



2019 NBIC

NATIONAL BOARD INSPECTION CODE



PART 4

PRESSURE
RELIEF DEVICES

NATIONAL BOARD INSPECTION CODE

2019 EDITION

DATE OF ISSUE — JULY 1, 2019

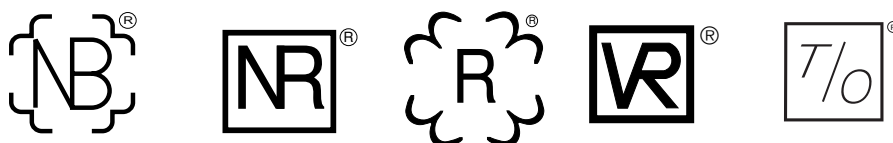
This code was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code was balanced to ensure that individuals from competent and concerned interests had an opportunity to participate. The proposed code was made available 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.nationalboard.org

Copyright © 2019 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-Retaining Items	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	3
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 Devices	9
2.3.3 Location	9
2.3.4 Capacity	9
2.3.5 Set Pressure	9
2.3.6 Installation	9
2.4 Pressure Relief Valves for Steam Heating, Hot Water Heating, and Hot Water Supply Boiler	11
2.4.1 General Requirements	11
2.4.1.1 Installation of Pressure Relief Valves for Heating Boilers	11
2.4.1.1.1 Permissible Installation	11
2.4.1.1.2 Requirements for Common Connections for Two or More Valves	11
2.4.1.2 Threaded Connections	11
2.4.1.3 Prohibited Installations	12
2.4.1.4 Use of Shutoff Valves Prohibited	12
2.4.1.5 Pressure Relief Valve Discharge Piping	12
2.4.1.6 Temperature and Pressure Relief Valves	12
2.4.2 Pressure Relief Valve Requirements for Steam Heating Boilers	12
2.4.3 Pressure Relief Valve Requirements for Hot Water Heating or Hot Water Supply Boilers	13
2.4.4 Temperature and Pressure Relief Valve Requirements for Potable Water Heaters	14
2.4.4.1 Installation	14
2.4.4.2 Permissible Installations	15
2.4.4.3 Requirements for Common Connection for Two or More Valves	15
2.4.4.4 Threaded Connections	15
2.4.4.5 Prohibited Installations	15
2.4.4.6 Use of Shutoff Valves Prohibited	15
2.4.4.7 Temperature and Pressure Relief Valve Discharge Piping	15
2.4.5 Pressure Relief Valves for Tanks and Heat Exchangers	16

2.4.5.1	Steam to Hot-Water Supply	16
2.4.5.2	High Temperature Water to Water Heat Exchanger	16
2.4.5.3	High Temperature Water to Steam Heat Exchanger	16
2.5	Pressure Vessel Pressure Relief Devices	16
2.5.1	Device Requirements	16
2.5.2	Number of Devices	16
2.5.3	Location	17
2.5.4	Capacity	17
2.5.5	Set Pressure	17
2.5.6	Installation and Discharge Piping Requirements	18
2.5.7	Temperature and Pressure Relief Devices for Hot Water Storage Tanks	19
2.6	Piping System Pressure Relief Devices	19
2.6.1	Device Requirements	19
2.6.2	Number of Devices	19
2.6.3	Location	20
2.6.4	Capacity	20
2.6.5	Set Pressure	20
2.6.6	Inlet and Discharge Piping Requirements	20
Section 3	In-service Inspection of Pressure Relief Devices	22
3.1	Scope	22
3.2	General	22
3.2.1	Pressure Relief Device Data	22
3.2.2	Inspection Requirements for Device Condition	23
3.2.3	Inspection Requirements for Installation Condition	23
3.2.4	Additional Inspection Requirements	24
3.2.4.1	Power Boilers	24
3.2.4.2	Hot-Water Heating Boilers, Hot Water Supply Boilers, and Water Heaters	24
3.2.4.3	Pressure Vessels and Piping	24
3.2.4.4	Rupture Disks	24
3.2.5	Testing and Operational Inspection of Pressure Relief Devices	26
3.2.5.1	Corrective Action	27
3.2.5.2	Valve Adjustments	27
3.2.6	Recommended Inspection and Testing Frequencies for Pressure Relief Devices	27
3.2.6.1	Establishment of Inspection and Test Intervals	29
3.2.6.2	Establishment of Service Intervals	29
3.3	Accreditation of "T/O" Test Only Organizations	30
3.3.1	Scope	30
3.3.2	Jurisdictional Participation	30
3.3.3	Quality System	30
3.3.3.1	General	30
3.3.3.2	Written Description	30
3.3.3.3	Maintenance of a Controlled Copy	31
3.3.3.4	Outline of Requirements for a Quality System	31
3.3.4	Testing & Adjustment	34
3.3.4.1	Audit Requirements	35
3.4	Training and Qualification of Personnel	35
3.4.1	Contents of Training Program	35
3.5	Marking Requirements for Valves Tested Under the "T/O" Program	35
3.5.1	Nameplates	35
3.5.2	Test Only Nameplate & Valve Sealing	36
Section 4	Repair of Pressure Relief Valves	37
4.1	Scope	37
4.2	General Requirements	37
4.2.1	"VR" Repair	37
4.2.2	Construction Standards for Pressure Relief Devices	37
4.2.3	Installation of Pressure Relief Devices	38
4.2.4	Initial Adjustments to Pressure Relief Valves	38

4.3	Materials for Pressure Relief Valve Repair.....	38
4.3.1	Replacement Parts for Pressure Relief Devices	38
4.4	Welding for Pressure Relief Valves	39
4.4.1	Welding Procedure Specifications.....	39
4.4.2	Standard Welding Procedure Specifications	39
4.4.3	Performance Qualification	39
4.4.4	Welding Records	40
4.4.5	Welder's Identification	40
4.4.6	Welder's Continuity	40
4.4.7	Weld Repairs to Pressure Relief Valve Parts by an "R" Stamp Holder	40
4.5	Heat Treatment.....	41
4.5.1	Preheating	41
4.5.2	Postweld Heat Treatment	41
4.6	Pressure Relief Valve Performance Testing and Testing Equipment	41
4.6.1	Test Medium and Testing Equipment	41
4.6.2	Owner-User ASME Code Section VIII Steam Testing	42
4.6.3	Lift Assist Testing	42
4.6.4	Pressure Test of Parts	43
4.7	Stamping Requirements for Pressure Relief Devices	43
4.7.1	Nameplates	43
4.7.2	Repair Nameplates	44
4.7.3	Changes to Original Pressure Relief Valve Nameplate Information	45
4.7.4	Test Only Nameplate	45
4.7.5	Replacement of Illegible or Missing Nameplates	46
4.8	Accreditation of "VR" Repair Organizations	46
4.8.1	Scope	46
4.8.2	Jurisdictional Participation	46
4.8.3	Issuance and Renewal of the "VR" <i>Certificate of Authorization</i>	47
4.8.3.1	General.....	47
4.8.3.2	Issuance of Certificate	47
4.8.4	Use of the "VR" Authorization	47
4.8.4.1	Technical Requirements	47
4.8.4.2	Stamp Use	47
4.8.5	Quality System	47
4.8.5.1	General	47
4.8.5.2	Written Description	47
4.8.5.3	Maintenance of Controlled Copy	47
4.8.5.4	Outline of Requirements for a Quality System	48
4.8.6	Field Repair	53
4.8.6.1	Audit Requirements	53
4.8.6.2	Use of Owner or User Personnel	53
4.9	Training and Qualification of Personnel	53
4.9.1	Contents of Training Program	53
4.9.2	Qualification of Personnel	54
4.9.3	Annual Review of Qualification	54
Section 5	INTENTIONALLY LEFT BLANK	55
Section 6	Supplements	56
Supplement 1	Pressure Relief Valves on the Low Pressure side of Steam Pressure	
	Reducing Valves	56
S1.1	Scope	56
S1.2	Pressure Relief Valve Capacity	56
S1.3	Calculation of Pressure Relief Valve Relieving Capacity	57
S1.4	Steam Flow When Flow Coefficients are Not Known	64
S1.5	Two-Stage Pressure Reducing Valve Stations	64

Supplement 2 Pressure Differential Between Pressure Relief Valve Setting and Boiler or Pressure Vessel Operating Pressure	66
S2.1 Scope	66
S2.2 Hot Water Heating Boilers	66
S2.3 Steam Heating Boilers	66
S2.4 Power Boilers	66
S2.5 Pressure Vessels	67
Supplement 3 Guide to Jurisdictions for Authorization of Owners or Users to Make Adjustments to Pressure Relief Valves	69
S3.1 General	69
S3.2 Training	69
S3.3 Documentation	69
S3.4 Quality System	69
S3.5 External Adjustments	70
S3.6 Repairs	70
Supplement 4 Recommended Procedures for Repairing Pressure Relief Valves	71
S4.1 Introduction	71
S4.2 Spring-Loaded Pressure Relief Valves	71
S4.3 Pilot Operated Pressure Relief Valves	73
S4.4 Packaging, Shipping and Transportation of Pressure Relief Devices	75
Supplement 5 Recommended Guide for the Design of a Test System for Pressure Relief Devices in Compressible Fluid Service	76
S5.1 Scope	76
S5.2 General	76
S5.3 Test System Description	76
S5.4 Test Vessel Sizing Data	78
Supplement 6 Procedures for Repairs of Nuclear Safety Related Pressure Relief Valves	80
S6.1 Scope	80
S6.2 Definitions	80
S6.3 Nuclear Safety Related Valve Groups	80
S6.4 Administrative Procedures	80
S6.5 General Rules	81
Supplement 7 Recommended Procedures for Test Only of Pressure Relief Valves	83
S7.1 Introduction	83
S7.2 Pressure Relief Valves	83
Section 7 NBIC Policy for Metrication	85
7.1 General	85
7.2 Equivalent Rationale	85
7.3 Procedure for Conversion	85
7.4 Referencing Tables	86
Section 8 Preparation of Technical Inquiries to the <i>National Board Inspection Code Committee</i>	91
8.1 Introduction	91
8.2 Inquiry Format	91
8.3 Code Revisions or Additions	92
8.4 Code Interpretations	92
8.5 Submittals	93
Section 9 Glossary of Terms	94
9.1 Definitions	94

Section 10	NBIC Approved Interpretations	101
10.1	Scope	101
Section 11	Index	111

INTRODUCTION

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

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

SCOPE

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

- Installation
- Inspection
- Repairs and Alterations

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

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

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

ORGANIZATION

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

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

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

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

TEXT IDENTIFICATION AND NUMBERING

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

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

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

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

SUPPLEMENTS

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

EDITIONS

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

CODE STAMPING

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

INTERPRETATIONS, CODE ADDITIONS AND CODE REVISIONS

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

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

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

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

JURISDICTIONAL PRECEDENCE

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

UNITS OF MEASUREMENT

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

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

ACCREDITATION PROGRAMS

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

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

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

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

New Construction

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

Inservice

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

Owner-User

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

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

Federal Government

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

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

CERTIFICATES OF AUTHORIZATION FOR ACCREDITATION PROGRAMS

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

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