. Carlson
Member at Large

T. Clark
Member at Large

J. Amato
Secretary/Treasurer

Advisory Committee

V. Scarcella
Representing authorized inspection agencies
(insurance companies)

M. Lower
Representing boiler and pressure vessel users

T. Melfi
Representing welding industries

M. Quisenberry
Representing National Board Certificate Holders

T. Simmons
Representing organized labor

J. Roberts
Representing pressure vessel manufacturers

E. Verderose
Representing boiler manufacturers

National Board Members

Alabama	Edward Wiggins
Alaska	Aaron Dirks
Arizona	Arnel Buquis
Arkansas	Bruce Broadway
California	Micah Davidian
Colorado	Robert Becker
Connecticut	Michael Devanney
Delaware	Steven Van Slavens
Florida	Kenneth Noble
Georgia	William Lynch
Hawaii	Julius Dacanay
Illinois	Patrick Polick
Indiana	Roger Boillard
Iowa	Robert Bunte
Kansas	Robert Stimson
Kentucky	Mark Jordan
Louisiana	Rhett Termini
Maine	John Burpee
Maryland	Steven Noonan
Massachusetts	Edward Kawa
Michigan	David Stenrose
Minnesota	Howard Berny
Mississippi	Thomas Carter
Missouri	Timothy Boggs
Montana	Brent Ricks
Nebraska	David Pleiss
Nevada	Jeffrey Oliver
New Hampshire	Brian Oliver
New Jersey	Michael Amuzie
New York	Steven Brantigan
North Carolina	Donald Kinney
North Dakota	Trevor Seime
Ohio	John Sharier
Oklahoma	Thomas Granneman
Oregon	Tom Clark
Pennsylvania	William Ross
Rhode Island	Jose Taveras
South Carolina	Ronald Spiker
South Dakota	Aaron Lorimor
Tennessee	Jimmy Watson
Texas	Rob Troutt
Utah	Rick Sturm
Virginia	Kimberly Adkins
Washington	Michael Carlson
Chicago, IL	Thomas Maher
Detroit, MI	Aijalon Denham
Milwaukee, WI	Adrian Gibbs
Los Angeles, CA	Juan Chavez
New York, NY	William McGivney
Seattle, WA	Steve Frazier
Alberta	Djordje Smic
British Columbia	Rajesh Kamboj
Manitoba	Ryan DeLury
New Brunswick	Eben Creaser
Newfoundland & Labrador	David Brockerville
Northwest Territories	Matthias Mailman
Nova Scotia	Donald Ehler
Ontario	Caslav Dinic
Prince Edward Island	Nancy Chiasson
Quebec	Aziz Khssassi
Saskatchewan	Christopher Selinger

National Board Inspection Code Main Committee

G. Galanes, Chair
Diamond Technical Services, Inc.

M. Wadkinson, Vice Chair
Fulton

J. Ellis, Secretary
National Board

K. Beise
Dowco Valve Company

J. Burpee
State of Maine

T. Clark
State of Oregon

C. Hopkins
Seattle Boiler Works, Inc.

K. Moore
Joe Moore & Company

B. Morelock
Eastman Chemical Company

V. Newton
XL Insurance

T. Patel
Farris Engineering

D. Patten
Bay City Boiler

P. Polick
State of Illinois

B. Ray
Marathon Petroleum Company

A. Renaldo
Linde

M. Richards
Southern Company

B. Schaefer
AEP

T. Seime
State of North Dakota

J. Sekely
Consultant

T. Simmons
International Brotherhood of Boilermakers

M. Toth
ECS Consulting

R. Underwood
Hartford Steam Boiler Inspection and Insurance Company

National Board Inspection Code Subcommittee Installation (Part 1)

D. Patten
Bay City Boiler

S. Konopacki
NRG

D. Rodriguez, Secretary
National Board

R. Black
ABMA

J. Brockman
Factory Mutual Insurance Company

M. Byrum
Arise Boiler Inspection and Insurance Company

T. Clark
State of Oregon

T. Creacy
Zurich Services Corporation

J. Downs
Weil-McLain

J. Kleiss
Lochinvar

M. Richards
Southern Company

R. Smith
Naval Facilities Engineering Command

R. Spiker
State of South Carolina

M. Wadkinson
Fulton

National Board Inspection Code Subcommittee Inspection (Part 2)

M. Horbaczewski, Chair
Diamond Technical Services, Inc.

D. Graf, Vice Chair
Consulting

J. Metzmaier, Secretary
National Board

J. Beauregard
Los Alamos National Laboratory

C. Becker
Bureau Veritas Inspection and Insurance Company

T. Bolden
CNA

D. Burton
Air Products and Chemicals, Inc.

J. Calvert
Eli Lilly and Company

J. Clark
Worthington Enterprises

D. Dexter
Dow Chemical Company

W. Hackworth
Arise Boiler Inspection and Insurance Company

J. Jessick
Fusion Integrated Solutions

J. Mangas
Becht

Clay Moultrie
Quality Steel

V. Newton
XL Insurance

P. Polick
State of Illinois

B. Ray
Marathon Petroleum

J. Roberts
TRIARC Tank

D. Rose
T&T Inspections

W. Ross
Commonwealth of Pennsylvania

J. Safarz
Karldungs USA

M. Sansone
State of New York

V. Scarcella
CNA

B. Steinhart
Factory Mutual Insurance Company

T. Vandini
Quality Steel Corporation

G. Whitlock
The Hartford Steam Boiler Inspection and Insurance Company

P. Becker
Electric Power Research Institute

B. Boseo
Burns & McDonnell

Michael Carlson
State of Washington

P. Davis
Wood Group USA

S. Frazier
City of Seattle

P. Gilston
The Hartford Steam Boiler Inspection and Insurance Company

C. Hopkins
Seattle Boiler Works, Inc.

T. McBee
Arise Boiler Inspection and Insurance Company

R. Miletti
Babcock and Wilcox

L. Moedinger
Strasburg Railroad Company

B. Morelock
Eastman Chemical Company

M. Quisenberry
Spartan Boiler & Mechanical

B. Schaefer
AEP

T. Seime
State of North Dakota

J. Sekely
Consultant

P. Shanks
Arise Boiler Inspection and Insurance Company

J. Siefert
Electric Power Research Institute

R. Spuhl
Hartford Steam Boiler Inspection and Insurance Company

R. Valdez
ARB, Inc.

National Board Inspection Code Subcommittee for Repairs and Alterations (Part 3)

K. Moore, Chair
Joe Moore & Company

M. Toth, Vice Chair
ECS Consulting

T. Hellman, Secretary
National Board

National Board Inspection Code Subcommittee Pressure Relief Devices (Part 4)

A. Renaldo, Chair
Linde

J. Simms, Vice Chair
Baker Hughes

R. Viers, Secretary
National Board

N. Bailey
JAC Consulting

K. Beise
Dowco Valve Company, Inc.

H. Cornett
Emerson Automation Solutions

E. Creaser
Province of New Brunswick

D. DeMichael
Chemours Co.

P. Dhobi
Lakeside Process Controls. Ltd.

A. Donaldson
Baker Hughes

D. Marek
Mainthia Technologies

D. McHugh
Consultant

B. Nutter
E.I. Dupont De Nemours & Co.

T. Patel
Farris Engineering

D. Schirmer
XL Insurance America, Inc.

D. Sullivan
XL Insurance America, Inc.

T. Tarbay
Consultant

J. Wolf
Zurich Services Corporation

National Board Inspection Code Subgroup Installation (Part 1)

J. Brockman, Chair
Factory Mutual Insurance Company

T. Clark, Vice Chair
State of Oregon

D. Rodriguez, Secretary
National Board

R. Adams
Zurich Services Corporation

H. Berny
State of Minnesota

R. Black
ABMA

M. Byrum
Arise Boiler Inspection and Insurance Company

J. Choitz
*Hartford Steam Boiler Inspection and
Insurance Company*

T. Creacy
Zurich Services Corporation

J. Downs
Weil-McLain

S. Konopacki
NRG

D. Patten
Bay City Boiler

H. Richards
Southern Company

R. Smith
Naval Facilities Engineering Command

R. Spiker
State of South Carolina

M. Wadkinson
Fulton

National Board Inspection Code Subgroup Inspection (Part 2)

J. Roberts, Chair
TRIARC Tank

J. Clark, Vice Chair
Worthington Enterprises

J. Metzmaier, Secretary
National Board

J. Beauregard
Los Alamos National Laboratory

C. Becker
Bureau Veritas Inspection and Insurance Company

T. Bolden
CNA

D. Burton
Air Products and Chemicals, Inc.

J. Calvert
Eli Lilly and Company

D. Dexter
Dow Chemical Company

D. Graf
Consulting

W. Hackworth
Arise Boiler Inspection and Insurance Company

M. Horbaczewski
Diamond Technical Services, Inc.

J. Jessick
Fusion Integrated Solutions



Documents

Document Sharing Hub
PERSONNEL XVII

R. Kennedy
Babcock & Wilcox

J. Mangas
Becht

Clay Moultrie
Quality Steel

V. Newton
XL Insurance America

P. Polick
State of Illinois

B. Ray
Marathon Petroleum Company

D. Rose
T&T Inspections

W. Ross
Commonwealth of Pennsylvania

J. Safarz
Karlungs USA

V. Scarcella
CNA

J. Smith
North Carolina Department of Labor

B. Steinhart
Factory Mutual Insurance Company

T. Vandini
Quality Steel Corporation

G. Whitlock
The Hartford Steam Boiler Inspection and Insurance Company

C. Hopkins
Seattle Boiler Works, Inc.

F. Johnson
Johnson Welding

A. Khssassi
Province of Quebec

T. LeBeau
Southern Company

T. McBee
Arise Boiler Inspection and Insurance Company

R. McGuire
GE Steam Power, Inc.

M. Quisenberry
Spartan Boiler & Mechanical

B. Schaefer
AEP

M. Schaser
The Equity Engineering Group

T. Seime
State of North Dakota

J. Sekely
Consultant

J. Siefert
Electric Power Research Institute

W. Sperko
Sperko Engineering Services

M. Toth
ECS Consulting, LLC

A. Triplett
UT-Battelle, LLC

R. Valdez
ARB, Inc.

M. Vogt
Vistra

T. White
NRG Energy

National Board Inspection Code Subgroup for Repairs and Alterations (Part 3)

R. Underwood, Chair
Hartford Steam Boiler Inspection and Insurance Company

P. Davis, Vice Chair
Wood Group USA

T. Hellman, Secretary
National Board

L. Baker
TUV Rheinland

R. Collins
Eastman Chemical Company

L. Dutra
Bay City Boiler

J. Ferreira
Hartford Steam Boiler Inspection and Insurance Company

S. Frazier
City of Seattle

National Board Inspection Code Subgroup Pressure Relief Devices (Part 4)

D. Marek, Chair
Mainthia Technologies, Inc.

D. McHugh, Vice Chair
Consulting

R. Viers, Secretary
National Board

N. Bailey
JAC Consulting, Inc.

K. Beise, Chair
Dowco Valve Company, Inc.

R. Ceccarelli
Factory Mutual Insurance Company



H. Cornett
Emerson Automation Solutions

E. Creaser
Province of New Brunswick

W. DeKeyzert
Trillium Services

D. DeMichael
Chemours Co.

P. Dhobi
Lakeside Process Controls

A. Donaldson
Baker Hughes

J. Grace
Chemours Co.

E. Heck
ARI-Armaturen USA

D. Mosley
Occidental Petroleum

B. Nutter
El DuPont De Nemours & Co., Inc.

T. Patel
Farris Engineering

A. Renaldo
Linde

G. Salwan
Quality Valve, Inc.

D. Schirmer
XL Insurance America, Inc.

J. Simms
Setpoint Integrated Solutions

D. Sullivan
XL Insurance America, Inc.

T. Tarbay
Consultant

C. Theiler
Law Valve of Texas

C. Turner
SFE

J. Wolf
Zurich Service Corporation

National Board Inspection Code Task Group Graphite

A. Viet, Chair
CG Thermal LLC

J. Ellis, Secretary
National Board

G. Becherer
CG Thermal

F. Brown
Consultant

C. Cary
The Dow Chemical Company

J. Clements
Graphite Maintenance

K. Cummins
Mersen USA

N. Lee
Mersen USA

S. Mehrez
The Dow Chemical Company

T. Rudy
Mersen USA

A. Stupica
SGL Carbon Technic

J. Wince
SGL Carbon Technic

National Board Inspection Code Task Group Fiber-Reinforced Pressure Vessels

D. McCauley, Chair
E.I. DuPont

J. Ellis, Secretary
National Board

A. Beckwith
Strand Composites, LLC

J. Bustillos
Bustillos and Associates

T. Cowley
FRP Consulting

J. Eihusen
Hexagon Lincoln

D. Eisberg
Avista Technologies

M. Gorman
Digital Wave

B. Linnemann
RL Industries Inc.

N. Newhouse
Lincoln Composites

J. Richter
Sentinel Consulting, Inc.

B. Shelley
E.I. DuPont



Documents

Document Sharing Hub

PERSONNEL | XIX

National Board Inspection Code Task Group Locomotive Boilers

G. Ray, Chair
Tennessee Valley Authority

C. Cross
PUCN

J. Metzmaier, Secretary
National Board

E. Armpriester
Strasburg Rail Road Company

T. Botti
Steam Services of America

S. Butler
Morton Locomotive & Machine, LLC

J. Churchill
Cargill

D. Conrad
Valley Railroad Co.

D. Domitrovich
East Broad Top Railroad

W. Fengler
FMW Solutions

R. Franzen
Steam Services of America

D. Griner
Arizona Mechanical Engineering

M. Jordan
Commonwealth of Kentucky

S. Lee
Union Pacific Railroad

K. Lynch
FMW Solutions

L. Moedinger
Strasburg Rail Road Company

T. Sposato
Age of Steam Roundhouse

R. Stone
ARVOS, Inc.

B. Zeigler
Strasburg Rail Road Company

National Board Inspection Code NR Task Group

R. Spuhl, Chair
The Hartford Steam Boiler Inspection and Insurance Company

T. Hellman, Secretary
National Board

E. Creaser
Province of New Brunswick

C. Dinic
Province of Ontario

A. Khssassi
Province of Quebec

T. Roberts
Consultant

B. Schaefer
AEP

W. Sperko
Sperko Engineering Services

B. Toth
Stone & Webster, Inc.

T. White
Consultant

National Board Inspection Code Task Group Historical Boiler

T. Seime, Chair
State of North Dakota

T. Dillon, Vice Chair
MSEA

J. Metzmaier, Secretary
National Board

K. Anderson
Anderson Machine, Inc.

H. Berny
State of Minnesota

M. Carlson
State of Washington

J. Ferreira
The Hartford Steam Boiler Inspection and Insurance Company

M. Horton
MHSEA

F. Johnson
Johnson Welding

C. Jowett
Construction Equipment Services, Inc.

D. Rose
T&T Inspections

D. Rupert
Consultant

J. Smith
North Carolina Department of Labor

M. Wahl
WHSEA



J. Wolf
Zurich Services Corporation

P. Gilston
The Hartford Steam Boiler Inspection and Insurance Company

National Board Inspection Code Task Group Interpretations (Part 3)

T. Seime, Chair
State of North Dakota

M. Schaser, Vice Chair
The Equity Engineering Group

T. Hellman, Secretary
National Board

B. Boseo
Burns & McDonnell

M. Carlson
State of Washington

R. Derby
United Association International Training Fund

K. Derrick
Chevron

J. Ferreira
The Hartford Steam Boiler Inspection and Insurance Company

G. Galanes
Diamond Technical Services

B. Hrubala
TUV Rheinland

S. Marks
Bureau Veritas Inspection and Insurance Company

T. McBee
Arise Boiler Inspection and Insurance Company

K. Moore
Joe Moore & Company

M. Quisenberry
Spartan Boiler & Mechanical

M. Toth
ECS Consulting, LLC

A. Triplett
UT-Battelle, LLC

National Board Inspection Code Parts 2 & 3 Joint Task Group

J. Clark, Chair
Worthington Enterprises

P. Davis, Vice Chair
Wood Group USA

D. Rodriguez, Secretary
National Board

T. Bolden
CNA

M. Horbaczewski
Diamond Technical Services, Inc.

B. Ray
Marathon Petroleum Company

R. Valdez
ARB, Inc.

T. White
NRG Energy



Documents

Document Sharing Hub

PERSONNEL | XXI

PART 4, SECTION 1 PRESSURE RELIEF DEVICES — GENERAL AND ADMINISTRATIVE REQUIREMENTS

1.1 SCOPE

This Part provides guidelines and requirements for the installation, in-service inspection and testing, and repairs of pressure relief devices.

1.2 CONSTRUCTION STANDARDS FOR PRESSURE RELIEF DEVICES

- a) When the standard governing the original construction is the ASME Code, installation and repairs to pressure relief devices shall conform to the ASME Code section and edition most applicable to the work planned.
- b) If the pressure relief device was not constructed to the ASME Code, then installation, inspection and repair shall wherever possible reference the original code of construction most applicable to the work.
- c) If the pressure relief device was not constructed to any recognized construction code or standard, then installation, inspection, and repair shall reference a construction standard or specification most applicable to the work.
- d) Where this is not possible or practicable, it is permissible to use other codes, standards, or specifications, including the ASME Code, provided there is concurrence of the Inspector (if applicable) and the Jurisdiction where the pressure relief device is installed.

1.3 PRESSURE RELIEF DEVICES — DEFINITIONS

Refer to Section 9, *Glossary* for definitions relating to pressure relief devices.

1.3.1 ADDITIONAL DEFINITIONS RELATING TO PRESSURE RELIEF DEVICES

Unless otherwise specified in the NBIC, the definitions relating to pressure relief devices in Section 2 of ASME PTC-25 shall apply.

1.4 ACCREDITATION

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

1.4.1 ACCREDITATION PROCESS

- a) The National Board administers accreditation programs for authorization of organizations performing repairs and inservice testing to pressure relief valves.
- b) Any organization may apply to the National Board to obtain a *Certificate of Authorization* for a requested scope of activities. A review shall be conducted to evaluate the organization's Quality Management System (QMS). The individual assigned to conduct the review shall meet the qualification requirements prescribed by the National Board. Upon completion of the review, any deficiencies regarding the organization's QMS will be documented, and a recommendation regarding issuance of a *Certificate of Authorization* will be made to the National Board.
- c) National Board procedures provide for a confidential review resulting in a recommendation to issue or not issue a *Certificate of Authorization*.
- d) The accreditation program provides requirements for organizations performing repairs, inservice testing, or both to pressure relief valves. Depending upon the expected scope of activities at the time of review, organizations may be authorized to perform repairs and inservice testing in the shop only, field only, or shop and field. Repair and inservice testing activities shall be limited to the scope of work authorized.
- e) Organizations desiring to renew or obtain a National Board *Certificate of Authorization* shall apply to the National Board using forms obtained from the National Board. Application for renewal shall be made prior to the expiration date of the *Certificate of Authorization*.
- f) When an organization has shops in more than one location, the organization shall submit separate applications for each shop. The organization may perform repairs in its shop, in the field, or both, provided such operations are described in the organization's QMS.

PART 4, SECTION 2

PRESSURE RELIEF DEVICES — INSTALLATION OF PRESSURE RELIEF DEVICES

2.1 SCOPE

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

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

2.2 PRESSURE RELIEF VALVES FOR POWER BOILERS

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

2.2.1 GENERAL REQUIREMENTS

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

2.2.2 NUMBER

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

2.2.3 LOCATION

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

2.2.4 CAPACITY

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

$$C=Q/L$$

Where,

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

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

L = 1000 BTU/lb (646 W • hr/kg)

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

TABLE 2.2.4

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

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

Notes:

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

2.2.5 SET PRESSURE

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

2.2.6 FORCED-FLOW STEAM GENERATORS

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

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

2.2.7 SUPERHEATERS

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

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

2.2.8 ECONOMIZERS

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

2.2.9 PRESSURE REDUCING VALVES

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

2.2.10 INSTALLATION AND DISCHARGE REQUIREMENTS

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

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

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

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

2.2.11 SUPPORTS, FOUNDATIONS, AND SETTINGS

Each pressure relief valve 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 other industry standards, as applicable.

2.3 OVERPRESSURE PROTECTION FOR THERMAL FLUID HEATERS

2.3.1 GENERAL REQUIREMENTS

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

2.3.2 PRESSURE RELIEF VALVES

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

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

2.3.3 LOCATION

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

2.3.4 CAPACITY

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

2.3.5 SET PRESSURE

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

2.3.6 INSTALLATION

Pressure relief valves and the associated discharge piping shall be installed in accordance with the heater Manufacturer's recommendations. The installation of the pressure relief valves required for Thermal Fluid Heaters shall include but not be limited to following requirements:

- a) The pressure relief valve shall be provided with discharge piping. The cross-sectional area of discharge piping shall not be less than the full area of the valve outlet. The size of the discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity or adversely affect the operation of the attached pressure vessel relief valves. Discharge piping shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief valve.
- b) The pressure relief valve shall be connected to the pressure vessel in accordance with the original code of construction.

- c) The cross sectional area of the piping between the heater and the relief device shall be sized either to avoid restricting the flow to the pressure relief devices or made at least equal to the inlet area of the pressure relief devices connected to it.
- d) When two or more required pressure relief devices are placed on one connection, the inlet cross-sectional area of this connection shall be sized either to avoid restricting the flow to the pressure relief devices or made at least equal to the combined inlet areas of the pressure relief devices connected to it.
- e) Unless permitted by the code of construction, there shall be no intervening stop valve between the vessel and its pressure relief device(s), or between the pressure relief device and the point of discharge.
- f) Pressure relief device discharges shall be arranged such that they are not a hazard to personnel or other equipment and, when necessary, lead to a safe location, such as a catchment tank, for the disposal of fluids being relieved.
- g) Discharge lines from pressure relief valves shall be designed to facilitate drainage. Drain piping shall discharge to a safe location for the disposal of the fluids being relieved. The possibility of solidification of fluid leakage into the discharge piping system shall be considered.
- h) The pressure relief discharge shall be connected to a closed, vented storage tank with solid piping (no drip pan elbow, or other air gap). The storage tank should be located as close to the system as possible, but away from flammable surfaces. Overflow or high level protection should be considered. The capacity of the storage tank should consider the volume of fluid which may be relieved or sized in accordance with the heater manufacturer's recommendation. Storage tanks located outdoors shall be located such that water cannot collect in the vessel. The following shall be considered for discharge piping hazards:
 - 1) Both thermal and chemical reactions (personnel hazard);
 - 2) Combustible materials (fire hazard);
 - 3) Surface drains (pollution and fire hazard);
 - 4) Heat tracing for systems using high freeze point fluids along the discharge line (prevent blockage).
- i) Pressure relief valve discharge capacity for liquid service shall be determined from the following equation:

U.S. Customary Units:

$$W = 2,407KA \sqrt{(P - P_d)w}$$

SI Units:

$$W = 5.092 KA \sqrt{(P - P_d)w}$$

Where:

W = Liquid Capacity in lb/hr (kg/hr)

A = Discharge Area of Pressure relief Valve, in² (mm²)

K = coefficient of discharge for valve design

P = (Set pressure + OP + Atmosphere pressure, psia (MPa))

OP = Overpressure required for pressure relief valve to reach capacity specified in code of construction

P_d = Pressure at discharge of valve, psia (MPa)

w = Specific weight of liquid at inlet condition lb/ft³ (kg/m³) To convert lb/hr of water to gal/min, multiply the capacity in lb/hr by 1/500.

2.4 OVERPRESSURE PROTECTION FOR ORGANIC FLUID VAPORIZERS

2.4.1 GENERAL REQUIREMENTS

Organic Fluid Vaporizers shall be provided with overpressure protection in accordance with the code of construction. The vaporizer shall be designed in accordance with the rules of the Code of Construction for a working pressure of at least 40 psi (280 kPa) above the operating pressure at which it will be used.

2.4.2 PRESSURE RELIEF DEVICES

Organic Fluid Vaporizers 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.
- b) A lifting lever shall not be used in pressure relief valve(s). A body drain is not required.
- 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.
- f) The inlet connection to the valve shall be not less than NPS $\frac{1}{2}$ (DN 15).

2.4.3 LOCATION

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

2.4.4 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.

2.4.5 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.

2.4.6 INSTALLATION

The pressure relief devices and its associated discharge piping shall be installed in accordance with original code of construction. The installation of pressure relief devices for organic fluid vaporizers shall include but not limited to following requirements.

- a) A rupture disk may be installed between the pressure relief valve and the vaporizer to minimize the loss by leakage of material through the pressure relief valve, provided the following requirements are met:
 - 1) The cross-sectional area of the piping 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 does 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, is sufficient to permit a flow equal to the capacity of the attached valve, and there is no 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) A pressure gage, try cock, free vent, or a suitable telltale indicator should be provided in space between a rupture disk and the pressure relief valve. This arrangement permits the detection of disk rupture or leakage.
 - 5) Every rupture disk shall have a specified bursting pressure at a specified temperature and shall be marked with a lot number.
 - 6) Every rupture disk shall be guaranteed by its manufacturer to burst within 5% (plus or minus) of its specified bursting pressure.
- b) The pressure relief valve should be provided with suitable discharge piping in accordance with the vaporizer manufacturer's recommendations, the fluid manufacturer's recommendations and should consider any applicable safety concerns and any applicable codes and standards. Any discharge piping should not affect the performance or capacity of the relief valve.
- c) A suitable condenser that will condense all the vapors discharged from the pressure relief valve or other safe catchment may be used.
- d) Pressure relief valves shall be disconnected from the vaporizer at least once yearly for inspection and repair if necessary. Pressure relief valves shall be tested after repair and then replaced on the vaporizer.
- e) 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, in² (mm²)

C = Constant for vapor that is a function of Specific Heats $k = C_p/C_v$ (See Figure 2.4.6-d).

Note: Where k is not known, $k = 1.001$

K = coefficient of discharge for valve design

M = molecular weight

P = (set pressure + OP + atmosphere pressure), psia (Mpa)

T = absolute temperature at inlet, °F + 460 (°C + 273).

W = flow of vapor, lb/hr (kg/hr)

OP = Overpressure required for Pressure Relief Valve to reach capacity specified in code of construction

The required minimum pressure relief valve relieving capacity shall be determined from the following equation:

$$W = (C \times H \times 0.75)/h$$

Where:

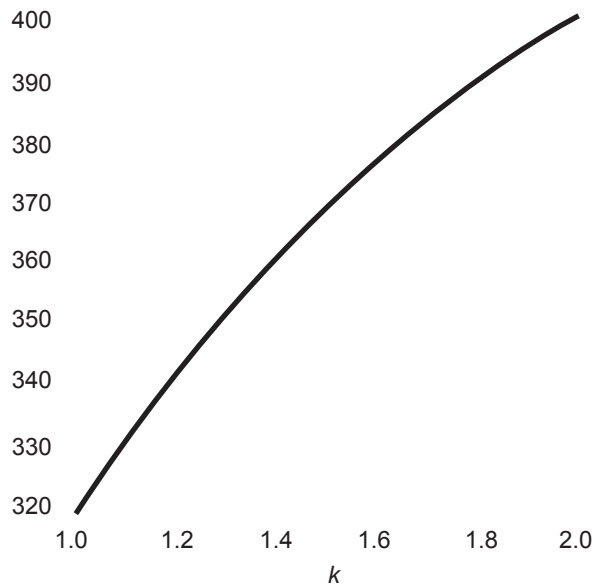
C = maximum total weight or volume of fuel burned per hour, lb (kg) or ft³ (m³).

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 lb per hour (kg per hour)

Figure 2.4.6 (U.S. Customary Units)
Constant, C, for Vapor Related to Ratio of
Specific Heats ($k = C_p/C_v$)



GENERAL NOTE: Flow formula calculations

$$W = K (CAP \sqrt{M/T})$$

(U.S. Customary Units)

$$C = 520 \sqrt{k \left(\frac{2}{k+1} \right)^{\frac{k+1}{k-1}}}$$

(SI Units)

$$C = 39.48 \sqrt{k \left(\frac{2}{k+1} \right)^{\frac{k+1}{k-1}}}$$

(SI Units)

The sum of the pressure relief valve capacities marked on the valves shall be equal to or greater than W.

2.5 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, 2.5.

2.5.1 GENERAL REQUIREMENTS

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

- a) All covers, caps, and plugs utilized for shipping or transport shall be removed prior to the valve being installed or placed in service.
- b) Ensure any wire or restraining device that was utilized during shipment is removed prior to placing the valve in service.

2.5.1.1 INSTALLATION OF PRESSURE RELIEF VALVES FOR HEATING BOILERS

2.5.1.1.1 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.

2.5.1.1.2 REQUIREMENTS FOR COMMON CONNECTIONS FOR TWO OR MORE VALVES

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

2.5.1.2 THREADED CONNECTIONS

A threaded connection may be used for attaching a valve.

2.5.1.3 PROHIBITED INSTALLATIONS

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

2.5.1.4 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.

2.5.1.5 PRESSURE RELIEF VALVE DISCHARGE PIPING

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

(25) 2.5.1.6 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 valves installed. The requirements of 2.5.1.1 through 2.5.1.5 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.
- d) The location of relief valve mounting shall ensure that the relief valve's temperature probe is constantly submerged at or near the hot-water outlet.

2.5.2 PRESSURE RELIEF VALVE REQUIREMENTS FOR STEAM HEATING BOILERS

- a) Pressure relief valves shall be manufactured in accordance with a national or international standard and be certified for capacity by the National Board.
- b) Each steam boiler shall have one or more National Board capacity certified pressure relief valves of the spring pop type adjusted and sealed to discharge at a pressure not to exceed 15 psig (100 kPa).

- c) No pressure relief valve for a steam boiler shall be smaller than NPS 1/2 (DN 15). No pressure relief valve shall be larger than NPS 4 (DN 100).
- d) The minimum valve capacity in lbs/hr (kg/hr) shall be as follows:
 - 1) The minimum pressure relief capacity as declared on the boiler nameplate for the specified fuel.
 - 2) If the capacity is not marked on the boiler nameplate or the fuel has been changed; the capacity shall be the greater of the following:
 - a) Minimum mass of steam per area of heating surface; lbs steam/hr ft² (kg steam/hr m²), as specified in Table 2.2.4.
 - b) The maximum output method; required valve capacity is determined by the following equation:

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

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

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

In many cases, a relieving capacity greater than the minimum capacity specified by these rules have to be provided. In every case, the requirement of 2.5.2 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 2.5.2 e). The additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.

2.5.3 PRESSURE RELIEF VALVE REQUIREMENTS FOR HOT WATER HEATING OR HOT WATER SUPPLY BOILERS (25)

- a) Pressure relief valves shall be manufactured in accordance with a national or international standard and shall be National Board capacity-certified.
- 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. Each pressure relief valve shall be 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 2.5.3 b), above, one or more National Board capacity-certified temperature and pressure relief valves of the automatic reseating type. Each temperature and pressure relief valve shall be set to relieve at or below the boiler's maximum allowable working pressure.
- d) No pressure relief valve shall be smaller than NPS 3/4 (DN 20) nor larger than NPS 4 (DN 100), except for boilers having a heat input not greater than 15,000 Btu/hr (4.4 kW), which should be equipped with a rated pressure relief valve of NPS 1/2 (DN 15).

- e) The required relieving capacity of the boiler's pressure relief valve(s) in lbs/hr (kg/hr) 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/lb (645 W/kg), or shall be determined on the basis of lbs steam/hr/ft² (kg steam/hr/m²), as given in Table 2.2.4. For cast-iron boilers, the minimum valve capacity shall be determined by the maximum output method. In many cases, a greater relieving capacity of valves than the minimum specified by these rules will have to be provided. In every case, the requirements of 2.5.3 g) shall be met.
- 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 shall be in accordance with 2.5.3 g). The additional valves required on account of changed conditions may be installed on the outlet piping, provided there is no intervening valve.
- g) 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 2.5.3 b) or c).

(25) 2.5.4 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 or spring-loaded pressure relief valve. No pressure relief valve shall be smaller than NPS 3/4 (DN 20).

Note: Temperature and pressure relief valves are recommended for fired storage water heaters due to the additional temperature relief function provided. Other standards for this equipment may require the use of temperature and pressure relief valves. The design or size of the water heater may not be compatible with the use of a temperature and pressure relief valve.

- 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 (e.g., valves, pumps, expansion or storage tanks, or piping) have a lower working pressure rating than the water heater, the pressure setting for the pressure relief valve(s) shall be based upon the component with the lowest maximum allowable working pressure rating. If more than one pressure relief valve is used, the additional valve(s) may be set within a range not to exceed 110% of the set pressure of the first valve.
- c) The required relieving capacity of the pressure relief valve in Btu/hr (W) shall not be less than the maximum rated heat input unless the rated burner input capacity is marked on the water heater casing in a readily visible location. In this 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 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 exceed 110% of 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. They may also have a Canadian Standards Association (CSA) rating value, which is lower than the National Board 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 (e.g., plumbing or building code), then that rating shall be used.

- d) If operating conditions are changed or additional heating surface is installed, the 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. Any additional valves required resulting from changed conditions may be installed on the outlet piping, provided there is no intervening valve.

2.5.4.1 INSTALLATION

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

2.5.4.2 PERMISSIBLE INSTALLATIONS

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

2.5.4.3 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 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.

2.5.4.4 THREADED CONNECTIONS

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

2.5.4.5 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.

2.5.4.6 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.

2.5.4.7 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.
- d) Discharge piping shall be rated for the discharge fluid conditions of pressure and temperature including a minimum and maximum design temperature. Material selection for the discharge piping shall consider the reduction in material toughness at the low end of design temperature and the reduction in material strength at the high end of design temperature. Rigid pipe or tubing should be used for discharge lines that carry hot water or steam.
- e) Plastic discharge pipe and fittings are permitted (when compatible with the process fluid, system design temperatures, and other ambient conditions such as light and humidity) and shall conform to NSF/ANSI 14 Plastics Piping System Components and Related Materials.
- f) Discharge piping shall be rated for any static pressure present and the back pressure that may develop when the pressure relief device is at full capacity. Where multiple pressure relief devices or vents discharge into common piping, the back pressure that could develop due to simultaneous flow from all sources shall be considered.

2.5.5 PRESSURE RELIEF VALVES FOR TANKS AND HEAT EXCHANGERS

(25) 2.5.5.1 STEAM TO HOT-WATER SUPPLY

When a hot-water supply system is heated indirectly by steam in a coil or pipe, 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 installed on the tank.

(25) 2.5.5.2 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, 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; the pressure relief valve(s) shall also be of sufficient rated capacity to prevent the heat exchanger pressure from rising more than 10% above the maximum allowable working pressure of the vessel.

(25) 2.5.5.3 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, 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); the pressure relief valve(s) shall also be 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.

2.6 PRESSURE VESSEL PRESSURE RELIEF DEVICES

See NBIC Part 1, 4.1 for the scope of pressure vessels covered by the requirements of Part 4, 2.6.

Pressure relief devices protecting pressure vessels shall meet 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.
- 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.

2.6.2 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.

2.6.3 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 2.6.6 e).
- 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.

2.6.4 CAPACITY

- a) The pressure relief device(s) shall have sufficient capacity to ensure that the pressure vessel is not exposed to pressure greater than that specified in the original code of construction.
- b) Pressure vessels that can be exposed to fire or other sources of unexpected external heat may require supplemental pressure relief devices to provide additional relieving capacity.
 - 1) The combined capacity of all installed pressure relief devices shall be adequate to prevent the pressure from rising more than 21% above maximum allowable working pressure.
 - 2) The set point of any supplemental pressure relief device(s) shall not exceed 110% of the maximum allowable working pressure. If a single pressure relief device is utilized to protect the vessel during both operational and fire or other unexpected external heating conditions, the set point shall not exceed maximum allowable working pressure.
- c) Vessels connected together by a system of piping not containing valves that can isolate any pressure vessel may be considered as one unit when determining capacity requirements.

- d) Heat exchangers and similar vessels shall be protected with a pressure relief device of sufficient capacity to avoid overpressure in case of internal failure.
- e) When a non-reclosing device is installed between a pressure relief valve and the pressure vessel, the reduction in capacity due to installation of the non-reclosing device shall be determined in accordance with the code of construction by use of a National Board certified Combination Capacity Factor (CCF). For rupture disks, if a certified combination capacity factor is not available, the capacity of the pressure relief valve shall be multiplied by 0.9 and this value used as the capacity of the combination installation.
- f) The owner shall document the basis for selection of the pressure relief devices used, including capacity, and have such calculations available for review by the Jurisdiction.

2.6.5 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.
- 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.

2.6.6 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 2.6.6 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 2.6.6 a).
- e) There shall be no intervening stop valves between the vessel and its pressure relief device(s), or between the pressure relief device(s) and the point of discharge, except under the following conditions:
 - 1) When these stop valves are so constructed or positively controlled that the closing of the maximum number of block valves at one time will not reduce the pressure relieving capacity below the required relieving capacity.
 - 2) Upon specific acceptance of the Jurisdiction, when necessary for the continuous operation of processing equipment of such a complex nature that shutdown of any part is not feasible, a full area stop valve between a pressure vessel and its pressure relief device may be provided for inspection and repair purposes only. This stop valve shall be arranged so that it can be locked or sealed open, and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station.

- 3) A full area stop valve may also be placed on the discharge side of a pressure relief device when its discharge is connected to a common header for pressure relief devices to prevent discharges from these other devices from flowing back to the first device during inspection and repair. This stop valve shall be arranged so that it can be locked or sealed open, and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked and sealed in the open position before the authorized person leaves the station. This valve shall only be used when a stop valve on the inlet side of the pressure relief device is first closed.
 - 4) A pressure vessel in a system where the pressure originates from an outside source may have a stop valve between the vessel and the pressure relief device, and this valve need not be sealed open, provided it also closes off that vessel from the source of the pressure.
 - 5) Pressure vessels designed for human occupancy (such as decompression or hyperbaric chambers) shall be provided with a quick opening stop valve between the pressure vessel and its pressure relief valve. The stop valve shall be normally sealed open with a frangible seal and be readily accessible to the pressure relief attendant.
- f) All pressure relief devices shall relieve to a safe point of discharge.
 - g) Discharge lines from pressure relief devices shall be designed to facilitate drainage or be fitted with drains to prevent liquid from collecting in the discharge side of a pressure relief device. The size of discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the pressure relief device or adversely affect the operation of the pressure relief device. It shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.
 - h) Pressure relief devices shall be installed so they are readily accessible for inspection, repair, or replacement.
 - i) Pressure 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 other industry standards, as applicable.

2.6.7 TEMPERATURE AND PRESSURE RELIEF DEVICES FOR HOT WATER STORAGE TANKS/POTABLE HOT WATER STORAGE TANK

- a) Each potable hot water storage tank shall be equipped with an ASME/NB certified temperature and pressure relief valve set at a pressure not to exceed the maximum allowable working pressure and 210°F.(99°C).
- b) Potable hot water storage tanks exceeding the pressure limit of ASME Code Section IV shall meet the original code of construction and shall be protected by a pressure relief valve set not to exceed the vessel's maximum allowable working pressure. A temperature limiting device shall be installed so that the water inside the storage tank does not exceed 210°F (99°C).
- c) Each hot water storage tank shall be equipped with an ASME/NB certified pressure relief valve set at a pressure not to exceed the maximum allowable working pressure.
- d) The temperature and pressure relief valves shall meet the requirements of 2.6.1 through 2.6.6 above.

2.7 PIPING SYSTEM PRESSURE RELIEF DEVICES

See NBIC Part 1, Section 5 for the piping systems associated with Part 4, 2.7.

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

2.7.1 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.

2.7.2 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.

2.7.3 LOCATION

Pressure relief devices, except those covered by NBIC Part 4, 2.2 through 2.5, may be installed at any location in the system provided the pressure in any portion of the system cannot exceed the maximum over-pressure permitted by the original code of construction. Pressure drop to the pressure relief device under flowing conditions shall be considered when determining pressure relief device location. The pressure-relief device shall not be isolated from the piping system except as permitted by 2.7.6 e).

2.7.4 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.

2.7.5 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.

2.7.6 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 2.7.6 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 2.7.6 a).
- e) There shall be no intervening stop valves between the piping system and its pressure relief device(s), or between the pressure relief device(s) and the point of discharge except under the following conditions:
 - 1) These stop valves shall be so constructed or positively controlled that the closing of the maximum number of block valves at one time will not reduce the pressure relieving capacity below the required relieving capacity;
 - 2) Upon specific acceptance of the Jurisdiction, when necessary for the continuous operation of processing equipment of such a complex nature that shutdown of any part is not feasible, a full area stop valve between a piping system and its pressure relief device may be provided for inspection and repair purposes only. This stop valve shall be arranged so that it can be locked or sealed open and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station;
 - 3) A full area stop valve may be placed on the discharge side of a pressure relief device when its discharge is connected to a common header for pressure relief devices to prevent discharges from these other devices from flowing back to the first device during inspection and repair. This stop valve shall be arranged so that it can be locked or sealed open and it shall not be closed except by an authorized person who shall remain stationed there during that period of operation while the valve remains closed. The valve shall be locked or sealed in the open position before the authorized person leaves the station. This valve shall only be used when a stop valve on the inlet side of the pressure relief device is first closed; or
 - 4) A piping system where the pressure originates from an outside source may have a stop valve between the system and the pressure relief device, and this valve need not be sealed open, provided it also closes off that vessel from the source of pressure.

- f) Pressure relief device discharges shall be arranged such that they are not a hazard to personnel or other equipment and, when necessary, lead to a safe location for disposal of fluids being relieved.
- g) Discharge lines from pressure relief devices shall be designed to facilitate drainage or be fitted with drains to prevent liquid from collecting in the discharge side of a pressure relief device. The size of discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the pressure relief device or adversely affect the operation of the pressure relief device. It shall be as short and straight as possible and arranged to avoid undue stress on the pressure relief device.
- h) The reaction forces due to discharge of pressure relief devices shall be considered in the design of the inlet and discharge piping.
- i) Pressure relief devices shall be installed so they are accessible for inspection, repair, or replacement.