ASME BPVC.XIII-2023

SECTION XIII

2023 ASME Boiler and Pressure Vessel Code

An International Code

Rules for Overpressure Protection

ASME

SETTING THE STANDARD

AN INTERNATIONAL CODE

2023 ASME Boiler & Pressure Vessel Code

2023 Edition July 1, 2023

XIII

RULES FOR OVERPRESSURE PROTECTION

ASME Boiler and Pressure Vessel Committee
on Overpressure Protection

The American Society of Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: July 1, 2023

Library of Congress Catalog Card Number: 56-3934

Adopted by the Council of The American Society of Mechanical Engineers, 1914; latest edition 2023.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD*

In 1911, The American Society of Mechanical Engineers established the Boiler and Pressure Vessel Committee to formulate standard rules for the construction of steam boilers and other pressure vessels. In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees:

(a) Committee on Power Boilers (I)
(b) Committee on Materials (II)
(c) Committee on Construction of Nuclear Facility Components (III)
(d) Committee on Heating Boilers (IV)
(e) Committee on Nondestructive Examination (V)
(f) Committee on Pressure Vessels (VIII)
(g) Committee on Welding, Brazing, and Fusing (IX)
(h) Committee on Fiber-Reinforced Plastic Pressure Vessels (X)
(i) Committee on Nuclear Inservice Inspection (XI)
(j) Committee on Transport Tanks (XII)
(k) Committee on Overpressure Protection (XIII)
(l) Technical Oversight Management Committee (TOMC)

Where reference is made to "the Committee" in this Foreword, each of these committees is included individually and collectively.

The Committee's function is to establish rules of safety relating to pressure integrity, which govern the construction** of boilers, pressure vessels, transport tanks, and nuclear components, and the inservice inspection of nuclear components and transport tanks. The Committee also interprets these rules when questions arise regarding their intent. The technical consistency of the Sections of the Code and coordination of standards development activities of the Committees is supported and guided by the Technical Oversight Management Committee. This Code does not address other safety issues relating to the construction of boilers, pressure vessels, transport tanks, or nuclear components, or the inservice inspection of nuclear components or transport tanks. Users of the Code should refer to the pertinent codes, standards, laws, regulations, or other relevant documents for safety issues other than those relating to pressure integrity. Except for Sections XI and XII, and with a few other exceptions, the rules do not, of practical necessity, reflect the likelihood and consequences of deterioration in service related to specific service fluids or external operating environments. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property, and to provide a margin for deterioration in service to give a reasonably long, safe period of usefulness. Advancements in design and materials and evidence of experience have been recognized.

This Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities and inservice inspection and testing activities. The Code does not address all aspects of these activities and those aspects that are not specifically addressed should not be considered prohibited. The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment. The phrase *engineering judgment* refers to technical judgments made by knowledgeable engineers experienced in the application of the Code. Engineering judgments must be consistent with Code philosophy, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of the Code.

The Committee recognizes that tools and techniques used for design and analysis change as technology progresses and expects engineers to use good judgment in the application of these tools. The designer is responsible for complying with Code rules and demonstrating compliance with Code equations when such equations are mandatory. The Code neither requires nor prohibits the use of computers for the design or analysis of components constructed to the requirements of the Code. However, designers and engineers using computer programs for design or analysis are cautioned that they are responsible for all technical assumptions inherent in the programs they use and the application of these programs to their design.

* The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Code.

** *Construction*, as used in this Foreword, is an all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification, and overpressure protection.

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

The Committee meets regularly to consider revisions of the rules, new rules as dictated by technological development, Code Cases, and requests for interpretations. Only the Committee has the authority to provide official interpretations of this Code. Requests for revisions, new rules, Code Cases, or interpretations shall be addressed to the Secretary in writing and shall give full particulars in order to receive consideration and action (see Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees). Proposed revisions to the Code resulting from inquiries will be presented to the Committee for appropriate action. The action of the Committee becomes effective only after confirmation by ballot of the Committee and approval by ASME. Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute (ANSI) and published at http://go.asme.org/BPVCPublicReview to invite comments from all interested persons. After public review and final approval by ASME, revisions are published at regular intervals in Editions of the Code.

The Committee does not rule on whether a component shall or shall not be constructed to the provisions of the Code. The scope of each Section has been established to identify the components and parameters considered by the Committee in formulating the Code rules.

Questions or issues regarding compliance of a specific component with the Code rules are to be directed to the ASME Certificate Holder (Manufacturer). Inquiries concerning the interpretation of the Code are to be directed to the Committee. ASME is to be notified should questions arise concerning improper use of the ASME Single Certification Mark.

When required by context in this Section, the singular shall be interpreted as the plural, and vice versa, and the feminine, masculine, or neuter gender shall be treated as such other gender as appropriate.

The words "shall," "should," and "may" are used in this Standard as follows:

– *Shall* is used to denote a requirement.
– *Should* is used to denote a recommendation.
– *May* is used to denote permission, neither a requirement nor a recommendation.

STATEMENT OF POLICY ON THE USE OF THE ASME SINGLE CERTIFICATION MARK AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use the ASME Single Certification Mark for marking items or constructions that have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the ASME Single Certification Mark for the benefit of the users, the enforcement jurisdictions, and the holders of the ASME Single Certification Mark who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the ASME Single Certification Mark, Certificates of Authorization, and reference to Code construction. The American Society of Mechanical Engineers does not "approve," "certify," "rate," or "endorse" any item, construction, or activity and there shall be no statements or implications that might so indicate. An organization holding the ASME Single Certification Mark and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities "are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code," or "meet the requirements of the ASME Boiler and Pressure Vessel Code." An ASME corporate logo shall not be used by any organization other than ASME.

The ASME Single Certification Mark shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of the ASME Single Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the ASME Single Certification Mark.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the ASME Single Certification Mark described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the ASME Single Certification Mark shall not be used on any item that is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME that tend to imply that all Code requirements have been met when, in fact, they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

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CORRESPONDENCE WITH THE COMMITTEE

General

ASME codes and standards are developed and maintained by committees with the intent to represent the consensus of concerned interests. Users of ASME codes and standards may correspond with the committees to propose revisions or cases, report errata, or request interpretations. Correspondence for this Section of the ASME Boiler and Pressure Vessel Code (BPVC) should be sent to the staff secretary noted on the Section's committee web page, accessible at https://go.asme.org/CSCommittees.

NOTE: See ASME BPVC Section II, Part D for guidelines on requesting approval of new materials. See Section II, Part C for guidelines on requesting approval of new welding and brazing materials ("consumables").

Revisions and Errata

The committee processes revisions to this Code on a continuous basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Code. Approved revisions will be published in the next edition of the Code.

In addition, the committee may post errata and Special Notices at http://go.asme.org/BPVCerrata. Errata and Special Notices become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata and Special Notices.

This Code is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Code

(4) to permit use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Code.

(c) The committee will consider proposed cases concerning the following topics only:

(1) equipment to be marked with the ASME Single Certification Mark, or

(2) equipment to be constructed as a repair/replacement activity under the requirements of Section XI

(d) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Code Section and the paragraph, figure, or table number(s) to which the proposed case applies

(4) the edition(s) of the Code to which the proposed case applies

(e) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Cases that have been approved will appear in the next edition or supplement of the Code Cases books, "Boilers and Pressure Vessels" or "Nuclear Components." Each Code Cases book is updated with seven Supplements. Supplements will be sent or made available automatically to the purchasers of the Code Cases books until the next edition

of the Code. Annulments of Code Cases become effective six months after the first announcement of the annulment in a Code Case Supplement or Edition of the appropriate Code Case book. The status of any case is available at http://go.asme.org/BPVCCDatabase. An index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases is available at http://go.asme.org/BPVCC.

Interpretations

(a) Interpretations clarify existing Code requirements and are written as a question and reply. Interpretations do not introduce new requirements. If a revision to resolve conflicting or incorrect wording is required to support the interpretation, the committee will issue an intent interpretation in parallel with a revision to the Code.

(b) Upon request, the committee will render an interpretation of any requirement of the Code. An interpretation can be rendered only in response to a request submitted through the online Interpretation Submittal Form at http://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic e-mail confirming receipt.

(c) ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers may track the status of their requests at http://go.asme.org/Interpretations.

(d) ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME committee or subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

(e) Interpretations are published in the ASME Interpretations Database at http://go.asme.org/Interpretations as they are issued.

Committee Meetings

The ASME BPVC committees regularly hold meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the applicable committee. Information on future committee meetings can be found at http://go.asme.org/BCW.

SUMMARY OF CHANGES

Changes listed below are identified on the pages by a margin note, **(23)**, placed next to the affected area.

Page	*Location*	*Change*
viii	List of Sections	(1) Under Section III, Division 4 added
		(2) Title of Section XI and subtitle of Section XI, Division 2 revised
		(3) Information on interpretations and Code cases moved to "Correspondence With the Committee"
xii	Personnel	Updated
xxxiv	Correspondence With the Committee	Added (replaces "Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees")
xxxvii	Cross-Referencing in the ASME BPVC	Updated
5	Table 2.1-1	Note (9) revised
7	3.1.2	Subparagraph (b) revised
9	3.3.2	Subparagraph (d) revised
10	3.4.2.3	Subparagraphs (a) and (b) revised
11	3.5	Subparagraphs (b) and (c) added and subsequent subparagraphs redesignated
12	3.6.2	Subparagraph (b) revised
13	Table 3.6.3.1-2	Last UV row and Note (3) added
13	3.6.4	Subparagraph (b) revised
14	3.9	Subparagraph (e)(5)(-b) revised
17	4.2	Subparagraph (d) added
19	4.7.3	Subparagraph (g) revised
20	5.2	Subparagraph (j) revised
44	10.7	Subparagraph (b) revised
50	I-2	Definitions of *Assembler*, *Manufacturer*, and *Material Test Report* revised
58	III-2.11	Revised in its entirety
58	III-2.13	Subparagraph (d) revised
74	Table C-2-1	Instructions for reference number (17) revised
77	Table C-2-2	Instructions for reference number (18) revised
78	Form K-4	"Certification of Shop Compliance" editorially revised
79	Table C-2-3	Instructions for reference number (18) revised
80	Form K-5	"Certification of Shop Compliance" editorially revised
81	Table C-2-4	Instructions for reference number (17) revised
84	Table C-2-5	Instructions for reference number (18) revised

CROSS-REFERENCING IN THE ASME BPVC (23)

Paragraphs within the ASME BPVC may include subparagraph breakdowns, i.e., nested lists. The following is a guide to the designation and cross-referencing of subparagraph breakdowns:

(a) Hierarchy of Subparagraph Breakdowns

(1) First-level breakdowns are designated as (a), (b), (c), etc.

(2) Second-level breakdowns are designated as (1), (2), (3), etc.

(3) Third-level breakdowns are designated as (-a), (-b), (-c), etc.

(4) Fourth-level breakdowns are designated as (-1), (-2), (-3), etc.

(5) Fifth-level breakdowns are designated as (+a), (+b), (+c), etc.

(6) Sixth-level breakdowns are designated as (+1), (+2), etc.

(b) Cross-References to Subparagraph Breakdowns. Cross-references within an alphanumerically designated paragraph (e.g., PG-1, UIG-56.1, NCD-3223) do not include the alphanumerical designator of that paragraph. The crossreferences to subparagraph breakdowns follow the hierarchy of the designators under which the breakdown appears. The following examples show the format:

(1) If X.1(c)(1)(-a) is referenced in X.1(c)(1), it will be referenced as (-a).

(2) If X.1(c)(1)(-a) is referenced in X.1(c)(2), it will be referenced as (1)(-a).

(3) If X.1(c)(1)(-a) is referenced in X.1(e)(1), it will be referenced as (c)(1)(-a).

(4) If X.1(c)(1)(-a) is referenced in X.2(c)(2), it will be referenced as X.1(c)(1)(-a).

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PART 1
GENERAL REQUIREMENTS

1.1 SCOPE

(a) The rules of this Section provide the requirements for the overpressure protection of pressurized equipment such as boilers, pressure vessels, and piping systems. Overpressure protection methods include

(1) releasing excess pressure by use of pressure relief devices

(2) applying controls to prevent an increase in pressure (overpressure protection by system design)

(3) using a combination of (1) and (2)

(b) The referencing Code or Standard specifies the objectives of the overpressure protection and acceptable methods to achieve it. Where a pressure-releasing overpressure protection method is specified, the referencing Code or Standard identifies the permissible devices based on this Section's rules for devices to be marked with the Certification Mark and appropriate Designator (e.g., HV, UV, UD).

(c) This Section includes

(1) requirements relating to pressure integrity and performance governing the construction and installation of pressure relief devices. Construction requirements include materials, design, manufacture, examination, inspection, production testing, and certification. Installation requirements address only the variables that affect the performance and pressure-relieving function of the devices, including the inlet and outlet piping.

(2) requirements for conducting tests and analyses to determine the performance of pressure relief devices. These include rules for device-type certification of relieving capacity and/or flow resistance and production testing for new pressure relief devices.

(3) requirements for the use of overpressure protection by system design.

(4) Mandatory Appendices that address specific subjects not covered elsewhere in this Section.

(5) Nonmandatory Appendices that provide information and suggested best practices.

(d) This Section contains requirements, specific prohibitions, and nonmandatory guidance for the design, materials, manufacture, examination, inspection, testing, assembly, installation, and certification of pressure relief devices. The Code does not address all aspects of overpressure protection, and those aspects that are not specifically addressed should not be considered prohibited. In these situations, engineering judgment shall be applied in a manner consistent with the philosophy of this Section, and such judgments shall never be used to overrule mandatory requirements or specific prohibitions of this Section or the referencing Code or Standard.

(e) The scope of this Section has been established to identify the devices and methods considered in formulating the rules given in this Section. Laws or regulations issued by municipal, state, provincial, federal, or other enforcement or regulatory bodies having jurisdiction at the location of an installation establish the mandatory applicability of the Code rules, in whole or in part, within their jurisdiction.

(f) In relation to the geometry of pressure-containing and pressure-retaining parts of a device, the scope of this Section shall begin at the inlet connection of the device and end at the outlet connection of the device. The inlet and outlet connections are defined as

(1) the first circumferential joint for welded connections, excluding the connecting weld

(2) the first threaded joint for screwed connections

(3) the face of the flange for bolted, flanged connections, excluding the bolting

(4) the first sealing surface for proprietary connections or fittings

1.2 ORGANIZATION

(a) This Section is divided into 13 Parts.

(1) Part 1 contains the scope and general requirements of this Section.

(2) Part 2 contains the responsibilities for providing overpressure protection.

(3) Part 3 contains requirements for the design, materials, inspection, testing, welding, and marking of pressure relief valves.

(4) Part 4 contains requirements for the design, materials, inspection, testing, welding, and marking of rupture disk devices.

(5) Part 5 contains requirements for the design, materials, inspection, testing, welding, and marking of pin devices.

(6) Part 6 contains requirements for the design, materials, inspection, testing, welding, and marking of spring-actuated non-reclosing devices.

(7) Part 7 contains requirements for the design, materials, inspection, testing, welding, and marking of temperature and pressure relief valves.

Table 1.4-1
Year of Acceptable Edition of Referenced Standards in This Section

Designator	Title	Acceptable Edition
ANSI/API Standard 521	Pressure-Relieving and Depressuring Systems	2007, 5th Ed.
ANSI Z21.22/CSA 4.4	Valves for Hot Water Supply Systems	2015
API 527	Seat Tightness of Pressure Relief Valves	2014, 4th Ed.
ASME B16.34	Valves — Flanged, Threaded, and Welding End	Latest edition
ASME B31.3	Process Piping	Latest edition
ASME B36.10M	Welded and Seamless Wrought Steel Pipe	2015
ASME CA-1	Conformity Assessment Requirements	Latest edition
ASME PTC 25	Pressure Relief Devices	2018
ASME QAI-1	Qualifications for Authorized Inspections	2018
NBBI NB-18	Pressure-Relief Device Certification	Latest edition
WRC Bulletin 498	Guidance on the Application of Code Case 2211 — Overpressure Protection by Systems Design	2005

(8) Part 8 contains requirements for the use and marking of devices in combination.

(9) Part 9 contains requirements for capacity and flow resistance certification certification of pressure relief devices.

(10) Part 10 contains requirements concerning the use of the Certification Mark.

(11) Part 11 contains requirements for open flow paths and vents.

(12) Part 12 contains requirements and guidelines for the installation of pressure relief devices; these requirements and guidelines address only the variables that affect the performance and pressure-relieving function of the devices.

(13) Part 13 contains requirements for overpressure protection by system design.

(b) The Mandatory Appendices contain specific rules that are not covered elsewhere in this Section. Their requirements are mandatory, when applicable.

(c) The Nonmandatory Appendices provide information and suggested best practices. The information provided is not mandatory; however, if guidance in a Nonmandatory Appendix is used, it shall be used in its entirety.

(d) When a Part, Article, or paragraph is referenced in this Section, the reference shall be taken to include all subdivisions under that Part, Article, or paragraph (including all subparagraphs) and any tables, charts, or figures referenced by that paragraph.

(e) Figures and tables providing relevant illustrations or supporting information for text passages have been designated based on the paragraph they illustrate or support. For a single figure or table, the designator consists of the relevant paragraph designator followed by "-1" (e.g., "10.1-1"). For multiple figures or tables referenced by the same paragraph, each designator consists of the paragraph number followed by a hyphenated numerical suffix that reflects the order of reference.

1.3 DEFINITIONS

The definitions for the terminology used in this Section are contained in Mandatory Appendix I.

1.4 STANDARDS REFERENCED BY THIS SECTION

Throughout this Section, references are made to various standards, such as ASME standards. These standards, with the year of the acceptable edition, are listed in Table 1.4-1. Rules for the use of these standards are stated elsewhere in this Section.

The publishers of the referenced standards are as follows:

American National Standards Institute (ANSI)
American Petroleum Institute (API)
The American Society of Mechanical Engineers (ASME)
National Board of Boiler and Pressure Vessel Inspectors (NBBI)
Welding Research Council (WRC)

1.5 UNITS OF MEASURE

(a) Either U.S. Customary, SI, or any local customary units may be used to demonstrate compliance with requirements of this Section. However, one system of units shall be used consistently throughout the construction cycle for each individual relief device.

(b) For any single equation, all variables shall be expressed in a single system of units. When separate equations are provided for U.S. Customary and SI units, those equations shall be executed using variables in the units

associated with the specific equation. Data expressed in other units shall be converted to U.S. Customary units or SI units for use in these equations. The result obtained from execution of these equations or any other calculations carried out in either U.S. Customary or SI units may be converted to other units.

(c) Production, measurement and test equipment, drawings, welding procedure specifications, welding procedure and performance qualifications, and other manufacturing documents may be in U.S. Customary, SI, or local customary units in accordance with the Manufacturer's or Assembler's practice. When values shown in calculations and analysis, manufacturing documents, or measurement and test equipment are in different units, any conversions necessary to verify Code compliance and ensure that dimensional consistency is maintained shall be in accordance with the following:

(1) Conversion factors shall be accurate to at least four significant figures.

(2) The results of conversions of units shall be expressed to a minimum of three significant figures.

(d) Conversion of units to the level of precision specified in (c) shall be performed to ensure that dimensional consistency is maintained. Conversion factors between U.S. Customary and SI units may be found in the Nonmandatory Appendix A. Whenever local customary units are used, the Manufacturer shall provide the source of the conversion factors, which shall be subject to verification and acceptance by the Certified Individual.

(e) Dimensions shown in the text, tables, and figures, whether given as a decimal or a fraction, may be taken as a decimal or a fraction and do not imply any manufacturing precision or tolerance on the dimension.

(f) Material that has been manufactured and certified to either the U.S. Customary or SI material specification (e.g., SA-516M) may be used regardless of the unit system used in design. Standard fittings (flanges, elbows, etc.) that have been certified to either U.S. Customary units or SI units may be used regardless of the unit system used in design.

(g) It is acceptable to show alternative units parenthetically.

1.6 TOLERANCES

This Section does not fully address tolerances. When dimensions, sizes, or other parameters are not specified with tolerances, the values of these parameters are considered nominal, and allowable tolerances or local variances may be considered acceptable when based on engineering judgment and standard practices as determined by the designer.

PART 2
PROTECTION AGAINST OVERPRESSURE

2.1 GENERAL

(a) The requirements of this Section, including the Certification Mark and Designators, must be referenced by an ASME Boiler and Pressure Vessel Code (BPVC) Section or other Standard for pressurized equipment before this Section becomes effective for that Code or Standard.

(b) The referencing Code or Standard specifies the objectives of the overpressure protection.

(c) The referencing Code or Standard provides the required performance of the relief system, including maximum relieving pressure and maximum set pressure. The pressure relief devices provided in accordance with this Section are designed to meet the performance requirements of the referencing Code or Standard.

(d) The referencing Code or Standard provides basic installation requirements for the protection of the pressurized equipment. This Section provides additional installation requirements that will affect the performance and safety function of the devices.

(e) The referencing Code or Standard identifies the permissible device types or methods. This Section provides specific requirements for pressure relief devices and methods.

(f) The referencing Code or Standard may specify portions of this Section. In this case, only the referenced portions of this Section shall apply, and the remaining requirements shall come from the referencing Code or Standard.

EXAMPLE: ASME Boiler and Pressure Vessel Code (BPVC) Sections I and III currently refer to this Section for capacity certification only. Materials, design, fabrication, nondestructive examination, pressure testing, and Certification by the Manufacturer shall meet the requirements of Section I or Section III. The V and NV Designators are used in this Section only to highlight requirements specific to pressure relief devices for Section I and Section III service, respectively.

(g) If there is a conflict between Section XIII and the referencing Code or Standard, the referencing Code or Standard takes precedence.

(h) Table 2.1-1 summarizes the pressure relief devices and methods permitted by ASME BPVC Sections. If there is a difference between the information in Table 2.1-1 and the provisions of the ASME BPVC Section, the ASME BPVC Section shall apply.

2.2 RESPONSIBILITIES

(a) The referencing Code or Standard defines the duties required for Code compliance and the parties responsible for performing those duties. The duties include, but are not limited to, the following:

(1) design, construction, and installation of the pressure relief system other than the pressure relief device

(2) determination of all potential overpressure scenarios and of the method of overpressure protection used to mitigate each scenario

(3) selection of the type of overpressure protection as described in this Section

(4) sizing and selection of the pressure relief device(s) based on the intended service

(5) installation of the pressure-relieving device prior to operation

(b) The Manufacturer or Assembler of the pressure relief device to which the Certification Mark will be applied shall be responsible for complying with all of the requirements of this Section. A Certified Individual (CI) shall provide oversight as required by 10.6. The Manufacturer or Assembler is not responsible for the requirements or guidance for installation of pressure relief devices provided in this Section.

(c) Some types of work performed on devices (e.g., machining, forming, nondestructive examination, and heat treating) may be performed by parties other than the Manufacturer. It is the Manufacturer's responsibility to ensure that all work so performed complies with all the applicable requirements of this Section.

2.3 SET PRESSURE

The range of allowable set pressures for each pressure relief device is defined by the referencing Code or Standard.

2.4 OVERPRESSURE

The maximum allowable overpressure for each pressure relief device is defined by the referencing Code or Standard.

Table 2.1-1 Permitted Pressure Relief Devices or Methods by ASME BPVC Section

(23)

Device or Method	I	III			IV	VIII			X	XII
		NB	NCD	NE		Division 1	Division 2 [(1)]	Division 3		
Direct spring-loaded pressure relief valve	V	NV-1	NV-2, NV-3	NV-1, NV-2 [(2)]	HV, V	UV, V [(3)]	UV, V [(3)]	UV3, UV [(4)]	UV, HV, V [(3)]	TV, UV [(5), (6)]
Pilot-operated pressure relief valve	V	NV-1	NV-2, NV-3	. . .	. . .	UV	UV, V [(3)]	. . .	UV	. . .
Power-actuated relief valve	V	NV-1	NV-2, NV-3	P	. . .	. . .	. . .	P [(7)]	. . .	. . .
Rupture disk	. . .	P	P	[(8)]	. . .	UD	UD	UD3, UD [(9)]	UD	TD, UD [(5), (6)]
Pin device	. . .	. . .	. . .	[(8)]	. . .	UD	UD	. . .	UD	TD, UD [(5), (6)]
Spring-loaded non-reclosing pressure relief valve	. . .	. . .	. . .	[(8)]	. . .	UV	UV	. . .	. . .	. . .
Temperature and pressure relief valves	. . .	. . .	. . .	. . .	HV	. . .	. . .	. . .	. . .	. . .
Rupture disk upstream of pressure relief valve (see 8.2) [(10)]	P [(11)]	. . .	P	. . .	. . .	P	P	P	. . .	P [(12)]
Rupture disk downstream of pressure relief valve (see 8.3) [(10)]	. . .	P	P	. . .	. . .	P	P	P	. . .	. . .
Pin device upstream of pressure relief valve (see 8.4) [(10)]	. . .	. . .	. . .	. . .	. . .	P	P	. . .	. . .	P [(12)]
Open flow paths or vents	. . .	. . .	. . .	. . .	. . .	P	P	P	P	. . .
Fusible plugs	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	P [(13)]
Overpressure protection by system design	. . .	. . .	. . .	. . .	. . .	P	P	. . .	P	. . .
Vacuum relief devices	. . .	. . .	NV-2, NV-3	NV-2	. . .	. . .	. . .	. . .	. . .	. . .

GENERAL NOTES:

(a) If there is a difference between the information in Table 2.1-1 and the provisions of the ASME BPVC Section, the ASME BPVC Section shall apply.

(b) Allowable devices and methods are indicated by either the letter P (permitted) or one or more of the following Certification Mark Designators:

HV = heating boiler pressure relief valve
NV-1 = nuclear Class 1 pressure relief valve
NV-2 = nuclear Class 2 pressure relief valve
NV-3 = nuclear Class 3 pressure relief valve
TV = transport tank pressure relief valve
UD = pressure vessel pressure relief device
UD3 = high pressure vessel pressure relief device, Section VIII, Division 3
UV = pressure vessel pressure relief valve
UV3 = high pressure vessel pressure relief valve, Section VIII, Division 3
V = power boiler safety relief valve

Table 2.1-1
Permitted Pressure Relief Devices or Methods by ASME BPVC Section (Cont'd)

NOTES:

(1) All pressure relief devices permitted in Section VIII, Division 1 and bearing the Certification Mark and either the UV or UD Designator may be used on pressure vessels constructed to Section VIII, Division 2.

(2) A pressure relief device designed to either Class 1 or Class 2, as classified by the Design Specification, may be used for Section III NE service.

(3) Pressure relief valves certified for a steam-discharging capacity under the provisions of Part 9 and bearing the Certification Mark and V Designator may be used on Section VIII, Division 1 or Division 2, and Section X pressure vessels.

(4) Pressure relief valves meeting the requirements of Section VIII, Division 1 or Division 2 may be used on pressure vessels constructed to Section VIII, Division 3, provided they also meet specific requirements for Section VIII, Division 3.

(5) Pressure relief devices certified for service in unfired pressure vessels per Section VIII, Division 1 may be used for Section XII applications if they meet the additional requirements of Section XII, particularly the Modal Appendices.

(6) Pressure relief devices, rupture disk devices, or pin devices certified for service in unfired pressure vessels per Section VIII, Division 1 may be used in transport tank service, provided the tank Manufacturer or user of the tank has determined that the devices are suitable for the intended service application. Suitability shall be determined based on the temperatures, pressures, and compatibility with the goods transported in the specific application.

(7) Section VIII, Division 3 power-actuated pressure relief valves are not within the scope of Section XIII. See Section VIII, Division 3 for requirements.

(8) Non-reclosing pressure relief devices are unacceptable. See Section III, Division 1, Subsection NE, NE-7161.

(9) Rupture disk devices bearing the Certification Mark and UD Designator in accordance with Section XIII may be used [see Section VIII, Division 3, KOP-152(c)].

(10) Each device of a combination shall be marked with the Certification Mark and appropriate Designator.

(11) Rupture disks are permitted on the inlet of pressure relief valves for organic vaporizers only. A rupture disk bearing the Certification Mark is not required. See Section I, PVG-12.3.

(12) Non-reclosing pressure relief devices for Section XII applications shall be used only as part of a combination relief device, except where their use as the sole overpressure protection device is specifically authorized by the competent authorities with jurisdiction over the tank's operation.

(13) The Certification Mark and Designator are not required. See Section XII for requirements.

PART 3
REQUIREMENTS FOR PRESSURE RELIEF VALVES

3.1 GENERAL

3.1.1 Applicability of Part 3 Requirements

This Part contains requirements applicable to all pressure relief valves that are to be marked with the Certification Mark and any Designator. Requirements unique to a specific Designator are identified.

(23) 3.1.2 Valve Characteristics

(a) All pressure relief valves shall be of the direct spring-loaded, pilot-operated, or power-actuated type.

(b) Pilot-operated pressure relief valves shall be designed such that

(1) the pilot is self-actuated

(2) the main valve will open automatically at a pressure not exceeding the set pressure

(3) if some essential part of the pilot fails, the main valve will discharge its full rated capacity at or below the relieving pressure used to determine its rated capacity

(c) Section VIII, Division 1 and Division 2 (UV Designator) pressure relief valves shall be designed and constructed such that when installed per Section VIII, Division 1, UG-156, they comply with the following:

(1) They shall operate without chattering.

(2) When operating at the flow-rated pressure, they shall not flutter in a way that would either interfere with the measurement of capacity or result in damage.

3.2 DESIGN AND MECHANICAL REQUIREMENTS

3.2.1 Body

In the design of the body of the pressure relief valve, consideration shall be given to minimizing the effects of deposits.

3.2.2 Drains

(a) If the design of a pressure relief valve is such that liquid can collect on the discharge side of the disk, then, except as permitted in (b), the valve shall be equipped with a drain at the lowest point at which liquid can collect.

(b) Pressure relief valves that cannot be equipped with a drain as required in (a) because of design or application may be used, provided all the following conditions are met:

(1) The pressure relief valves are used only on gas service where there is neither liquid discharged from the valve nor liquid formed by condensation on the discharge side of the valve.

(2) The pressure relief valves are provided with a cover or discharge piping per 12.8(c) to prevent liquid or other contaminant from entering the discharge side of the valve.

(3) The pressure relief valve is marked FOR GAS SERVICE ONLY in addition to being marked as required by 3.9.

(c) For Section IV (HV Designator) pressure relief valves exceeding DN 65 (NPS 2$^1\!/_2$), the drain hole or holes shall be tapped not less than DN 10 (NPS $^3\!/_8$). For valves of DN 65 (NPS 2$^1\!/_2$) or smaller, the drain hole shall not be less than 6 mm ($^1\!/_4$ in.) in diameter.

3.2.3 Bonnet

The bonnet of Section VIII, Division 3 (UV3 Designator) pressure relief valves shall be vented to prevent accumulation of pressure. Sealing or isolation of the bonnet area from the relieving fluid may be required for protection of the spring assembly from corrosion or solids accumulation.

3.2.4 Seat

If the valve seat is not integral with the body of the pressure relief valve, it shall be secured to the body of the pressure relief valve in such a way that there is no possibility of the seat lifting or separating.

3.2.5 Springs for Direct Spring-Loaded Valves

(a) The spring of a direct spring-loaded valve shall be designed so that the spring compression at full lift of the valve shall not be greater than 80% of the nominal solid deflection. Alternatively, for Section XII (TV Designator) valves only, a design in which the spring compression at full lift equals or exceeds 80% is permitted, provided the valve has been tested and meets the acceptance criteria of Part 9.

(b) The permanent set of the spring shall not exceed 0.5% of the original free length. Permanent set is defined as the difference between the original free length and the free length after the spring has been preset at room temperature by compressing it to its

solid height three times. Measurement shall be taken at least 10 min following the preset.

(c) For direct spring-loaded valves that have set pressures above the maximum pressure used in the capacity certification tests, the spring force ratio shall not exceed 1.1 times the spring force ratio of the valve with the highest set pressure that was used in the capacity certification tests. For direct spring-loaded valves that have orifices larger than the largest size used in the capacity certification tests, the spring force ratio shall not exceed 1.1 times the spring force ratio of the valve with largest size orifice in the capacity certification tests. The spring force ratio, R_{sf}, shall be calculated as follows:

$$R_{sf} = F_{so}/F_{sc}$$

where

F_{sc} = force exerted by the spring when the valve is closed or seated

F_{so} = force exerted by the spring when the valve is at rated lift

3.2.6 Guiding Arrangements

(a) The design of the pressure relief valve shall incorporate guiding arrangements necessary to ensure consistent operation and seat tightness.

(b) Bottom-guided designs are not permitted on Section IV (HV Designator) pressure relief valves.

3.2.7 Lifting Device

(a) Section VIII (UV Designator) pressure relief valves intended for use on air or steam service, or on water service where the valve inlet temperature exceeds 60°C (140°F) excluding overpressure or relief events, shall have a substantial lifting device that, when activated, will release the seating force on the disk when the pressure relief valve is subjected to a pressure of at least 75% of the set pressure of the valve.

(b) Section VIII (UV Designator) pilot-operated pressure relief valves used on the services described in (a) shall be provided with either a lifting device as described in (a) or a means for connecting and applying pressure to the pilot adequate to verify that the moving parts critical to proper operation are free to move.

(c) Section IV (HV Designator) pressure relief valves shall have a lifting device and a mechanical connection between the lifting device and the disk capable of lifting the disk from the seat a distance of at least 1.5 mm ($^1/_{16}$ in.) with no pressure on the boiler.

3.2.8 Wrenching Surfaces

Pressure relief valves having threaded inlet or outlet connections shall be provided with wrenching surfaces to allow for normal installation without damage to operating parts.

3.2.9 Sealing of Adjustments

(a) Means shall be provided in the design of all pressure relief valves for sealing all external adjustments that can be made without disassembly of the valve.

(b) Seals shall be installed by the Manufacturer or Assembler after all adjustments required for production testing.

(c) Seals shall be installed in a manner to prevent changing the adjustment without breaking the seal.

(d) For pressure relief valves larger than DN 15 (NPS $^1/_2$), the seal shall serve as a means of identifying the Manufacturer or Assembler making the adjustment.

3.2.10 Diaphragm Valves

(a) For pressure relief valves of the diaphragm type, the space above the diaphragm shall be vented to prevent a buildup of pressure above the diaphragm.

(b) Pressure relief valves of the diaphragm type shall be designed so that failure or deterioration of the diaphragm material will not impair the ability of the valve to relieve at the rated capacity.

3.2.11 Restricted-Lift Designs

Valve capacity may be limited by restricting the lift of a valve, provided the following requirements are met:

(a) The valve size shall be DN 20 (NPS $^3/_4$) or larger.

(b) No changes shall be made in the design of the valve, except to change the valve lift by use of a lift-restraining device described in (c).

(c) The restriction of valve capacity shall be permitted only by the use of a lift-restraining device that shall limit valve lift and shall not otherwise interfere with flow through the valve.

(1) The design of the lift-restraining device shall be subject to review by an ASME Designated Organization.

(2) The lift-restraining device shall be designed so that, if the device is adjustable, the adjustable feature can be sealed. Seals shall be installed by the valve Manufacturer or Assembler at the time of initial adjustment.

(d) The valve lift shall be no less than 30% of full rated lift, or 2 mm (0.080 in.), whichever is greater.

(e) The restricted-lift nameplate capacity shall be determined by multiplying the capacity at full rated lift by the ratio of the restricted lift to the full rated lift.

3.2.12 O-Rings and Packing

O-rings or other packing devices, when used on the stems of pressure relief valves, shall be arranged so that valve performance meets the requirements of this Section.

3.2.13 Inlet/Outlet Connections

(a) The inlet opening of a Section IV (HV Designator) pressure relief valve shall have an inside diameter approximately equal to, or greater than, the seat diameter. In no case shall the maximum opening through any part of the valve be less than 6 mm ($^1/_4$ in.) in diameter or its equivalent area.

(b) Pressure relief valves for Section IV, Part HLW (HV Designator) potable water heaters shall be at least DN 20 (NPS $^3/_4$).

(c) Any Section VIII (UV Designator) pressure relief valve in liquid service shall be at least DN 15 (NPS $^1/_2$).

(d) Threaded inlet or outlet connections for Section VIII, Division 3 (UV3 Designator) valves shall be in accordance with Section VIII, Division 3, KD-6.

3.2.14 Pop Action

Section IV (HV Designator) pressure relief valves shall have pop action (rapid opening) when tested using steam.

3.3 MATERIAL REQUIREMENTS

3.3.1 General

(a) Materials used in bodies, bonnets, yokes, and body-to-bonnet or body-to-yoke bolting shall be as permitted in Section II, Part D by the referencing Code, except for Section IV (HV Designator) pressure relief valves, for which the Manufacturer may use materials other than those listed in Section II. In those cases, the Manufacturer shall establish and maintain specifications requiring equivalent control of chemical and physical properties and quality.

In addition, the following requirements apply:

(1) For Section VIII, Division 1 (UV Designator) pressure relief valves, the bodies, bonnets, yokes, and body-to-bonnet or body-to-yoke bolting shall meet all applicable requirements of Section VIII, Division 1, Subsection C.

(2) For Section VIII, Division 3 (UV3 Designator) pressure relief valves, the bodies, bonnets, yokes, and body-to-bonnet or body-to-yoke bolting shall meet all applicable requirements of Section VIII, Division 3, Article KM.

(3) For Section XII (TV Designator) pressure relief valves, the bodies, bonnets, yokes, and body-to-bonnet or body-to-yoke bolting shall meet all applicable requirements of Section XII, Part TM.

(b) Other than as specified in (a), all parts required for the pressure-relieving or pressure-retaining function shall be of materials that are

(1) listed in Section II, or

(2) listed in ASTM specifications, or

(3) controlled by the Manufacturer of the pressure relief valve by a specification ensuring control of chemical and physical properties and quality at least equivalent to that of ASTM standards

(c) No materials liable to fail due to deterioration or vulcanization when subjected to saturated steam temperature corresponding to capacity test pressure shall be used for Section IV (HV Designator) pressure relief valves.

3.3.2 Seats and Disks (23)

(a) Cast iron seats and disks are not permitted.

(b) The seats and disks of pressure relief valves shall be of suitable material to resist corrosion by the fluid to be contained. The degree of corrosion resistance, appropriate to the intended service, shall be a matter of agreement between the Manufacturer and the purchaser.

(c) When selecting materials for seating surfaces, the Manufacturer shall consider the potential for brinelling and its effects on the performance of the pressure relief valve.

(d) Material for seats and disks should be such as to provide a reasonable degree of resistance to erosion caused by high-velocity steam (i.e., steam cutting) when the pressure relief valve is used in steam or hot water applications.

(e) Nonmetallic disk inserts and seals shall be compatible with the maximum design temperature established for the pressure relief valve.

3.3.3 Guiding/Sliding Surfaces

(a) When selecting materials for sliding surfaces, the Manufacturer shall consider the potential for galling and its effects on the performance of the pressure relief valve.

(b) Adjacent sliding surfaces, such as guides and disks or disk holders, shall both be of corrosion-resistant material. The degree of corrosion resistance, appropriate to the intended service, shall be a matter of agreement between the Manufacturer and the purchaser.

(c) For Section VIII, Division 3 (UV3 Designator) pressure relief valves, galling resistance shall be demonstrated on a prototype valve by popping a valve to full stem lift ten times, with subsequent disassembly and inspection showing no indication of galling.

3.3.4 Springs

Springs shall be made of corrosion-resistant material or shall have a corrosion-resistant coating.

3.4 INSPECTION OF MANUFACTURING AND/OR ASSEMBLY

3.4.1 General

(a) A Manufacturer or Assembler shall demonstrate to the satisfaction of a representative from an ASME Designated Organization that the manufacturing, production, and testing facilities and quality control procedures

will ensure agreement between the performance of random production samples and the performance of those devices submitted for capacity certification.

(b) At the time of the submission of pressure relief valves for capacity certification or testing in accordance with 3.4.2, the representative of the ASME Designated Organization has the authority to review the device design for conformity with the requirements of 3.2 and 3.3, and to reject or require modification of designs that do not conform.

(c) Manufacturing, assembly, inspection, and test operations, including capacity testing, are subject to inspections at any time by a representative of the ASME Designated Organization.

3.4.2 Production Certification

A Manufacturer or Assembler may be granted permission to apply the Certification Mark and appropriate Designator to production pressure relief valves whose capacity has been certified in accordance with Part 9, provided the testing described in this paragraph is successfully completed. This permission shall expire on the sixth anniversary of the date it is initially granted. The permission may be extended for 6-yr periods if the testing described in this paragraph is successfully repeated within the 6-month period before expiration.

3.4.2.1 Sample Selection. Two sample production pressure relief valves of a size and capacity within the testing capability of an ASME-accepted laboratory shall be selected by a representative from an ASME Designated Organization. All sample pressure relief valves having adjustable blowdown construction shall have the control elements positioned by the Manufacturer or Assembler per the Manufacturer's specification.

3.4.2.2 Testing. Operational and capacity tests shall be conducted in the presence of a representative from an ASME Designated Organization at a testing facility meeting the requirements of ASME CA-1. The pressure relief valve Manufacturer or Assembler shall be notified of the time of the test and may have representatives present to witness the tests.

(23) **3.4.2.3 Test Results**

(a) Should any pressure relief valve fail to relieve at or above its certified capacity, or should it fail to meet performance requirements of this Section, the test shall be repeated at the rate of two replacement pressure relief valves, selected in accordance with 3.4.2.1, for each pressure relief valve that failed.

(b) If a sample pressure relief valve with adjustable blowdown construction selected from a Manufacturer exhibits a blowdown that exceeds the value in Table 3.4.2.3-1, then an adjustment shall be made to meet this performance condition, and the operational and capacity tests shall be repeated. This adjustment may be made at the flow test facility. For each valve whose blowdown requirement cannot be met through adjustment, the test shall be repeated with one replacement pressure relief valve, selected in accordance with 3.4.2.1.

(c) Should any of the replacement pressure relief valves described in (a) fail to meet the capacity or performance requirements of this Section, the Manufacturer or Assembler shall determine the cause of failure and take corrective action to guard against future occurrence. This cause of failure and corrective action shall be documented and submitted to the ASME Designated Organization within 60 days of the failure or be cause for revocation of the authorization to use the Certification Mark on that particular type of valve. Upon the ASME Designated Organization's acceptance of the submitted corrective action, the requirements of 3.4.2 shall apply.

3.4.3 Alternative Tests for Valves That Exceed the Laboratory Capabilities

(a) For valves that exceed the laboratory testing capabilities and for which lift at rated overpressure can be measured, the alternative method described below shall be used in lieu of the test requirements of 3.4.2.1, 3.4.2.2, and 3.4.2.3(a).

(1) Two production valves that are representative of the design shall be tested per ASME PTC 25, Part III. The tests shall demonstrate to the satisfaction of the representative of the ASME Designated Organization that the valves satisfy the following conditions:

(-a) The measured set pressure is consistent with the stamped set pressure within the tolerances required by Table 3.6.3.1-2.

(-b) The valve will achieve the minimum lift for its certified capacity.

(-c) The valve will operate without chatter or flutter.

Table 3.4.2.3-1
Maximum Blowdown for Sample Valves During Testing

Certification Mark Designator [Note (1)]	Maximum Blowdown for Sample Valves During Testing
HV	15 kPa to 30 kPa (2 psi to 4 psi) [Note (2)]
UV or UV3	7% of the set pressure or 20 kPa (3 psi), whichever is greater
TV	7% of the set pressure or 20 kPa (3 psi), whichever is greater

NOTES:
(1) See the General Note of Table 2.1-1 for the valve types to which the Certification Mark Designators apply.
(2) This maximum applies to low-pressure steam heating boiler pressure relief valves with set pressure equal to or less than 100 kPa (15 psi) only. This blowdown need not be adjustable.

If only one valve of the design will be produced within the 6-yr period for which the permission is granted, only that valve need be tested as stated above.

(2) The testing shall be performed at a facility that is mutually agreeable to the Manufacturer, the representative of an ASME Designated Organization, and the facility owner. The facility shall be capable of demonstrating the characteristics stated in (1)(-a) through (1)(-c).

(3) In the event of failure of the tests, 3.4.2.3(c) shall apply.

(b) For valves that exceed the laboratory testing capabilities and for which lift at rated overpressure cannot be measured, the alternative method described below shall be used.

(1) For initial certification, two functional models that are representative of the design shall be used, provided the test requirements of 3.4.2.1, 3.4.2.2, 3.4.2.3(a), and 3.4.2.3(c) are followed and the following additional test requirements are met:

(-a) Two production valves that are representative of the design shall be tested per ASME PTC 25, Part III. The testing shall demonstrate to the satisfaction of the representative of the ASME Designated Organization that

(-1) the measured set pressure is consistent with the stamped set pressure within the tolerances required by Table 3.6.3.1-2

(-2) a secondary pressure zone leakage test and a seat tightness test are demonstrated in accordance with 3.6.2 and 3.6.4

If only one valve of the design will be produced within the 6-yr period for which the permission is granted, only that valve need be tested as stated above.

(-b) The testing shall be performed at a facility that is mutually agreeable to the Manufacturer, the representative of an ASME Designated Organization, and the facility owner. The facility shall be capable of demonstrating the characteristics stated in (-a)(-1) and (-a)(-2).

(-c) In the event of failure of the tests, 3.4.2.3(c) shall apply.

(2) For 6-yr renewal of capacity certification, (1)(-a) through (1)(-c) shall apply.

(23) 3.5 ASSEMBLER REQUIREMENTS

The following requirements apply only to valves to be marked with the Certification Mark and UV or TV Designator:

(a) Use of the Certification Mark and appropriate Designator by an Assembler indicates the use of original, unmodified parts in strict accordance with the instructions of the Manufacturer of the pressure relief valve.

(b) An Assembler shall be geographically located independent of and use different facilities than those used by the Manufacturer.

(c) An Assembler may be organizationally independent of the Manufacturer or may be wholly or partly owned by the Manufacturer.

(d) An Assembler may transfer original and unmodified pressure relief parts produced by the Manufacturer to another Assembler, provided all of the following conditions are met:

(1) Both Assemblers have been granted permission to apply the Certification Mark and appropriate Designator to the specific valve type in which the parts are to be used.

(2) The quality control system of the Assembler receiving the pressure relief valve parts defines the controls for the procurement and acceptance of those parts.

(3) The pressure relief valve parts are appropriately packaged, marked, or sealed by the Manufacturer to ensure that the parts are produced by the Manufacturer and are original and unmodified.

(e) An Assembler may convert original finished parts by either machining to another finished part or applying a corrosion-resistant coating to valve springs for a specific application under the following conditions:

(1) Conversions shall be specified by the Manufacturer. Drawings and/or written instructions used for part conversion shall be obtained from the Manufacturer and shall include a drawing or description of the converted part before and after the conversion.

(2) The Assembler's quality control system, as accepted by an ASME Designee, shall describe in detail the conversion of original parts, provisions for inspection and acceptance, personnel training, and control of current Manufacturer's drawings and/or written instructions.

(3) The Assembler shall document each use of a converted part and that the part was used in strict accordance with the instructions of the Manufacturer.

(4) The Assembler shall demonstrate to the Manufacturer the ability to perform each type of conversion. The Manufacturer shall document all authorizations granted to perform part conversions. The Manufacturer and Assembler shall maintain a file of such authorizations.

(5) For an Assembler to offer restricted lift valves, the Assembler shall demonstrate to the satisfaction of the Manufacturer the ability to perform valve lift restrictions. The Manufacturer shall document all authorizations granted to restrict the lift of the valves. The Assembler shall maintain a file of such authorizations and the records of each lift restriction made.

(6) At least annually the Manufacturer shall review each Assembler's system and conversion capabilities. The Manufacturer shall document the results of these reviews. The Assembler shall keep a copy of this documentation on file. The review results shall be made available to a representative from an ASME Designated Organization.

(f) In addition to the data required by 3.9, the marking shall include the name of the Manufacturer and the final Assembler. The Certification Mark shall be that of the final Assembler.

3.6 PRODUCTION TESTING

All pressure relief valves to which the Certification Mark is to be applied shall be subjected to the tests of this paragraph by the Manufacturer or Assembler. A Manufacturer or Assembler shall have a documented system for the application, calibration, and maintenance of gages and instruments used during these tests. Testing time on steam pressure relief valves shall be sufficient, depending on size and design, to ensure that test results are repeatable and representative of field performance.

3.6.1 Pressure Testing

The requirements of 3.6.1 shall not apply to Section IV (HV Designator) pressure relief valves.

(a) The pressure-containing parts of the shell of each valve are subject to pressure testing. The valve shell is defined by parts such as the body, bonnet, and cap that isolate primary or secondary pressure from atmosphere.

(b) A valve shell part is exempt from pressure testing if both of the following conditions apply:

(1) The stress that would be applied under hydrostatic test conditions does not exceed 50% of the allowable stress.

(2) The part is not cast or welded.

(c) When the valve is designed for discharging directly to atmosphere, the valve components downstream of the valve disk are exempt from pressure testing.

(d) Valve components are exempt from pressure testing if they are fully contained within pressure-containing parts that have been either pressure tested or exempted from pressure testing by (b).

(e) A valve shell part requiring pressure testing shall be tested either

(1) hydrostatically at a minimum 1.5 times the design pressure of the part, or

(2) pneumatically at a minimum 1.25 times the design pressure of the part

CAUTION: Pneumatic testing can be hazardous; it is therefore recommended that special precautions be taken when conducting a pneumatic test.

(f) Pressure testing may be done in the part or assembled condition.

(g) Pressure testing shall be conducted after all machining and welding operations have been completed.

(h) Parts subjected to pressure testing shall not exhibit a sign of leakage.

3.6.2 Secondary Pressure Zone Test (23)

(a) Except for the valves described in (b), all closed-bonnet pressure relief valves that have an inlet size exceeding DN 25 (NPS 1) and that are designed for discharge to a closed system shall have their secondary pressure zones tested with air or other gas at a pressure of at least 200 kPa (30 psi). The user may specify a higher test pressure commensurate with the back pressure anticipated in service.

(b) The secondary pressure zone of each Section VIII, Division 3 (UV3 Designator) closed-bonnet pressure relief valve shall be tested at 1.25 times the stated design pressure of the secondary pressure zone but not at less than 0.125 times the design pressure of the primary parts.

(c) Parts subjected to secondary pressure zone testing shall not exhibit a sign of leakage.

3.6.3 Set Pressure Tests

3.6.3.1 General

(a) Each pressure relief valve to which the Certification Mark and appropriate Designator is to be applied shall be tested by the Manufacturer or Assembler to demonstrate the valve's set pressure.

(b) Set pressure tests for pressure relief devices shall be conducted using the test fluid specified in Table 3.6.3.1-1.

(c) Test fixtures and test drums, where applicable, shall be of adequate size and capacity to ensure that pressure relief valve action is consistent with the marked set pressure within the applicable tolerances shown in Table 3.6.3.1-2.

(d) When pressure relief valve service conditions differ from test stand conditions due to superimposed back pressure or temperature, or both, the actual test pressure (cold differential test pressure) shall be adjusted and marked on the valve per 3.9(e)(4)(-a). When superimposed back pressure contributes to the cold differential test pressure, it shall also be marked on the valve per 3.9(e)(4)(-b).

(e) When pressure relief valves to be tested with steam, air, or other suitable gas are beyond the capability of the production test facility, either because of size or set pressure, the valves may be tested using an alternate test fluid. Steam service valves may be tested on air or other gas. Gas or vapor service valves may be tested on steam. The test pressure using an alternate fluid shall be the product of the Manufacturer's correction factor for the differential between steam and air or gas multiplied by the set pressure. If a cold differential test pressure is applicable due to superimposed back pressure or service temperature, or both, then the Manufacturer's correction factor shall be applied to the cold differential test pressure. The correction factor between steam and air or gas shall not be included in the cold differential test pressure marked on the valve per 3.9(e)(4)(-a).

Table 3.6.3.1-1
Test Fluid for Set Pressure Tests

Pressure Relief Device: Certification Mark Designator [Note (1)]	Pressure Relief Device: Service	Test Fluid
HV	Steam	Steam or air
	Saturated water	Water, steam, or air
UV	Steam [Note (2)]	Steam [Note (3)]
	Gas or vapor	Air or other suitable gas
	Incompressible fluids (liquids)	Water or other suitable liquid
UV3	Compressible fluids	Air or other suitable gas
	Incompressible fluids (liquids)	Water or other suitable incompressible fluid
TV	Compressible fluids	Air or other suitable gas
	Incompressible fluids (liquids)	Water or other suitable liquid

NOTES:
(1) See the General Note of Table 2.1-1 for the valve types to which the Certification Mark Designators apply.
(2) Also applicable for valves having special internal parts for steam service.
(3) If the size or set pressure of the pressure relief valve to be tested is beyond the capability of the production steam test facility, the valve may be tested on air. Necessary corrections for differentials in set pressure between steam and air shall be established by the Manufacturer and applied to the set pressure on air.

Table 3.6.3.1-2
Set Pressure Tolerances for Pressure Relief Valves (23)

Certification Mark Designator [Note (1)]	Set Pressure, kPa (psi)	Tolerance
HV	≤100 (≤15)	±15 kPa (±2 psi) [Note (2)]
	≤400 (≤60)	±20 kPa (±3 psi)
	>400 (>60)	±5% of set pressure
UV	≤500 (≤70)	±15 kPa (±2 psi)
	>500 (>70)	±3% of set pressure
	All pressures	−0%, +10% of set pressure [Note (3)]
UV3	All pressures	±3% of set pressure
TV	≤500 (≤70)	±15 kPa (±2 psi)
	>500 (>70)	±3% of set pressure

NOTES:
(1) See the General Note of Table 2.1-1 for the valve types to which the Certification Mark Designators apply.
(2) This set pressure tolerance applies to low-pressure steam heating boilers only.
(3) This set pressure tolerance applies to valves that are capacity certified for application in accordance with Section VIII, Division 1, UG-153(a)(3).

3.6.3.2 Alternative Test Methods

(a) If testing of a direct spring-loaded pressure relief valve is beyond the capabilities of the production test equipment, an alternative test method [see (b)] may be used, provided all of the following conditions are met:

(1) Testing the valve at full pressure may cause damage to the valve, or testing of the valve is impractical due to safety considerations related to operating the boiler system.

(2) The valve lift has been mechanically verified as meeting or exceeding the required lift.

(3) For valves with adjustable blowdown, the blowdown control elements are set to the valve manufacturer's specification.

(4) The valve design is compatible with the alternative test method selected.

(b) One of the following alternative test methods may be used:

(1) The valve lift may be temporarily restricted to avoid damage and tested on the appropriate test fluid to demonstrate set pressure.

(2) The valve may be fitted with an auxiliary lift-assist device and tested on the appropriate test fluid at a pressure less than the valve set pressure. The lift-assist device and test procedure shall be calibrated to provide the set pressure setting within the tolerance shown in Table 3.6.3.1-2.

3.6.4 Seat Tightness Test (23)

After completion of the tests required by 3.6.3, a seat tightness test shall be conducted in accordance with the following:

(a) For Valves to Be Marked With the Certification Mark and UV Designator. Unless otherwise designated by a Manufacturer's published pressure relief valve specification or another specification agreed to by the user, the seat tightness test and acceptance criteria shall be in accordance with API 527.

(b) For Valves to Be Marked With the Certification Mark and UV3 Designator. The seat tightness test shall be conducted at a maximum expected operating pressure but at a pressure not exceeding the reseating pressure of the valve. When the test is conducted with an incompressible fluid, the valve shall exhibit no visible signs of leakage. The leak rate of a valve tested with a compressible

fluid shall meet the criteria specified in the User's Design Specification (see Section VIII, Division 3).

(c) For Valves to Be Marked With the Certification Mark and HV Designator. A tightness test shall be conducted at maximum expected operating pressure but at a pressure not exceeding the reseating pressure of the valve.

(d) For Valves to Be Marked With the Certification Mark and TV Designator. Unless otherwise designated by a Manufacturer's published pressure relief valve specification or another specification agreed to by the user, the seat tightness test and acceptance criteria shall be in accordance with API 527.

3.6.5 Blowdown Testing

Each Section IV (HV Designator) pressure relief valve with adjustable blowdown shall be tested to demonstrate blowdown in accordance with Table 3.4.2.3-1. When the blowdown is nonadjustable, the blowdown test may be performed on a sampling basis.

3.7 WELDING, BRAZING, HEAT TREATMENT, AND NONDESTRUCTIVE EXAMINATION

All welding, brazing, heat treatment, and nondestructive examination used in the construction of bodies, bonnets, and yokes shall be performed in accordance with the applicable requirements of the Section of the Certification Mark Designator applied to the pressure relief valve.

3.8 SET PRESSURE CHANGE

The set pressure of a valve may be changed after completion of the appropriate Certificate of Conformance (see Nonmandatory Appendix C) but before the valve is put into service for overpressure protection, provided all of the following requirements are met:

(a) All parts conversions, valve adjustments, and testing shall be performed by the Manufacturer or an Assembler that has been granted permission to apply the Certification Mark and appropriate Designator to the specific valve type.

(b) The valve Manufacturer or Assembler that performs the set pressure change shall update the Certificate of Conformance or create a new Certificate of Conformance (see Nonmandatory Appendix C).

(c) The change to the set pressure shall be validated per 3.6.3.

(d) The set pressure and capacity marked on the valve shall be obliterated. The new set pressure and capacity shall be marked in accordance with 3.9. When marking is accomplished by metal nameplate, the original nameplate shall be removed and destroyed, and a new nameplate affixed to the valve.

(e) All other requirements of this Section for the use of the Certification Mark and appropriate Designator shall apply, in particular leak testing per 3.6.1 and 3.6.4, and resealing adjustments per 3.2.9.

3.9 MARKING (23)

(a) The Manufacturer or Assembler shall plainly mark each pressure relief valve with the required data in such a way that the marking will not be obliterated in service.

(b) The markings shall be located on the valve or a corrosion-resistant metal plate or plates securely fastened to the valve.

(c) Small valves [less than DN 15 (NPS ½) inlet] may have the nameplate attached with a chain or wire or adhesive meeting the requirements of Mandatory Appendix II or other means suitable for the service conditions.

(d) For units of measure other than those included in (e), see 1.5.

(e) The marking shall include the following:

(1) name or identifying trademark of the Manufacturer and/or Assembler, as appropriate.

(2) Manufacturer's design or type number.

(3) DN (NPS) size _____ (the nominal pipe size of the valve inlet).

(4) set pressure _____ kPa (psi) and, if applicable per 3.6.3.1(d)

(-a) cold differential test pressure _____ kPa (psi)

(-b) superimposed back pressure _____ kPa (psi)

(5) certified capacity as follows:

(-a) For Valves to Be Marked With the Certification Mark and UV Designator. The valve shall be marked with one of the following, as applicable:

(-1) _______ kg/h (lbm/hr) of saturated steam at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for valves certified on steam.

(-2) _________ L/min (gpm) of water at 20°C (70°F) at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for valves certified on water.

(-3) ________ m^3/min of air at 20°C and 101 kPa [standard cubic feet per minute (SCFM) of air at 60°F and 14.7 psia] or ________ kg/min (lbm/min) of air at an overpressure of 10% or 20 kPa (3 psi), whichever is greater for valves certified on air. Valves that are capacity certified for application in accordance with Section VIII, Division 1, UG-153(a)(3) shall be marked "at 20% overpressure."

In addition to one of the fluids specified in (-1) through (-3), the Manufacturer may indicate the capacity in other fluids (see Mandatory Appendix IV).

(-b) For Valves to Be Marked With the Certification Mark and UV3 Designator

_______ m^3/h of air at 20°C and 101 kPa (SCFM of air at 60°F and 14.7 psia), or _______ L/min (gpm) of water at 20°C (70°F) if the pressure relief valve is to be tested to have a certified flow capacity; see Section VIII, Division 3, KOP-153(b) and KOP-154(b). If the pressure relief valve is not flow capacity tested and certified, the flow capacity shall be marked "NONE" [see Section VIII, Division 3, KOP-154(c)]. In addition, the Manufacturer/Assembler may indicate the flow capacity in other fluids (see Mandatory Appendix IV).

(-c) For Valves to Be Marked With the Certification Mark and HV Designator

_______ kg/h (lbm/hr), or ____ kW (Btu/hr) in accordance with 9.7.1(d)

(-d) For Valves to Be Marked With the Certification Mark and TV Designator. The valve shall be marked with one of the following, as applicable:

(-1) ______ L/min (gpm) of water at 20°C (70°F) at the flow rating pressure [typically an overpressure of 10% or 20 kPa (3 psi), whichever is greater] for valves certified on water

(-2) ______ m^3/min of air at 20°C and 101 kPa (SCFM of air at 60°F and 14.7 psia) or _______ kg/min (lbm/min) of air at the flow rating pressure [typically an overpressure of 10% or 20 kPa (3 psi), whichever is greater] for valves certified on air. Valves that are capacity certified at 120% of marked set pressure as permitted by the appropriate Section XII Modal Appendix shall be marked "at 20% overpressure."

In addition to one of the fluids specified in (-1) and (-2), the Manufacturer may indicate the capacity in other fluids (see Mandatory Appendix IV).

(6) year built, or alternatively, a coding may be marked on the valve such that the valve Manufacturer or Assembler can identify the year the valve was assembled and tested.

(7) Certification Mark and the appropriate Designator placed under the Certification Mark (see Figure 10.1-1). A marking method other than the stamp issued by the Society may be used, provided it is acceptable to the ASME Designated Organization.

(f) Specific valve types require additional markings, as follows:

(1) The pilot of a pilot-operated pressure relief valve shall be plainly marked by the Manufacturer or Assembler with the name of the Manufacturer, the Manufacturer's design or type number, the set pressure in kilopascals (pounds per square inch), and the year built or, alternatively, a coding that the Manufacturer can use to identify the year built. The pilot and main valve of a pilot-operated pressure relief valve shall each be marked with the same unique identifier to establish association of both components.

(2) Restricted lift valves shall be marked with their restricted lift in millimeters (inches).

(3) Section XII (TV Designator) pressure relief valves shall be marked with the vessel class, based on the applicable Modal Appendix used to establish the certified flowing capacity.

PART 4
REQUIREMENTS FOR RUPTURE DISK DEVICES

4.1 GENERAL

4.1.1 Applicability of Part 4 Requirements

This Part contains requirements applicable to all rupture disk devices that are to be marked with the Certification Mark and any Designator. Requirements unique to a specific Designator are identified.

4.1.2 Burst Pressure

(a) Every rupture disk shall have a marked burst pressure established by the requirements of 4.5.2 within a manufacturing design range at a specified disk temperature and shall be traceable by lot number. The manufacturing design range shall be evaluated in conjunction with the specified burst pressure to ensure that the marked burst pressure of the rupture disk will always be within the limits of the particular agreed-upon requirement. Users are cautioned that certain types of rupture disks have manufacturing ranges that can result in a marked burst pressure greater than the specified burst pressure.

(b) For rupture disk devices with marked burst pressures up to and including 300 kPa (40 psi), the burst pressure tolerance at the specified disk temperature shall not exceed ±15 kPa (±2 psi); for devices with marked burst pressures above 300 kPa (40 psi), the burst pressure tolerance at specified disk temperature shall not exceed ±5%. For Section XII (TD Designator) devices, these tolerances apply unless other requirements are identified by the competent authority or by the Section XII Modal Appendices.

4.1.3 Relieving Capacity

4.1.3.1 The relieving capacity of rupture disk devices shall be certified based on the simple system or flow resistance methods described in 4.1.3.2 or the coefficient of discharge method described in 4.1.3.3.

4.1.3.2 The rated flow capacity of a pressure relief system that uses a rupture disk device as the sole relieving device shall be determined by the user based on a value calculated in accordance with one of the following methods:

(a) Simple System Method. The simple system method may be used to determine the relieving capacity of a pressure relief system that includes a rupture disk device, provided the following conditions are met:

(1) The pressure relief system that includes the rupture disk device discharges directly to the atmosphere.

(2) The rupture disk device is installed within eight pipe diameters of the vessel nozzle entry.

(3) The discharge piping downstream of the rupture disk device is not greater than five pipe diameters in length.

(4) The nominal diameters of the inlet and discharge piping are equal to or greater than the marked DN (NPS) designator of the device.

The calculated relieving capacity of the simple pressure relief system shall not exceed a value based on the applicable theoretical flow equation [see 9.7.6.4 and Mandatory Appendix IV] for the various fluids multiplied by a coefficient of discharge, K, equal to 0.62. The area, A, in the theoretical flow equation shall be the minimum net flow area as specified by the rupture disk device Manufacturer.

(b) Flow Resistance Method. The calculated capacity of any pressure relief system may be determined by analyzing the total system resistance to flow. This analysis shall take into consideration the flow resistance of the rupture disk device; piping; and piping components, including the exit nozzle on the vessels, and elbows, tees, reducers, and valves. The calculation shall be made using accepted engineering practices for determining fluid flow through piping systems. This calculated relieving capacity shall be multiplied by a factor of 0.90 or less to allow for uncertainties inherent to this method. The certified flow resistance, K_R, for the rupture disk device, expressed as the velocity head loss, shall be determined in accordance with Part 9.

4.1.3.3 The relieving capacity of a pressure relief system that uses a capacity-certified rupture disk device as the sole relieving device shall be determined based on the certified capacity marked on the device and the characteristics of the system fluid and system components upstream and downstream of the rupture disk device. The certified coefficient of discharge, K_D, for the rupture disk device shall be determined in accordance with Part 9.

(23) 4.2 DESIGN AND MECHANICAL REQUIREMENTS

(a) The design of the rupture disk device shall incorporate features necessary to ensure consistent operation and tightness.

(b) Rupture disk devices having threaded inlet or outlet connections shall be designed to allow for normal installation without damage to the rupture disk.

(c) Section VIII, Division 3 (UD3 Designator) rupture disk holders shall comply with the applicable requirements of Section VIII, Division 3, Part KD. Alternatively, it is permissible to design rupture disk holders in accordance with the rules in ASME B31.3, Chapter IX, provided that

(1) the materials for the holder meet the requirements of 4.3.2

(2) all components of the rupture disk device are outside of the geometric scope of Section VIII, Division 3 and are part of the external piping as defined in Section VIII, Division 3, KG-110

(d) For Section VIII, Division 3 (UD3 Designator) rupture disk devices, the Manufacturer of the rupture disk holder may be different from the Manufacturer of the rupture disk.

4.3 MATERIAL REQUIREMENTS

4.3.1 Disk Material

(a) The rupture disk material is not required to conform to a material specification listed in Section II.

(b) The rupture disk material shall be controlled by the Manufacturer of the rupture disk device by a specification ensuring the control of material properties.

(c) Rupture disks may be fabricated from either ductile or brittle materials.

4.3.2 Pressure-Retaining Parts

4.3.2.1 Materials used in pressure-containing or pressure-retaining holder components and pressure-retaining bolting shall be as permitted in Section II, Part D by the referencing Code. In addition, the following requirements apply:

(a) Section VIII, Division 1 (UD Designator) pressure-containing or pressure-retaining holder components and pressure-retaining rupture disk holders and bolting shall meet all applicable requirements of Section VIII, Division 1, Subsection C.

(b) Section VIII, Division 3 (UD3 Designator) pressure-containing or pressure-retaining holder components and pressure-retaining rupture disk holders and bolting shall meet all applicable requirements of Section VIII, Division 3, Article KM.

(c) Section XII (TD Designator) pressure-containing or pressure-retaining holder components and pressure-retaining rupture disk holders and bolting shall meet all applicable requirements of Section XII, Part TM.

4.3.2.2 Other than as specified in 4.3.2.1, all parts required for the pressure-relieving or pressure-retaining function shall be of materials that are

(a) listed in Section II, or

(b) listed in ASTM specifications, or

(c) controlled by the Manufacturer of the pressure relief device by a specification ensuring control of chemical and physical properties and quality at least equivalent to that of ASTM standards

4.4 INSPECTION OF MANUFACTURING

4.4.1 General

(a) A Manufacturer shall demonstrate to the satisfaction of a representative from an ASME Designated Organization that the manufacturing, production, and testing facilities and the quality control procedures will ensure close agreement between the performance of random production samples and the performance of those devices submitted for certification.

(b) At the time of the submission of rupture disk devices for capacity certification or testing in accordance with 4.4.3, the representative of the ASME Designated Organization has the authority to review the device design for conformity with the requirements of 4.2 and 4.3, and to reject or require modification of designs that do not conform.

4.4.2 Verification

Manufacturing, assembly, inspection, and test operations are subject to inspections at any time by an ASME Designee.

4.4.3 Production Certification

A Manufacturer may be granted permission to apply the Certification Mark and appropriate Designator to production rupture disk devices capacity certified in accordance with Part 9, provided the testing described in this paragraph is successfully completed. This permission shall expire on the sixth anniversary of the date it is initially granted. The permission may be extended for 6-yr periods if the testing described in this paragraph are successfully repeated within the 6-month period before expiration.

4.4.3.1 Sample Selection

(a) Two production sample rupture disk devices of a size and capacity within the capability of an ASME-accepted laboratory shall be selected by a representative of an ASME Designated Organization.

(b) If a Section VIII, Division 3 (UD3 Designator) rupture disk device incorporates a Manufacturer's standard rupture disk holder from a different Manufacturer, two new rupture disk holders shall be procured by the rupture disk Manufacturer for use in the tests.

4.4.3.2 Testing. Burst and flow testing shall be conducted in the presence of a representative from an ASME Designated Organization at a testing facility meeting the requirements of ASME CA-1. The device Manufacturer shall be notified of the time of the test and may have representatives present to witness the test.

4.4.3.3 Test Results

(a) Should any device fail to meet or exceed the applicable performance requirements of this Section, the test(s) shall be repeated at the rate of two replacement devices, selected and tested in accordance with 4.4.3.1 and 4.4.3.2, for each device that failed.

(b) Should any of the replacement devices fail to meet the capacity or performance requirements of this Section, the Manufacturer shall determine the cause of failure and take corrective action to guard against future occurrence. This cause of failure and corrective action shall be documented and submitted to the ASME Designated Organization within 60 days of the failure or be cause for revocation of the authorization to use the Certification Mark on that particular type of device. Upon acceptance of the submitted corrective action by the ASME Designated Organization, the requirements of 4.4.3 shall apply.

4.5 PRODUCTION TESTING

Each rupture disk device to which the Certification Mark is to be applied shall be tested by the Manufacturer in accordance with 4.5.1 and 4.5.2. The Manufacturer shall have a documented system for the application, calibration, and maintenance of gages and instruments used during these tests.

4.5.1 Pressure Testing

(a) The pressure-containing parts of each rupture disk holder are subject to pressure testing.

(b) Except as specified in (c), a rupture disk holder part requiring pressure testing shall be tested either

(1) hydrostatically at a pressure no less than 1.5 times the design pressure of the part, or

(2) pneumatically at a pressure no less than 1.25 times the design pressure of the part

CAUTION: Pneumatic testing can be hazardous; it is therefore recommended that special precautions be taken when conducting a pneumatic test.

(c) Devices to be marked with the Certification Mark and UD3 Designator shall be tested hydrostatically only, at a pressure no less than 1.25 times the design pressure and no greater than the pressure determined in accordance with Section VIII, Division 3, KT-312.

(d) Pressure testing may be done in the part or assembled condition.

(e) Pressure testing shall be conducted after all machining and welding operations have been completed.

(f) Parts subjected to pressure testing shall not exhibit a sign of leakage.

(g) Parts fully contained within the holder or vessel, or parts downstream of the rupture disk and not designed to contain pressure, are exempt from pressure testing.

(h) A rupture disk holder part to be marked with the Certification Mark and UD or TD Designator is exempt from pressure testing if both of the following conditions apply:

(1) The stress that would be applied under hydrostatic test conditions does not exceed 50% of the allowable stress.

(2) The holder is not cast or welded.

4.5.2 Burst Tests

(a) General. Each lot of rupture disks shall be tested in accordance with one of the methods described in (b). All tests of disks for a given lot shall be performed with a holder of the same form and pressure area dimensions as that being used in service. Sample rupture disks, selected from each lot of rupture disks, shall be made from the same material and shall be of the same size as those to be used in service. Test results shall be applicable only to rupture disks used in disk holders supplied by the rupture disk Manufacturer or, for Section VIII, Division 3 (UD3 Designator) devices, installed in the Manufacturer's standard rupture disk holders as specified in the required rupture disk marking.

(b) Test Methods

(1) At least two sample rupture disks from each lot of rupture disks shall be burst at the specified disk temperature. The marked burst pressure shall be determined so that the sample rupture disk burst pressures are within the burst pressure tolerance specified in 4.1.2(b).

(2) At least four sample rupture disks, but not less than 5% from each lot of rupture disks, shall be burst at four different temperatures distributed over the applicable temperature range for which the disks will be used. This data shall be used to establish a smooth curve of burst pressure versus temperature for the lot of disks. The burst pressure for each data point shall not deviate from the curve by more than the burst pressure tolerance specified in 4.1.2(b). The value for the marked burst pressure shall be derived from the curve for a specified temperature. At least two disks from each lot of disks, made from this lot of material, shall be burst at the ambient temperature to establish the room temperature rating of the lot of disks.

(3) For prebulged solid metal disks or graphite disks only, at least four sample rupture disks using one size of disk from each lot of material shall be burst at four different temperatures distributed over the applicable temperature range for which this material will be used. These data shall be used to establish a smooth curve of percent change of burst pressure versus temperature for the lot of material. The acceptance criteria of smooth curve shall be as in (2). At least two disks

from each lot of disks, made from this lot of material and of the same size as those to be used, shall be burst at the ambient temperature to establish the room temperature rating of the lot of disks. The percent change shall be used to establish the marked burst pressure at the specified disk temperature for the lot of disks.

4.6 WELDING, BRAZING, HEAT TREATMENT, AND NONDESTRUCTIVE EXAMINATION

All welding, brazing, heat treatment, and nondestructive examination used in the construction of rupture disk holders and pressure parts shall be performed in accordance with the applicable requirements of the Section of the Certification Mark Designator applied to the rupture disk device.

4.7 MARKING

4.7.1 General

(a) The Manufacturer shall plainly mark each rupture disk and holder with the required data in such a way that the marking will not be obliterated in service and will not interfere with the function of the disk (see 12.3).

(b) The markings may be placed on the flange of the disk or a metal tag. The metal tag shall be securely fastened to the disk or, when attaching the tag is impracticable, shall accompany the disk, provided the lot number is also marked on the disk.

(c) For units other than those included in 4.7.2 and 4.7.3, see 1.5.

4.7.2 Rupture Disks

Each rupture disk shall be marked with the following information:

(a) name of the Manufacturer, or an acceptable abbreviation thereof.

(b) Manufacturer's design or type number.

(c) lot number.

(d) disk material.

(e) DN (NPS) size ________ of rupture disk holder, or nominal diameter, mm (in.), as applicable.

(f) marked burst pressure ________ kPa (psi).

(g) specified disk temperature ________ °C (°F).

(h) for capacity-certified devices, one of the following:

(1) _______ kg/h (lbm/hr) of saturated steam at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for devices certified on steam.

(2) _______ L/min (gpm) of water at 20°C (70°F) at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for devices certified on water.

(3) _______ m^3/min of air at 20°C and 101 kPa [standard cubic feet per minute (SCFM) of air at 60°F and 14.7 psia] or _______ kg/min (lbm/min) of air, at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for devices certified on air or gas. Devices that are capacity certified in accordance with the Section VIII, Division 1, UG-153(a)(3) shall be marked "at 20% overpressure."

In addition to one of the fluids specified in (1) through (3), the Manufacturer may indicate the capacity in other fluids (see Mandatory Appendix IV).

(i) for flow-resistance-certified devices

(1) minimum net flow area ____ mm^2 ($in.^2$)

(2) certified flow resistance (one or more as applicable)

(-a) K_{RG} ________ for rupture disks certified on air or gases

(-b) K_{RL} ________ for rupture disks certified on liquid

(-c) K_{RGL} ________ for rupture disks certified on air or gases, and liquid

(j) Certification Mark and the appropriate Designator placed under the Certification Mark (see Figure 10.1-1). A marking method other than the stamp issued by the Society may be used, provided it is acceptable to the ASME Designated Organization.

(k) year built, or alternatively, a coding may be marked such that the rupture disk device Manufacturer can identify the year the rupture disk device was manufactured and tested.

(l) design, type number, or drawing number of the intended Manufacturer's standard rupture disk holder [for Section VIII, Division 3 (UD3 Designator) devices only]

4.7.3 Rupture Disk Holders (23)

Each rupture disk holder shall be marked with the following information:

(a) name of the Manufacturer, or an acceptable abbreviation thereof.

(b) Manufacturer's design or type number.

(c) DN (NPS) size ________ of rupture disk holder, or nominal diameter, mm (in.), as applicable.

(d) Certification Mark and the appropriate Designator placed under the Certification Mark (see Figure 10.1-1). A marking method other than the stamp issued by the Society may be used provided it is acceptable to the ASME Designated Organization.

(e) year built, or alternatively, a coding may be marked such that the rupture disk device Manufacturer can identify the year the rupture disk device was manufactured and tested.

(f) flow direction.

(g) "DIV3" for UD rupture disk devices manufactured per Section VIII, Division 3, KOP-152(c).

PART 5
REQUIREMENTS FOR PIN DEVICES

5.1 GENERAL

5.1.1 Applicability of Part 5 Requirements

This Part contains requirements applicable to all pin devices that are to be marked with the Certification Mark and any Designator. Requirements unique to a specific Designator are identified.

5.1.2 Set Pressure

(a) Every pin device shall have a marked set pressure at the specified pin temperature established by the rules of 5.5.2.

(b) The pin temperature may be different from the process temperature for pin devices in which the pin is isolated from operating conditions.

(c) For pin devices with marked burst pressures up to and including 300 kPa (40 psi), the set pressure tolerance at the pin temperature shall not exceed ±15 kPa (±2 psi). For pin devices with marked set pressures above 300 kPa (40 psi), the set pressure tolerance at pin temperature shall not exceed ±5%. For Section XII (TD Designator) pin devices, these tolerances apply unless other requirements are identified by the competent authority or by the Section XII Modal Appendices.

5.1.3 Relieving Capacity

5.1.3.1 The relieving capacity of pin devices shall be certified based on the simple system or flow resistance methods described in 5.1.3.2, or the coefficient of discharge method described in 5.1.3.3.

5.1.3.2 The rated flow capacity of a pressure relief system that uses a pin device as the sole relieving pin device shall be determined by the user based on a value calculated in accordance with one of the following methods:

(a) Simple System Method. The simple system method may be used to determine the relieving capacity of a pressure relief system that includes a pin device, provided the following conditions are met:

(1) The pressure relief system that includes the pin device discharges directly to the atmosphere.

(2) The pin device is installed within eight pipe diameters of the vessel nozzle entry.

(3) The discharge piping downstream of the pin device is not greater than five pipe diameters in length.

(4) The nominal diameters of the inlet and discharge piping are equal to or greater than the marked DN (NPS) designator of the pin device.

The calculated relieving capacity of the simple pressure relief system shall not exceed a value based on the applicable theoretical flow equation [see 9.7.6.4 and Mandatory Appendix IV] for the various fluids multiplied by a coefficient of discharge, K, equal to 0.62. The area, A, in the theoretical flow equation shall be the minimum net flow area as specified by the pin device Manufacturer.

(b) Flow Resistance Method. The calculated capacity of any pressure relief system may be determined by analyzing the total system resistance to flow. This analysis shall take into consideration the flow resistance of the pin device; piping; and piping components, including the exit nozzle on the vessels, and elbows, tees, reducers, and valves. The calculation shall be made using accepted engineering practices for determining fluid flow through piping systems. This calculated relieving capacity shall be multiplied by a factor of 0.90 or less to allow for uncertainties inherent with this method. The certified flow resistance, K_R, for the pin device, expressed as the velocity head loss, shall be determined in accordance with Part 9.

5.1.3.3 The relieving capacity of the pressure relief system that uses a capacity-certified pin device as the sole relieving pin device shall be determined based on the certified capacity marked on the pin device and the characteristics of the system fluid and system components upstream and downstream of the pin device. The certified coefficient of discharge, K_D, for the pin device shall be determined in accordance with Part 9.

5.2 DESIGN AND MECHANICAL REQUIREMENTS (23)

(a) The design shall incorporate guiding arrangements necessary to ensure consistent operation and seat tightness.

(b) The seat of a pin device shall be fastened to the body of the pin device in such a way that there is no possibility of the seat moving from its required position.

(c) In the design of the pin device, consideration shall be given to minimizing the effects of deposits.

(d) Pin devices having threaded inlet or outlet connections shall be provided with wrenching surfaces to allow for normal installation without damage to operating parts.

(e) Means shall be provided in the design for sealing all critical parts to ensure that these parts are original and unmodified. Seals shall be installed in a manner to prevent changing or modifying parts without breaking the seal. If the pin is replaceable, this component is not required to be sealed if it is marked in accordance with 5.7.3(a). Seals shall be installed by the Manufacturer. For pin devices larger than DN 15 (NPS $\frac{1}{2}$), the seal shall serve as a means of identifying the pin device Manufacturer.

(f) If the design of the pin device is such that liquid can collect on the discharge side, then, except as permitted in (g), the pin device shall be equipped with a drain at the lowest point at which liquid can collect.

(g) A pin device that cannot be equipped with a drain as required in (f) because of design or application may be used, provided all of the following conditions are met:

(1) The pin device is used only on gas service where there is neither liquid discharged from the pin device nor liquid formed by condensation on the discharge side of the pin device.

(2) The pin device is provided with a cover or discharge piping per 12.8 to prevent liquid or other contaminant from entering the discharge side of the pin device.

(3) The pin device is marked FOR GAS SERVICE ONLY in addition to being marked as required by 5.7.

(h) All pin devices shall be constructed so that the failure of any part cannot obstruct the free and full discharge of fluid from the pin device.

(i) O-rings or other packing devices, when used on the stems of pin devices, shall be arranged so that the pin device performance meets the requirements of this Section.

(j) Pilot-operated pin devices shall be designed such that

(1) the pilot is self-actuated

(2) the main valve will open automatically at a pressure not exceeding the set pressure

(3) if some essential part of the pilot fails, the main valve will discharge its full rated capacity at or below the relieving pressure used to determine its rated capacity

(k) Pins shall be manufactured by the pin device Manufacturer.

5.3 MATERIAL REQUIREMENTS

(a) Cast iron seats and disks are not permitted.

(b) Adjacent sliding and sealing surfaces shall both be of a corrosion-resistant material suitable for use with the fluid to be contained.

(c) Materials used in pressure-containing or pressure-retaining components and pressure-retaining bolting, excluding proprietary pin material, shall be as permitted in Section II, Part D by the referencing Code. In addition, the following requirements apply:

(1) For Section VIII, Division 1 (UD Designator) pin devices, the pressure-containing or pressure-retaining components and pressure-retaining bolting shall meet all applicable requirements of Section VIII, Division 1, Subsection C.

(2) For Section VIII, Division 3 (UD3 Designator) pin devices, the pressure-containing or pressure-retaining components and pressure-retaining bolting shall meet all applicable requirements of Section VIII, Division 3, Article KM.

(3) For Section XII (TD Designator) pin devices, the pressure-containing or pressure-retaining components and pressure-retaining bolting shall meet all applicable requirements of Section XII, Part TM.

(d) Other than as specified in (c), all parts required for the pressure-relieving or pressure-retaining function shall be of materials that are

(1) listed in Section II, or

(2) listed in ASTM specifications, or

(3) controlled by the Manufacturer of the pin device by a specification ensuring control of chemical and physical properties and quality at least equivalent to that of ASTM standards

(e) Materials used for pins shall be controlled by the Manufacturer of the pin device by a specification ensuring the control of material properties.

(f) The seats and disks of pin devices shall be of suitable material to resist corrosion by the fluid to be contained. The degree of corrosion resistance, appropriate to the intended service, shall be a matter of agreement between the Manufacturer and the purchaser.

(g) Nonmetallic disk inserts and seals shall be compatible with the maximum design temperature established for the pin device.

(h) Adjacent sliding surfaces shall both be of corrosion-resistant material. The degree of corrosion resistance, appropriate to the intended service, shall be a matter of agreement between the Manufacturer and purchaser.

5.4 INSPECTION OF MANUFACTURING

5.4.1 General

(a) A Manufacturer shall demonstrate to the satisfaction of a representative from an ASME Designated Organization that the manufacturing, production, and testing facilities and the quality control procedures will ensure close agreement between the performance of random production samples and the performance of those pin devices submitted for certification.

(b) At the time of the submission of pin devices for capacity certification or testing in accordance with 5.4.2, the representative of the ASME Designated Organization has the authority to review the pin device design for conformity with the requirements of 5.2, 5.3, and 5.5.3, and to reject or require modification of designs that do not conform.

(c) Manufacturing, assembly, inspection, and test operations, including capacity, are subject to inspections at any time by a representative from an ASME Designated Organization.

5.4.2 Production Certification

A Manufacturer or Assembler may be granted permission to apply the Certification Mark and appropriate Designator to production pin devices whose capacity has been certified in accordance with Part 9, provided the testing described in this paragraph is successfully completed. This permission shall expire on the sixth anniversary of the date it is initially granted. The permission may be extended for 6-yr periods if the testing described in this paragraph is successfully repeated within the 6-month period before expiration.

5.4.2.1 Sample Selection. Two production sample pin devices of a size and capacity within the capability of an ASME-accepted laboratory shall be selected by a representative of an ASME Designated Organization.

5.4.2.2 Testing. Operational and capacity testing shall be conducted in the presence of a representative from an ASME Designated Organization at a testing facility meeting the requirements of ASME CA-1. The pin device Manufacturer shall be notified of the time of the test and may have representatives present to witness the test.

5.4.2.3 Test Results

(a) Should any pin device fail to meet or exceed the applicable performance requirements of this Section, the test(s) may be repeated at the rate of two replacement pin devices, selected and tested in accordance with 5.4.2.1 and 5.4.2.2, for each pin device that failed.

(b) Should any of the replacement pin devices described in (a) fail to meet the capacity or performance requirements of this Section, the Manufacturer shall determine the cause of failure and take corrective action to guard against future occurrence. This cause of failure and corrective action shall be documented and submitted to the ASME Designated Organization within 60 days of the failure or be cause for revocation of the authorization to use the Certification Mark on that particular type of pin device. Upon acceptance of the submitted corrective action by the ASME Designated Organization, the requirements of 5.4.2 shall apply.

5.4.2.4 Alternative Tests for Pin Devices That Exceed the Laboratory Capabilities

(a) For pin devices that exceed the laboratory testing capabilities and for which lift at rated overpressure can be measured or complete opening can be verified, the alternative method described below shall be used in lieu of the test requirements of 5.4.2, 5.4.2.1, and 5.4.2.3(a).

(1) Two production pin devices that are representative of the design shall be tested per ASME PTC 25, Part III. The tests shall demonstrate to the satisfaction of the representative of the ASME Designated Organization that the pin devices satisfy the following conditions:

(-a) The measured set pressure is consistent with the stamped set pressure within the tolerances required by 5.1.2(c).

(-b) The pin device will achieve complete opening or the minimum lift required to meet its certified capacity.

(-c) The pin device will operate in a stable manner.

If only one pin device of the design will be produced within the 6-yr period for which the permission is granted, only that pin device need be tested as stated above.

(2) The testing shall be performed at a facility that is mutually agreeable to the Manufacturer, the representative of an ASME Designated Organization, and the facility owner. The facility shall be capable of demonstrating the characteristics stated in (1)(-a) through (1)(-c).

(3) In the event of failure of the tests, 5.4.2.3(b) shall apply.

(b) For pin devices that exceed the laboratory testing capabilities and for which lift at rated overpressure cannot be measured or complete opening cannot be verified, the alternative method described below shall be used.

(1) For initial certification, two functional models that are representative of the design shall be used, provided the test requirements of 5.4.2 are followed and the following additional test requirements are met:

(-a) Two production pin devices that are representative of the design shall be tested per ASME PTC 25, Part III. The tests shall demonstrate to the satisfaction of the representative of the ASME Designated Organization that

(-1) the measured set pressure is consistent with the stamped set pressure within the tolerances required by 5.1.2(c)

(-2) a secondary pressure zone leakage test and a seat tightness test are demonstrated in accordance with 5.5.1(g) and 5.5.3

If only one pin device of the design will be produced within the 6-yr period for which the permission is granted, only that pin device need be tested as stated above.

(-b) The testing shall be performed at a facility that is mutually agreeable to the Manufacturer, the representative of an ASME Designated Organization, and the facility owner. The facility shall be capable of demonstrating the characteristics stated in (-a)(-1) and (-a)(-2).

(-c)) In the event of failure of the tests, 5.4.2.3(b) shall apply.

(2) For 6-yr renewal of capacity certification, (1)(-a) through (1)(-c) shall apply.

5.5 PRODUCTION TESTING

Each pin device to which the Certification Mark is to be applied shall be tested by the Manufacturer in accordance with 5.5.1 and 5.5.2. The Manufacturer shall have a documented system for the application, calibration, and maintenance of gages and instruments used during these tests.

5.5.1 Pressure Testing

(a) The pressure-containing parts of each pin device are subject to pressure testing.

(b) A pin device part is exempt from pressure testing if any of the following conditions exist:

(1) The stress that would be applied under hydrostatic test conditions does not exceed 50% of the allowable stress, and the part is not cast or welded.

(2) The part is downstream of the pressure-containing element and fully within pressure-containing parts that have been either pressure tested or exempted from pressure testing by (1).

(c) A pin device part requiring pressure testing shall be tested either

(1) hydrostatically at a pressure no less than 1.5 times the design pressure of the part, or

(2) pneumatically at a pressure no less than 1.25 times the design pressure of the part

CAUTION: Pneumatic testing can be hazardous; it is therefore recommended that special precautions be taken when conducting a pneumatic test.

(d) Pressure testing may be done in the part or assembled condition.

(e) Pressure testing shall be conducted after all machining and welding operations have been completed.

(f) Parts subjected to pressure testing shall not exhibit a sign of leakage.

(g) If a pin device designed for discharge to a closed system has a secondary pressure zone with an inlet size exceeding DN 25 (NPS 1), the secondary pressure zone shall be tested with air or other gas at a pressure of at least 200 kPa (30 psi). There shall be no visible signs of leakage. The user may specify a higher test pressure commensurate with the back pressure anticipated in service.

5.5.2 Set Pressure Qualification Testing

5.5.2.1 Set pressure qualification of a pin device shall be accomplished by completing set pressure testing in the pin device. At least two pins from the same lot shall be tested in the pin device. For single-use, permanently assembled pin devices that have the same specification and configuration and that will be supplied as a single lot, at least two completed pin devices shall be tested. The tests shall be conducted at the pin temperature or according to 5.5.2.2(d). The test pressure shall be within the tolerance specified in 5.1.2(c).

5.5.2.2 For all pin lot qualification testing, the following requirements apply:

(a) Sample pins selected from each lot shall be made from the same material and heat and shall be of the same critical dimension as those to be used in service.

(b) Test results shall be applicable only to pins used in pin devices supplied by the pin device Manufacturer.

(c) At least two pins or two single-use, permanently assembled pin devices from the same lot shall be tested.

(d) Tests shall be conducted at ambient temperature or the pin temperature (as agreed to between the pin device Manufacturer and the user). The Manufacturer shall establish a temperature range for which testing at ambient temperature is applicable. For qualification of a pin lot at a single pin temperature, at least two pin tests shall be conducted at the specified pin temperature.

(e) Pin testing shall be completed in the actual pin device(s) or in accordance with one or both of the following methods:

(1) Lot qualification testing shall be done in a test pin device of the same form and pressure area dimensions as that in which the pins will be used. At least two set pressure tests shall be completed at the pin temperature in accordance with (d). The tests shall be within the tolerance specified.

(2) The set pressure of a lot of pins for a pin device may be verified by a characterization test that determines the activation loading (force) under pin device–opening conditions. The following characterization test conditions shall apply:

(-a) The pin-retaining arrangement shall be the same for all characterization tests applied to a pin device.

(-b) At least two pins from the same lot as tested under 5.5.2.1 or (1) shall be tested to determine the activation force that correlates to the tested set pressure of the pin device. The average of these test results defines the base force that shall be used to permit further pin qualification by characterization rather than by set pressure testing of the pin device. The following equation shall be used to define a corrected base force that corresponds to the nominal set pressure of the pin device:

$$\text{corrected base force, N (lbf)} = \frac{\text{nominal set pressure, kPa (psi)} \times \text{average base force, N (lbf)}}{\text{average tested set pressure, kPa (psi) per 5.5.2.1 or (e)(1)}}$$

(-c) This corrected base force, rather than set pressure testing of the pin device, may be used to qualify additional pin quantities and lots, provided the pins function at activation forces that are within ±3% of the corrected base force for set pressures above 300 kPa (40 psi). For set pressures below 300 kPa (40 psi), the tested components shall function at activation forces within a plus–minus tolerance of the corrected base force determined as follows:

(SI Units)

$$\pm\%\text{ tolerance for actual test forces} = \frac{300\text{ kPa}}{\text{corresponding nominal set pressure, kPa}} \times 3\%$$

(U.S. Customary Units)

$$\pm\%\text{ tolerance for actual test forces} = \frac{40\text{ psi}}{\text{corresponding nominal set pressure, psi}} \times 3\%$$

5.5.3 Seat Tightness Test

A seat tightness test shall be conducted on each pin device. The test conditions and acceptance criteria shall be in accordance with the Manufacturer's published pin device specification or another specification agreed to by the user and the Manufacturer.

5.6 WELDING, BRAZING, HEAT TREATMENT, AND NONDESTRUCTIVE EXAMINATION

All welding, brazing, heat treatment, and nondestructive examination used in the construction of bodies, bonnets, and yokes shall be performed in accordance with the applicable requirements of the Section of the Certification Mark Designator applied to the pin device.

5.7 MARKING

5.7.1 General

The Manufacturer shall plainly mark each pin device with the required data in such a way that the marking will not be obliterated in service. The marking may be placed on the pin device housing or on a metal plate or plates securely fastened to the pin device. If such markings will not be visible when the pin device is in service, the marking may be placed on a tab attached as close as possible to the discharge side of the pin device. The tab shall remain visible when installed.

5.7.2 Pin Devices

Each pin device shall be marked with the following information. For units of measure other than those included below, see 1.5.

(a) name of the Manufacturer, or an acceptable abbreviation thereof.

(b) Manufacturer's design or type number.

(c) DN (NPS) size ________ (the nominal pipe size of the pin device inlet).

(d) set pressure ________ kPa (psi).

(e) flow direction.

(f) pin-to-pin device identifier.

(g) for capacity-certified pin devices, one of the following, as applicable:

(1) _____ kg/h (lbm/hr) of saturated steam at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for pin devices certified on steam.

(2) ______L/min (gpm) of water at 20°C (70°F) at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for pin devices certified on water.

(3) ______ m^3/min of air at 20°C and 101 kPa [standard cubic feet per minute (SCFM) of air at 60°F and 14.7 psia)] or _______ kg/min (lbm/min) of air at an overpressure of 10% or 20 kPa (3 psi), whichever is greater. Pin devices for use in accordance with Section VIII, Division 1, UG-153(a)(3) or at 120% of marked set pressure as permitted by the appropriate Section XII Modal Appendix shall be marked "at 20% overpressure."

In addition to one of the fluids specified in (1) through (3), the Manufacturer may indicate the capacity in other fluids (see Mandatory Appendix IV).

(h) for flow-resistance-certified pin devices

(1) minimum net flow area ________ mm^2 ($in.^2$)

(2) certified flow resistance (one or more as applicable)

(-a) K_{RG} ________ for pin devices certified on air or gases

(-b) K_{RL} ________ for pin devices certified on liquid

(-c) K_{RGL} ________ for pin devices certified on air or gases, and liquid

(i) Certification Mark and the appropriate Designator placed under the Certification Mark (see Figure 10.1-1). A marking method other than the stamp issued by the Society may be used provided it is acceptable to the ASME Designated Organization.

(j) year built, or alternatively, a coding may be marked on the pin device such that the pin device Manufacturer can identify the year the pin device was tested.

5.7.3 Pin

The pin shall be marked according to one of the following methods:

(a) For pin devices using a replaceable pin to control set pressure, the pin shall be marked with its lot number; pin temperature, °C (°F); and the information required by 5.7.2(a), 5.7.2(d), 5.7.2(f), and 5.7.2(j).

(b) For pin devices that are single use and permanently assembled, the pin shall be marked with its lot number.

(c) For pin devices that have a replaceable pin within the sealed body per 5.2, the pin shall be marked with its lot number.

When the pin size or configuration does not permit the use of an attached metal tag, a metal tag may be attached using a nonmetallic connector with an adhesive that complies with Mandatory Appendix II.

PART 6
REQUIREMENTS FOR SPRING-ACTUATED NON-RECLOSING DEVICES

6.1 GENERAL

6.1.1 Applicability of Part 6 Requirements

This Part contains requirements that are applicable to all spring-actuated non-reclosing devices that are to be marked with the Certification Mark and any Designator. Requirements unique to a specific Designator are identified.

6.1.2 Manually Reset Devices

A spring-actuated non-reclosing pressure relief device that is pressure actuated by means that permit the spring-loaded portion of the device to open at the specified set pressure and remain open until manually reset may be used, provided the design of the spring-actuated non-reclosing device is such that if the actuating means fail, the device will achieve full opening at or below its set pressure. Such a device may not be used in combination with any other pressure relief device. These devices may be direct spring loaded or pilot operated. These devices shall meet the requirements of 3.1.2(b) and 3.1.2(c).

6.2 DESIGN AND MECHANICAL REQUIREMENTS

Spring-actuated non-reclosing devices shall meet the applicable design and mechanical requirements for pressure relief valves in 3.2.

6.3 MATERIAL REQUIREMENTS

Spring-actuated non-reclosing pressure relief devices shall meet the applicable material requirements for pressure relief valves in 3.3.

6.4 INSPECTION OF MANUFACTURING AND/OR ASSEMBLY

Spring-actuated non-reclosing pressure relief devices shall meet the inspection requirements for pressure relief valves in 3.4.

6.5 PRODUCTION TESTING

Spring-actuated non-reclosing pressure relief devices shall meet the production testing requirements for pressure relief valves in 3.6 except the set pressure tolerance shall be in accordance with the following:

Set Pressure, kPa (psi)	Tolerance
≤300 (≤40)	±15 kPa (±2 psi)
>300 (>40)	±5% of set pressure

6.6 WELDING, BRAZING, HEAT TREATMENT, AND NONDESTRUCTIVE EXAMINATION

All welding, brazing, heat treatment, and nondestructive examination used in the construction of bodies, bonnets, and yokes shall be performed in accordance with the applicable requirements of the Section of the Certification Mark Designator applied to the spring-loaded non-reclosing relief device.

6.7 MARKING

Spring-actuated non-reclosing pressure relief devices shall be marked in accordance with 3.9.

PART 7
REQUIREMENTS FOR TEMPERATURE AND PRESSURE RELIEF VALVES

7.1 GENERAL

(a) This Part contains requirements that are applicable to temperature and pressure relief valves that are to be marked with the Certification Mark and HV Designator.

(b) A temperature and pressure relief valve is a pressure relief valve that may be actuated by pressure at the valve inlet or by temperature at the valve inlet. The pressure-relieving feature is normally achieved by a conventional direct spring-loaded type of relief valve design. The temperature-relieving feature is achieved by a separate thermal-sensing element. The pressure- and temperature-relieving features are independent of one another.

7.2 DESIGN AND MECHANICAL REQUIREMENTS

Temperature and pressure relief valves shall meet the design and mechanical requirements in 3.2. Additionally, the thermal-sensing elements for temperature and pressure relief valves shall be so designed and constructed that they will not fail in any manner that could obstruct flow passages or reduce capacities of the valves when the elements are subjected to saturated steam temperature corresponding to capacity test pressure. Temperature and pressure relief valves incorporating these elements shall comply with a nationally recognized standard (e.g., ANSI Z21.22/CSA 4.4).

7.3 MATERIAL REQUIREMENTS

Temperature and pressure relief valves shall meet the material requirements in 3.3.

7.4 INSPECTION OF MANUFACTURING AND/OR ASSEMBLY

Temperature and pressure relief valves shall meet the inspection of manufacturing and/or assembly requirements in 3.4.

7.5 PRODUCTION TESTING

Production testing of temperature and pressure relief valves shall be in accordance with 3.6.

7.6 WELDING

Welding is not allowed on temperature and pressure relief valves.

7.7 MARKING

Temperature and pressure relief valves shall be marked in accordance with 3.9.

7.8 CERTIFICATION OF CAPACITY

The capacity of temperature and pressure relief valves shall be certified in accordance with Part 9 and the following additional requirements:

(a) Set Pressure Tests of Temperature and Pressure Relief Valves. For the purpose of determining the set pressure of temperature and pressure relief valves, the test fluid shall be room temperature water. The actual set pressure is defined as the pressure at the valve inlet when the flow rate through the valve is 40 cc/min (2.4 in.^{3}/min).

(b) Capacity Tests of Temperature and Pressure Relief Valves. For the purpose of determining the capacity of temperature and pressure relief valves, dummy elements of the same size and shape as the regularly applied thermal element shall be substituted and the relieving capacity shall be based on the pressure element only. Valves selected to meet the requirements of production testing shall have their temperature elements deactivated by the Manufacturer prior to or at the time of capacity testing.

PART 8 REQUIREMENTS FOR DEVICES IN COMBINATION

8.1 GENERAL

(a) The rules of this Part are applicable only when specified by the referencing Code or Standard.

(b) A non-reclosing pressure relief device that meets the requirements of Part 4 or Part 5 may be used in combination with a pressure relief valve that meets the requirements of Part 3. This combination of devices may be advisable on pressurized equipment subject to one or more of the following conditions:

(1) The vessel contains substances that may render a pressure relief valve inoperative by fouling.

(2) A loss of valuable material by leakage should be avoided.

(3) Contamination of the atmosphere by leakage of noxious, flammable, or hazardous fluids must be avoided.

8.2 RUPTURE DISK DEVICE INSTALLED BETWEEN A PRESSURE RELIEF VALVE AND THE PRESSURIZED EQUIPMENT

A rupture disk device may be installed between a pressure relief valve and the pressurized equipment, provided the following conditions are met:

(a) The flow capacity of the combined pressure relief valve and the rupture disk device shall meet the maximum permissible overpressure requirements of the referencing Code or Standard.

(b) The combined capacity of the pressure relief valve (nozzle type) and rupture disk device shall be the rated capacity of the valve multiplied by a factor of 0.90. Alternatively, the capacity of such a combination shall be established in accordance with (c).

(c) The capacity of the combination of the rupture disk device and the pressure relief valve may be established in accordance with the appropriate paragraphs of 9.5.

(d) The space between the rupture disk device and the pressure relief valve shall be provided with a pressure gage, try cock, free vent, or other suitable telltale indicator. This arrangement permits detection of disk rupture or leakage. For Section VIII, Division 3 (UD3 Designator) devices, in lieu of one of the previously mentioned indicators, the series combination can be provided with a second rupture disk device in parallel whose burst pressure is 116% of vessel design pressure. Users are warned that a rupture disk will not burst at its marked bursting pressure if back pressure builds up in the space between the disk and the pressure relief valve, which will occur should leakage develop in the rupture disk due to corrosion or other cause.

(e) The opening provided through the rupture disk after the disk bursts shall be sufficient to permit a flow equal to the capacity of the pressure relief valve [see (b) and (c)], and there shall be no chance of interference with proper functioning of the pressure relief valve. However, in no case shall this area be less than the inlet area of the pressure relief valve unless the capacity and functioning of the specific combination of rupture disk device and pressure relief valve have been established by test according to 9.5.

(f) The use of a rupture disk device in combination with a pressure relief valve should be carefully evaluated to ensure that the fluid being handled and the valve operational characteristics will result in opening action of the valve coincident with the bursting of the rupture disk.

(g) The installation shall ensure that solid material will not collect in the inlet or outlet of the rupture disk; accumulation of such material could impair the relieving capacity of the relief system.

(h) Fragmenting-type rupture disks shall not be used upstream of a pressure relief valve.

8.3 RUPTURE DISK DEVICE INSTALLED ON THE OUTLET SIDE OF A PRESSURE RELIEF VALVE

A rupture disk device may be installed on the outlet side of a pressure relief valve, provided (a) through (i) are met. This use of a rupture disk device in series with the pressure relief valve is permitted to minimize leakage through the valve of valuable material or of noxious or otherwise hazardous materials, to accommodate the use of rupture disks on pressurized equipment for which a rupture disk alone or disk located on the inlet side of the valve is impracticable, or to prevent corrosive gases from a common discharge line from reaching the valve internals.

(a) The pressure relief valve shall not fail to open at its proper pressure setting regardless of any back pressure that can accumulate between the pressure relief valve disk and the rupture disk. The space between the pressure relief valve disk and the rupture disk shall be vented or drained to prevent accumulation of pressure, or suitable means shall be provided to ensure that an accumulation of pressure does not affect the proper operation of the pressure relief valve. Users are warned that many

types of pressure relief valves will not open at the set pressure if pressure builds up in the space between the pressure relief valve disk and the rupture disk device. A specially designed pressure relief valve such as a diaphragm valve, pilot-operated valve, or a valve equipped with a balancing bellows above the disk may be required.

(b) The valve and disk combination shall meet the maximum permissible overpressure requirements of the referencing Code or Standard.

(c) The marked bursting pressure of the rupture disk at the coincident temperature plus the additional pressure in the outlet piping that will occur during venting shall not exceed the design pressure of the outlet portion of the pressure relief valve and any pipe or fitting between the pressure relief valve and the rupture disk device. In addition, the marked bursting pressure of the rupture disk at the coincident disk temperature plus the pressure developed in the outlet piping during venting shall not exceed the set pressure of the pressure relief valve.

(d) The opening provided through the rupture disk device after the disk bursts shall be sufficient to permit a flow equal to the rated capacity of the attached pressure relief valve without exceeding the allowable overpressure.

(e) Any piping beyond the rupture disk shall be designed so that it will not be obstructed by the rupture disk or its fragments.

(f) The contents of the pressurized equipment shall be clean fluids, free from gumming or clogging matter, so accumulation in the relief system will not interfere with pressure relief valve function.

(g) The system shall be designed to consider the adverse effects of any leakage through the pressure relief valve or outlet-side rupture disk device, to ensure system performance and reliability. Some adverse effects resulting from leakage may include obstruction of the flow path, corrosion of pressure relief valve components, and undesirable bursts of the outlet-side rupture disk.

(h) The design pressure of the pressure relief valve's bonnet, bellows, if any, and exit connection to the rupture disk shall be greater than or equal to the burst pressure of the disk.

(i) The bonnet of a balancing bellows or diaphragm-type pressure relief valve shall be vented to prevent accumulation of pressure in the bonnet.

8.4 PIN DEVICE INSTALLED BETWEEN A PRESSURE RELIEF VALVE AND THE PRESSURIZED EQUIPMENT

(a) A pin device may be installed between a pressure relief valve and the pressurized equipment, provided the following conditions are met:

(1) The capacity of the combination of the pressure relief valve and the pin device shall meet the maximum permissible overpressure requirements of the referencing Code or Standard.

(2) The combined capacity of a Section XII (TV Designator) nozzle-type pressure relief valve and pin device (TD Designator) shall be the rated capacity of the valve multiplied by a factor of 0.90. Alternatively, the capacity of such a combination shall be established in accordance with (4).

(3) For Section VIII, Division 1 (UV Designator) valves, the combined capacity of the pressure relief valve and pin device shall be the rated capacity of the valve multiplied by a factor of 0.90, provided the appropriate resistance factor, K_{RG}, K_{RGL}, or K_{RL}, of the device is less than 6.0, or by a combination capacity factor established in accordance with (4).

(4) The capacity of the combination of the pin device and the spring-loaded pressure relief valve may be established in accordance with 9.5.

(5) The space between the pin device and the pressure relief valve shall be provided with a pressure gage, try cock, free vent, or suitable telltale indicator. Users are warned that a pin will not activate at its marked set pressure if back pressure builds up in the space between the pin device and the pressure relief valve because of leakage through the pin due to corrosion or other forms of deterioration.

(6) The opening provided through the pin device after activation shall be sufficient to permit flow equal to the capacity of the valve, and there shall be no chance of interference with proper functioning of the valve. However, in no case shall this area be less than the area of the inlet of the valve unless the capacity and functioning of the specific combination of pin device and pressure relief valve have been established by test in accordance with Part 9.

(7) The set pressure of the pin device shall be equal to or greater than 90% of the set pressure of the pressure relief valve.

(b) A pin device shall not be installed on the discharge side of a pressure relief valve.

8.5 MARKING

The combination of devices as described in 8.2 or 8.4 shall be identified by a metal plate or plates securely fastened to the pressure relief valve or rupture disk device. The marking shall include the following:

(a) name of the Manufacturer of the valve.

(b) design or type number of the valve.

(c) name of the Manufacturer of the non-reclosing pressure relief device.

(d) design or type number of the non-reclosing pressure relief device.

(e) capacity or combination capacity factor.

(f) name of the organization responsible for this marking. (This shall be the pressurized equipment user, pressurized equipment Manufacturer, non-reclosing pressure relief Manufacturer, or pressure relief valve Manufacturer.)

PART 9
CAPACITY AND FLOW RESISTANCE CERTIFICATION

9.1 GENERAL

9.1.1 General Certification Requirements

(a) Before the Certification Mark is applied to any pressure relief device, the Manufacturer shall have the capacity or flow resistance of their devices certified in accordance with the provisions of this Part.

(b) At the time of the submission of pressure relief devices for capacity certification or testing in accordance with this Part, an ASME Designated Organization has the authority to review the design for conformity with the requirements of this Section and to reject or require modification of designs that do not conform.

(c) Certified values for pressure relief devices are published in NBBI NB-18.

9.1.2 Test Facility and Supervision

(a) Capacity and flow resistance certification shall be conducted in accordance with ASME PTC 25.

(b) Testing shall be conducted by an accredited testing laboratory, in the presence of an Authorized Observer.

(c) Testing laboratories shall be accredited, and test supervisors shall have been accepted as Authorized Observers, in accordance with the requirements of ASME CA-1.

9.1.3 Test Data Report

Certification test data reports for each pressure relief device model, type, and size, signed by the Manufacturer and the Authorized Observer witnessing the tests, together with drawings showing the device construction shall be submitted to the ASME Designated Organization for review and acceptance.

9.1.4 Design Changes

(a) When changes are made in the design of a pressure relief device or power-actuated pressure relief valve in such a manner as to affect the flow path, lift, or performance characteristics of the device, new tests in accordance with this Part shall be performed.

(b) When changes are made in the design of a nonreclosing pressure relief device that affect the flow path or activation performance characteristics of the device, new tests in accordance with this Part shall be performed.

9.2 REQUIREMENTS FOR PRESSURE RELIEF VALVES

Pressure relief valves shall be capacity certified in accordance with 9.7.3, 9.7.4, 9.7.5, or 9.7.6, and 9.9, if applicable.

9.2.1 Blowdown

(a) Pressure relief valves for compressible fluids having an adjustable blowdown construction shall be adjusted prior to testing so that the blowdown does not exceed 5% of the set pressure or 20 kPa (3 psi), whichever is greater.

(b) Pressure relief valves for incompressible fluids and pressure relief valves for compressible fluids having nonadjustable blowdown shall have the blowdown noted and recorded.

(c) Pressure relief valves for Section I power boilers for steam service to be marked with the Certification Mark and V Designator shall be adjusted so that the blowdown does not exceed 4% of the set pressure. For pressure relief valves set at or below 700 kPa (100 psi), the blowdown shall be adjusted so as not to exceed 30 kPa (4 psi). Pressure relief valves used on forced-flow steam generators with no fixed steam and waterline, and pressure relief valves used on high-temperature water boilers shall be adjusted so that the blowdown does not exceed 10% of the set pressure. The reseating pressure shall be noted and recorded.

(d) Blowdown adjustment is not a requirement for Section IV (HV Designator) pressure relief valves.

9.2.2 Pilot-Operated Pressure Relief Valves

Capacity certification of pilot-operated pressure relief valves may be based on tests without the pilot devices installed, provided that, prior to capacity tests, it has been demonstrated by test to the satisfaction of the Authorized Observer that the following conditions have been met:

(a) The pilot device will cause the main device to open fully at a pressure that does not exceed the set pressure by more than specified below.

(1) 10% or 20 kPa (3 psi), whichever is greater, for all pilot-operated pressure relief valves except as specified in (2)

(2) 3% or 15 kPa (2 psi), whichever is greater, for steam pilot-operated pressure relief valves for Section I boilers marked with Certification Mark and V Designator

(b) The pilot device in combination with the main device will meet all the requirements of this Section.

9.2.3 Use of V-Designated Valves for UV-Designated Applications

(a) It is permissible to rate Section I pressure relief valves marked with the Certification Mark and V Designator and having capacity ratings at a flow pressure of 103% of the set pressure for use on pressure vessels in Section VIII, Division 1 compressible fluid service with absolute pressures up to 10.9 MPa (1,580 psia) without further test. In such instances, the capacity rating of the pressure relief valve may be increased by the following multiplier to allow for the Section VIII, Division 1 flow pressure of 110% of the set pressure:

(SI Units)

$$\frac{1.10p + 0.101}{1.03p + 0.101}$$

(U.S. Customary Units)

$$\frac{1.10p + 14.7}{1.03p + 14.7}$$

where

p = set pressure, MPa gage (psig)

Such valve capacity shall be marked in accordance with the requirements of 3.9 for for Section VIII (UV Designator) pressure relief valves. This multiplier shall not be used as a divisor to transform test ratings from a higher to a lower flow.

(b) For absolute steam pressures above 10.9 MPa (1,580 psia), the multiplier in (a) is not applicable. For pressure relief valves with absolute relieving pressures between 10.9 MPa (1,580 psia) and 22.1 MPa (3,200 psia), the capacity shall be determined by the equation for steam and the correction factor for high-pressure steam in 9.7.6.4(a), with the permitted absolute relieving pressure (for SI units, $1.10p + 0.101$; for U.S. Customary units, $1.10p + 14.7$) and the coefficient K for that valve design.

9.2.4 Nozzle-Type Pressure Relief Valves for Saturated Water

Rating of nozzle-type pressure relief valves, i.e., valves having a coefficient of discharge, K_D, greater than 0.90 and nozzle construction, for saturated water shall be in accordance with Mandatory Appendix IV, IV-2(f).

9.3 REQUIREMENTS FOR NON-RECLOSING PRESSURE RELIEF DEVICES

(a) Non-reclosing pressure relief devices shall be certified for either capacity or flow resistance. This requirement does not apply to Section VIII, Division 3 (UD3 Designator) devices.

(b) For rupture disks or pin devices to be certified for capacity, the requirements of 9.7.3, 9.7.4, 9.7.5, or 9.7.6 shall apply except where noted.

(c) For rupture disk and pin devices to be certified for flow resistance, 9.7.7 shall apply except where noted.

9.4 REQUIREMENTS FOR SPRING-ACTUATED NON-RECLOSING PRESSURE RELIEF DEVICES

Spring-actuated non-reclosing pressure relief devices shall be capacity certified in accordance with 9.7.3, 9.7.4, 9.7.5, or 9.7.6.

9.5 REQUIREMENTS FOR PRESSURE RELIEF VALVES IN COMBINATION WITH NON-RECLOSING PRESSURE RELIEF DEVICES

(a) For each combination of pressure relief valve design and non-reclosing pressure relief device design, the pressure relief valve Manufacturer or the non-reclosing pressure relief device Manufacturer may have the capacity of the combination certified as prescribed in (c) and (d).

(b) Capacity certification tests shall be conducted using the test fluids specified in 9.7.1.

(c) The pressure relief valve Manufacturer or the non-reclosing pressure relief device Manufacturer may submit for tests a non-reclosing pressure relief device of the smallest size intended to be used in a combination device, along with the equivalent-size pressure relief valve. The pressure relief valve to be tested shall have the largest orifice used in the particular inlet size.

(d) Tests may be performed in accordance with (1) through (6). The non-reclosing pressure relief device and pressure relief valve combination to be tested shall be arranged to duplicate the combination assembly design.

(1) The test shall embody the minimum set pressure of the non-reclosing pressure relief device design to be used in combination with the pressure relief valve design. The marked set pressure of the non-reclosing pressure relief device shall be between 90% and 100% of the marked set pressure of the valve.

(2) The test procedure to be used shall be as follows:

(-a) The pressure relief valve (one valve) shall be tested for capacity as an individual valve, without the non-reclosing pressure relief device, at a pressure 10% or 20 kPa (3 psi), whichever is greater, above the valve set pressure.

(-b) The non-reclosing pressure relief device shall then be installed at the inlet of the pressure relief valve and activated to operate the valve. The capacity test shall be performed on the combination at 10% or 20 kPa (3 psi), whichever is greater, above the valve set pressure, duplicating the individual pressure relief valve capacity test.

(3) Tests shall be repeated with two additional activation components of the same nominal rating for a total of three activation components to be tested with the single pressure relief valve. The results of the capacity test shall fall within a range of 10% of the average capacity of the three tests. Failure to meet this requirement shall be cause to require retest for determination of the cause of the discrepancies.

(4) From the results of the tests, a combination capacity factor shall be determined. The combination capacity factor is the ratio of the average capacity determined by the combination tests to the capacity determined on the individual valve. The maximum value for the combination capacity factor shall not be greater than 1.0.

(5) The combination capacity factor shall be used as a multiplier to make appropriate changes in the ASME-rated relieving capacity of the pressure relief valve in all sizes of the design. The combination capacity factor shall apply only to combinations of the same design of pressure relief valve and same design of non-reclosing pressure relief device as those tested.

(6) The test laboratory shall submit the test results to the ASME Designated Organization for acceptance of the combination capacity factor.

9.6 OPTIONAL TESTING OF NON-RECLOSING PRESSURE RELIEF DEVICES AND PRESSURE RELIEF VALVES

(a) If desired, a valve Manufacturer or a non-reclosing pressure relief device Manufacturer may conduct tests in the same manner as outlined in 9.5(d)(3) and 9.5(d)(4) using the next two larger sizes of the design of non-reclosing pressure relief device and pressure relief valve to determine a combination capacity factor applicable to larger sizes. If a greater combination capacity factor is established and can be certified, it may be used for all larger sizes of the combination, but it shall not be greater than 1.0.

(b) If desired, additional tests may be conducted at higher pressures, in accordance with 9.5(d)(3) and 9.5(d)(4), to establish a maximum combination capacity factor to be used at all pressures higher than the highest pressure previously tested, but it shall not be greater than 1.0.

9.7 CERTIFICATION METHODS

9.7.1 Test Fluid

Certification tests for pressure relief devices shall be conducted using test fluids in accordance with the following:

(a) For Devices to Be Marked With the Certification Mark and V or NV (for Main Steam) Designator

(1) For steam service, capacity certification tests shall be conducted using dry saturated steam. The limits for test purposes shall be 98% minimum quality and 10°C (20°F) maximum superheat. Correction from within these limits may be made to the dry saturated condition.

(2) For liquid service, capacity certification tests shall be conducted using water at a temperature between 5°C (40°F) to 50°C (125°F).

(b) For Devices to Be Marked With the Certification Mark and NV, UV, or UD Designator

(1) Compressible fluid devices shall be flow tested using dry saturated steam, or air or other gas. For test purposes, the temperature limit of air or other gases at the device inlet shall be between −20°C (0°F) and 90°C (200°F), and the limits of 98% minimum quality and 10°C (20°F) maximum superheat shall apply for steam. Correction from within these limits may be made to the dry saturated condition. Steam service valves flow tested with air or other gases shall have at least one valve of each series flow tested using steam to demonstrate the steam capacity and performance.

(2) Incompressible fluid devices certified for capacity shall be flow tested using water. For test purposes, the water temperature shall be between 5°C (40°F) and 50°C (125°F).

(c) For Devices to Be Marked With the Certification Mark and UV3 Designator. Flow capacity certification tests shall be conducted with liquids or vapors, as appropriate. For fluids that are near their critical point, or in any region where their thermodynamic properties are significantly nonlinear or where a change of phase may occur in the device (flashing), the flow capacity shall be determined using appropriate correlations and procedures from the vapor and liquid capacity data obtained in accordance with 9.7. Alternatively, the flow capacity and design of the pressure relief system may be specified by the user or the user's designated agent, based on basic data, testing, and demonstration on such actual fluids at expected operating conditions. This information is stated in the User's Design Specification.

(d) For Devices to Be Marked With the Certification Mark and HV Designator. Flow capacity certification tests shall be made with dry saturated steam. For test purposes, the limits of 98% minimum quality and 10°C (20°F) maximum superheat shall apply. Correction from within these limits may be made to the dry saturated condition. The relieving capacity shall be measured by condensing the steam or by

Table 9.7.2-1
Test Pressure for Certification Tests

Pressure Relief Device		
Certification Mark Designator [Note (1)]	**Service**	**Maximum Pressure for Capacity Certification Test**
V NV for main steam valves	Steam	103% of set pressure, or set pressure + 15 kPa (2 psi), whichever is greater
	Liquids	110% of set pressure, or set pressure + 20 kPa (3 psi), whichever is greater
HV	Steam boilers	Set pressure + 35 kPa (5 psi)
	Hot water heating and water supply boilers	110% set pressure
UV or UD NV for pressure relief valves	All except those indicated below	110% of set pressure, or set pressure + 20 kPa (3 psi), whichever is greater [Note (2)]
	Fire or unexpected external heating for vessels with no permanent supply connection [Note (3)]	120% of marked set pressure
UV3	All	110% of set pressure
TV or TD	All except those indicated below	110% of set pressure, or set pressure + 20 kPa (3 psi), whichever is greater [Note (2)]
	As permitted by the appropriate Section XII Modal Appendix [Note (4)]	120% of marked set pressure

NOTES:
(1) See the General Note of Table 2.1-1 for a listing of the devices to which the Certification Mark Designators apply.
(2) For pressure relief valves, minimum pressure for capacity certification tests shall be at least 20 kPa (3 psi) above the set pressure.
(3) See Section VIII, Division 1, UG-153(a)(3).
(4) See Section XII, Article TR-1.

using a calibrated steam flowmeter. To determine the discharge capacity of pressure relief valves in terms of British thermal units per hour, multiply the relieving capacity in pounds mass of steam per hour by 1,000.

(e) For Devices to Be Marked With the Certification Mark and TV or TD Designator

(1) Compressible fluid devices shall be tested using air or gas. For test purposes, the temperature limit of air or other gases at the device inlet shall be between −20°C (0°F) and 90°C (200°F).

(2) Incompressible fluid devices certified for capacity shall be flow tested using water. For test purposes, the water temperature shall be between 5°C (40°F) and 50°C (125°F).

9.7.2 Test Pressure

Certification tests shall be conducted at an absolute flow rating pressure as indicated in Table 9.7.2-1.

9.7.3 Design Certification by the Single-Valve Method

(a) When a single valve is to be capacity tested, the certified capacity may be based on three separate tests associated with each set pressure for which capacity certification is required.

(b) The certified capacity associated with each set pressure shall not exceed 90% of the average capacity established by the tests. Failure of the individual test capacities to fall within ±5% of the average capacity associated with each set pressure shall be cause for rejection of the test. The reason for the failure shall be determined and the test repeated.

(c) Should additional valves of the same design be constructed at a later date, the results of the tests on the original valve may be included as applicable to the particular test method selected.

9.7.4 Design Certification by the Three-Device Method

If a Manufacturer wishes to apply the Certification Mark to a single device size, design, and pressure setting, the following tests shall be performed:

(a) A capacity certification test is required on a set of three pressure relief devices for each combination of size, design, and pressure setting.

(b) The rated capacity for each combination of design, size, and test pressure shall be 90% of the average capacity of the three devices tested.

(c) The capacity of each device of the set shall fall within a range of ±5% of the average capacity.

(d) If the capacity of one of the three pressure relief devices tested falls outside the range specified in (c), the device shall be replaced by two devices, and a new average shall be calculated based on all four devices, excluding the replaced device. Failure of any of the four capacities to fall within a range of ±5% of the

new average shall be cause to refuse certification of that particular device design.

9.7.5 Design Certification by the Four-Device Method

If a Manufacturer wishes to apply the Certification Mark to a design of pressure relief devices, four devices of each combination of pipe size and orifice size shall be tested. These four devices shall be set at pressures that cover the approximate range of pressures for which the device will be used or that cover the range of pressures available at the certified test facility that shall conduct the tests. The capacities based on these four tests shall be as follows:

(a) For compressible fluids, the slope, S_m, of the measured capacity versus the absolute flow-rating pressure shall be determined for each test point as follows:

$$S_m = W / P_f$$

where

P_f = absolute flow-rating pressure, MPa (psia) (see Table 9.7.2-1)

S_m = slope, kg/h/MPa (lbm/hr/psia) or m^3/min/MPa (SCFM/psia)

W = measured capacity, kg/h (lbm/hr) of saturated steam, or m^3/min of air at 20°C and 101 kPa (SCFM of air at 60°F and 14.7 psia)

The average slope, S_{avg}, shall be the arithmetic mean of all calculated slope values, S_m. All experimentally determined slope values, S_m, shall fall within a range of ±5% of the average slope, S_{avg}. If all slope values, S_m, are not within ±5% of the average slope, S_{avg}, two additional devices shall be tested for each device beyond the ±5% range, up to a limit of four additional devices.

The average slope, S_{avg}, shall be multiplied by 0.90, and this product shall be taken as the rated slope, S, for that design and orifice size combination. The relieving capacity to be marked on the device shall not exceed the rated slope, S, multiplied by the absolute relieving pressure.

For direct spring-loaded valves, the results may be extrapolated to valves with set pressures higher than the highest set pressure used in the capacity certification tests if the spring in the valve with the higher set pressure meets the requirements of 3.2.5.

(b) For incompressible fluids, the flow factor, F_m, shall be determined from the ratio of the measured volumetric capacity versus the square root of the differential flow-rating pressure for each test point as follows:

$$F_m = \frac{Q}{\sqrt{P_f - P_d}}$$

where

P_d = absolute discharge pressure, MPa (psia)

P_f = absolute flow-rating pressure, MPa (psia) (see Table 9.7.2-1)

Q = measured volumetric capacity, L/min (gpm), corrected to 20°C (70°F)

The average flow factor, F_{avg}, shall be the arithmetic mean of all calculated flow factors, F_m. All experimentally determined flow factors, F_m, shall fall within a range of ±5% of the average flow factor, F_{avg}. If all the flow factors, F_m, are not within ±5% of F_{avg}, two additional devices shall be tested for each device beyond the ±5% range, up to a limit of four additional devices.

The average flow factor, F_{avg}, shall be multiplied by 0.90, and this product shall be taken as the flow factor, F, for that design and orifice size combination. The relieving capacity to be marked on the device shall not exceed the flow factor, F, multiplied by the square root of the differential relieving pressure.

For direct spring-loaded valves, the results may be extrapolated to valves with set pressures higher than the highest set pressure used in the capacity certification tests if the spring in the valve with the higher set pressure meets the requirements of 3.2.5.

9.7.6 Device Family Certification by the Coefficient of Discharge Method

A coefficient of discharge for the design, K, may be established for a specific pressure relief device design according to the procedures described in 9.7.6.1 through 9.7.6.5.

9.7.6.1 For each design, the pressure relief device Manufacturer shall submit for test at least three devices for each of three different sizes (a total of nine devices), together with detailed drawings showing the device construction. Each device of a given size shall be set at a different pressure so that the tests cover the range of pressures for which the device will be used or the range available at the facility where the tests are conducted. However, pressure relief valves for steam boilers marked with the Certification Mark and HV Designator shall have all nine valves set at 100 kPa (15 psig).

9.7.6.2 For each valve design intended to be restricted in lift, the Manufacturer shall have capacity tests conducted on three valves of different sizes. Each size valve shall be tested for capacity at the minimum lift for which certification is required, and at two intermediate lift points between the full-rated lift and minimum lift certification points. Each of the three test valves shall be set at a different pressure.

9.7.6.3 For each restricted-lift valve tested, it shall be verified that actual measured capacity at restricted lift will equal or exceed the ASME-rated capacity at full-rated lift multiplied by the ratio of measured restricted lift to full-rated lift.

9.7.6.4 Tests shall be made on each pressure relief device to determine its lift (if applicable) at capacity, set pressure and blowdown pressure (for pressure relief valves), and measured relieving capacity in terms of the fluid used in the test. A coefficient of discharge, K_D, shall be established for each test run as follows:

$$K_D = \frac{W}{W_T}$$

where

W = measured relieving capacity determined quantitatively by test, kg/h (lbm/hr)

W_T = theoretical relieving capacity calculated by the appropriate equation as given in (a) through (d), kg/h (lbm/hr)

(a) For Tests With Dry Saturated Steam

(1) For 45-deg seat

(SI Units)

$$W_T = 5.25 \times \pi DLP \times 0.707$$

(U.S. Customary Units)

$$W_T = 51.5 \times \pi DLP \times 0.707$$

where

D = seat diameter, mm (in.)

L = lift at pressure, P, mm (in.)

P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)

W_T = theoretical relieving capacity, kg/h (lbm/hr)

(2) For flat seat

(SI Units)

$$W_T = 5.25 \times \pi DLP$$

(U.S. Customary Units)

$$W_T = 51.5 \times \pi DLP$$

where

D = seat diameter, mm, (in.)

L = lift at pressure, P, mm (in.)

P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)

W_T = theoretical relieving capacity, kg/h (lbm/hr)

(3) For nozzle

(SI Units)

$$W_T = 5.25AP$$

(U.S. Customary Units)

$$W_T = 51.5AP$$

where

A = actual discharge area through the device at developed lift, mm^2 (in.^{2})

P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)

W_T = theoretical relieving capacity, kg/h (lbm/hr)

For dry saturated steam pressures over 10.9 MPa (1,580 psia) and up to 22.1 MPa (3,200 psia), W_T calculated from the equations in (1) through (3) shall be multiplied by one of the following correction factors only if the calculated correction factor is greater than 1.0:

(SI Units)

$$\frac{27.6P - 1\,000}{33.2P - 1\,061}$$

(U.S. Customary Units)

$$\frac{0.1906P - 1{,}000}{0.2292P - 1{,}061}$$

where

P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)

(b) For Tests With Air

For nozzle

(SI Units)

$$W_T = 27.03AP\sqrt{\frac{M}{T}}$$

(U.S. Customary Units)

$$W_T = 356AP\sqrt{\frac{M}{T}}$$

where

A = actual discharge area through the device at developed lift, mm^2 (in.^{2})

M = molecular weight of air
= 28.97 kg/kg-mol (28.97 lbm/lb-mole)

P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)

T = absolute temperature at inlet, K (°R)
K = °C + 273
°R = °F + 460
W_T = theoretical relieving capacity, kg/h (lbm/hr)

(c) For Tests With Other Gases
For nozzle

$$W_T = CAP\sqrt{\frac{M}{ZT}}$$

where
A = actual discharge area through the device at developed lift, mm^2 (in.^{2})
C = constant for gas or vapor based on ideal ratio, k, of the specific heat in constant pressure, c_p, to the specific heat in constant volume, c_v: $k = c_p/c_v$ [see Mandatory Appendix IV, Figure IV-1-1M (Figure IV-1-1)]. C is determined from one of the following equations:

(SI Units)

$$C = 39.48\frac{\sqrt{\text{kg} \times \text{kg-mol} \times \text{K}}}{\text{mm}^2 \times \text{h} \times \text{MPa}}\sqrt{k\left(\frac{2}{k+1}\right)^{\left(\frac{k+1}{k-1}\right)}}$$

(U.S. Customary Units)

$$C = 520\frac{\sqrt{\text{lbm} \times \text{lb-mole} \times {}^\circ\text{R}}}{\text{in.}^2 \times \text{hr} \times \text{psia}}\sqrt{k\left(\frac{2}{k+1}\right)^{\left(\frac{k+1}{k-1}\right)}}$$

M = molecular weight for specific fluid or mixture, kg/kg-mol (lbm/lb-mole)
P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)
T = absolute temperature at inlet, K (°R)
K = °C + 273
°R = °F + 460
W_T = theoretical relieving capacity, kg/h (lbm/hr)
Z = compressibility factor for the specific fluid at the specified conditions of P and T, unitless

(d) For Tests With Water or Other Incompressible Fluids
(1) For 45-deg seat

(SI Units)

$$W_T = 5.092\pi DL(0.707)\sqrt{(P - P_d)\rho}$$

(U.S. Customary Units)

$$W_T = 2{,}407\pi DL(0.707)\sqrt{(P - P_d)\rho}$$

where
D = seat diameter, mm (in.)
L = lift at pressure, P, mm (in.)
P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)
P_d = absolute discharge pressure, MPa (psia)
W_T = theoretical relieving capacity, kg/h (lbm/hr)
ρ = density of fluid at device inlet conditions, kg/m^3 (lbm/ft^3)

(2) For flat seat

(SI Units)

$$W_T = 5.092\pi DL\sqrt{(P - P_d)\rho}$$

(U.S. Customary Units)

$$W_T = 2{,}407\pi DL\sqrt{(P - P_d)\rho}$$

where
D = seat diameter, mm (in.)
L = lift at pressure, P, mm (in.)
P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)
P_d = absolute discharge pressure, MPa (psia)
W_T = theoretical relieving capacity, kg/h (lbm/hr)
ρ = density of fluid at device inlet conditions, kg/m^3 (lbm/ft^3)

(3) For nozzle

(SI Units)

$$W_T = 5.092A\sqrt{(P - P_d)\rho}$$

(U.S. Customary Units)

$$W_T = 2{,}407A\sqrt{(P - P_d)\rho}$$

where
A = actual discharge area through the device at developed lift, mm^2 (in.^{2})
P = absolute relieving pressure, MPa (psia) (see Table 9.7.2-1)
P_d = absolute discharge pressure, MPa (psia)
W_T = theoretical relieving capacity, kg/h (lbm/hr).
ρ = density of fluid at device inlet conditions, kg/m^3 (lbm/ft^3)

To convert kilograms of water per hour to liters of water per minute, multiply the capacity, W_T, in kilograms per hour by $^1\!/_{60}$. To convert pounds mass of water per hour to gallons of water per minute, multiply the capacity, W_T, in pounds mass per hour by $^1\!/_{500}$.

9.7.6.5 All experimentally determined coefficients, K_D, shall fall within a range of ±5% of the average K_D found. If a device fails to meet this requirement, two additional devices shall be tested as replacements for each device having an individual coefficient, K_D, outside the ±5% range, with a limit of four additional devices. Failure to meet this requirement shall be cause to refuse certification of that particular device design. The average of the coefficients, K_D, of the nine tests required shall be multiplied by 0.90, and this product shall be taken as the coefficient, K, of that design. The coefficient of the design shall not be greater than 0.878 (the product of 0.9 × 0.975).

9.7.6.6 The coefficient shall not be applied to devices whose beta ratio (ratio of device throat to inlet diameter) lies outside the range of 0.15 to 0.75, unless tests have demonstrated that the individual coefficient of discharge, K_D, for devices at the extreme ends of a larger range is within ±5% of the average coefficient, K_D.

9.7.6.7 For designs where the lift is used to determine the flow area, all valves shall have the same nominal lift to seat diameter ratio, L/D.

9.7.6.8 For direct spring-loaded valves, the results may be extrapolated to valves with set pressures higher than the highest set pressure used in the capacity certification tests, provided the spring in the valve with the higher set pressure meets the requirements of 3.2.5.

9.7.6.9 For pressure relief valves, the results may be extrapolated to valves larger or smaller than the valves used in the capacity certification tests, provided all dimensions of the flow path and all dimensions of the parts that can affect the overall thrust exercised by the fluid on the moving parts are scaled with the corresponding dimensions of the valves used in the capacity certification testing.

9.7.6.10 The coefficient shall not be applied to direct spring-loaded valves with springs that do not meet the requirements of 3.2.5.

9.7.6.11 The rated relieving capacity of all sizes and set pressures of a given design for which K has been established under the provision of 9.7.6 shall be determined by the following equation:

$$W_R \le W_T \times K$$

where

K = coefficient of discharge for the design
W_R = rated relieving capacity, kg/h (lbm/hr)
W_T = theoretical relieving capacity, defined by the same equation as used to determine K_D, kg/h (lbm/hr)

9.7.7 Flow Resistance Method

The certified flow resistance, K_R, of the non-reclosing pressure relief device (Parts 4 and 5) shall be either 2.4 or as determined in accordance with 9.7.7.1 through 9.7.7.8.

9.7.7.1 Test fluids for flow resistance certification tests shall be as follows:

(a) Non-reclosing pressure relief devices for air or gas service shall be activated and flow tested with air or gas to determine flow resistance, K_{RG}.

(b) Non-reclosing pressure relief devices for liquid service shall be activated with water and flow tested with air or gas to determine flow resistance, K_{RL}.

(c) The flow resistance of non-reclosing pressure relief devices for air or gas and liquid service, K_{RGL}, may be certified with air or gas as in (a) and (b), but at least one device of the number required under 9.7.7.6 for each size of each series shall be activated with water and flow tested with air or gas to demonstrate the liquid service flow resistance.

9.7.7.2 Flow resistance certification tests shall be conducted at an inlet pressure that does not exceed 110% of the device set pressure.

9.7.7.3 The flow resistance for devices tested with non-pressure-containing items, such as seals, support rings, and vacuum supports, is applicable to the same device design without seals, support rings, or vacuum supports.

9.7.7.4 A change in material for rupture disks and their non-pressure-containing disk items, such as seals, support rings, and vacuum supports, is not considered a design change and does not require retesting.

9.7.7.5 Additional linings, coatings, or platings may be used for the same design of devices, provided the following conditions are met:

(a) The Certificate Holder has performed a verification test with the additional linings, coatings, or platings and has documented that the addition of these materials does not affect the device opening configuration.

(b) The verification test described in (a) shall be conducted with devices of the smallest size and minimum set pressure for which the certified flow resistance with additional materials is to be used.

9.7.7.6 Flow resistance certification shall be determined by one of the following methods:

(a) *One-Size Method*

(1) For each non-reclosing pressure relief device design, three activation components from the same lot shall be individually activated and the device tested in accordance with 9.7.7.7. The set pressure shall be the minimum for the pressure to be certified.

(2) The certified flow resistance, K_R, determined in 9.7.7.7 shall apply only to the non-reclosing pressure relief device design of the size tested.

(3) If additional activation components of the same design are constructed at a later date, the test results on the original components may be included, as applicable, in the three-size method described in (b).

(b) *Three-Size Method*

(1) The three-size method of flow resistance certification may be used for a non-reclosing pressure relief device design of three or more sizes.

(2) For each of the three sizes of the non-reclosing pressure relief device design being tested, three activation components from the same lot shall be activated and the device flow tested in accordance with 9.7.7.7. For each size tested, the set pressure shall be the minimum pressure to be certified.

(3) The certified flow resistance, K_R, shall apply to all sizes and pressures of the non-reclosing pressure relief device design tested.

9.7.7.7 A certified flow resistance, K_R, may be established for a specific non-reclosing pressure relief device design according to the following procedure:

(a) For each design, the non-reclosing pressure relief device Manufacturer shall submit for test the required devices in accordance with 9.7.7.6, together with the cross section drawings showing the device design.

(b) Tests shall be made on each device to determine its set pressure and flow resistance at a facility that meets the requirements of 9.1.2.

(c) An average flow resistance shall be calculated from the individual flow resistances determined in (b). All individual flow resistances shall fall within the average flow resistance by an acceptance band of ±3 times the average of the absolute values of the deviations of the individual flow resistances from the average flow resistance. Any device for which the individual flow resistance falls outside of this band shall be replaced on a two-for-one basis. A new average flow resistance shall be computed and the individual flow resistances evaluated as stated above.

(d) The certified flow resistance, K_R, for a non-reclosing pressure relief device design shall be not less than zero and shall be not less than the sum of the average flow resistance plus 3 times the average of the absolute values of the deviations of individual flow resistances from the average flow resistance.

9.7.7.8 Flow resistance test data reports for each non-reclosing pressure relief device design, signed by the Manufacturer and the Authorized Observer witnessing the tests, shall be submitted to the ASME Designated Organization for review and acceptance.

9.8 ALTERNATIVE METHODS FOR VALVES AND PIN DEVICES EXCEEDING THE LABORATORY CAPABILITIES

(a) If the valve or pin device design exceeds the laboratory pressure capability, the method in 9.7.5 or 9.7.6 shall be followed with the following exceptions:

(1) Valves shall be tested with their disks fixed at the minimum design lift to establish the rated capacity.

(2) Pin devices shall be tested with their disks fixed at the minimum design lift or in the fully open position to establish rated capacity.

(b) If the valve or pin device design exceeds the laboratory size or capacity capability, 9.7.5 or 9.7.6 shall be followed except that flow models of three different sizes, each tested at three different pressures, shall be used in place of the valves or pin devices required in 9.7.5, 9.7.6.1, 9.7.6.2, or 9.7.6.3. Such flow models shall be sized consistent with the capabilities of the accepted test laboratory where the test will be conducted, and shall accurately model those features that affect flow capacity, such as orifice size, valve lift, and internal flow configuration. The test models need not be functional but shall be geometrically similar to the final product.

(c) In the case of either (a) or (b), the valve or pin device design (i.e., parameters such as spring properties, seat geometry, internal flow configuration in the fully open position, and mechanical valve lift) shall be evaluated to ensure that production valves will achieve design lift or complete opening as modeled above.

9.9 CAPACITY CERTIFICATION OF SECTION III (NV-DESIGNATED) PRESSURE RELIEF VALVES

The following paragraphs are revisions or additions to the requirements in 9.1 through 9.8 that apply only for Section III (NV Designator) pressure relief valves:

(a) *Capacity Certification*. Capacity certification obtained in compliance with other Designators which comply with all requirements of the NV Designator are qualified for capacity certification under the NV Designator. Capacity certification obtained under these requirements for one specific Class under the NV Designator which comply with all requirements of other classes under the NV Designator are qualified for capacity certification under these rules for those other Classes.

(b) *Demonstration-of-Function Test*. For each design, a demonstration-of-function test program as required by 9.9.4 shall be performed.

(c) *Proration of Capacity*

(1) The capacity of a pressure relief valve applied to a system may be prorated to an overpressure greater than the overpressure for which the valve design is certified. This overpressure shall be within the allowable limits of the system.

(2) Prorated capacity shall be determined by one of the following, depending on the method used for the initial capacity certification:

(-a) The prorated capacity shall be 90% of the average slope determined in 9.7.5 multiplied by the prorated relieving pressure, kPa abs (psia).

(-b) The prorated capacity shall be calculated using the appropriate equation from 9.7.6, where P is the prorated relieving pressure, kPa abs (psia), multiplied by the coefficient K.

9.9.1 Certification Set Pressures of 20 kPa (3 psig) Up to but Not Including 100 kPa (15 psig)

Capacity certification tests for air or gas service with set pressures of 20 kPa gage (3 psig) up to but not including 100 kPa gage (15 psig) shall be conducted in accordance with the requirements of 9.7.3, 9.7.5, 9.7.6, or 9.9.3 modified as follows:

(a) The capacity shall be determined at no more than 13.8 kPa (2 psi) above the actual set pressure.

(b) Valves set below 100 kPa gage (15 psig) and having adjustable blowdown construction shall be adjusted prior to capacity certification testing so that the blowdown shall not be greater than 20 kPa (3 psi) nor less than 4 kPa (0.5 psi).

9.9.1.1 Design Certification by the Four-Device Method

(a) For air and gas service valves with set pressures of 20 kPa gage (3 psig) up to but not including 100 kPa gage (15 psig) that are being certified by the four-device method (see 9.7.5), slope is defined as the measured capacity divided by the following quantity:

$$F\left[P(P-P_o)\right]^{1/2}$$

where

$$F=\sqrt{\left(\frac{k}{k-1}\right)\left(r^{2/k}\right)\left[\frac{1-(r)^{\frac{k-1}{k}}}{1-r}\right]}$$

k = ratio of specific heats, c_p/c_v
P = inlet pressure, kPa (psi)
P_o = discharge pressure, kPa (psi)
r = pressure ratio, P_o/P

(b) If any of the experimentally determined slopes fall outside of a range of ±5% of the average slope, the unacceptable valves shall be replaced by two valves of the same size and set pressure. Following the test of these valves, a new average slope shall be determined, excluding the replaced valve test results. If any individual slope is now outside of the ±5% range, then the tests shall be considered unsatisfactory and shall be cause for the ASME Designated Organization to refuse certification of the particular valve design.

(c) The certified slope shall be 90% of the average slope.

(d) The certified capacity shall be the certified slope multiplied by the quantity $F\left[P(P-P_o)\right]^{1/2}$.

9.9.1.2 Device Family Certification by the Coefficient of Discharge Method

(a) For air and gas service valves with set pressures of 20 kPa gage (3 psig) up to but not including 100 kPa gage (15 psig) that are being certified by the coefficient of discharge method as required by 9.7.6, one of the following equations shall be used for other than saturated steam flow:

(SI Units)

$$W = 55.8\,FA\left[\frac{MP(P-P_o)}{T}\right]^{1/2}$$

$$Q = 1\,320\,FA\left[\frac{MP(P-P_o)}{MT}\right]^{1/2}$$

(U.S. Customary Units)

$$W = 735\,FA\left[\frac{MP(P-P_o)}{T}\right]^{1/2}$$

$$Q = 279{,}000\,FA\left[\frac{P(P-P_o)}{MT}\right]^{1/2}$$

where

A = flow area, mm^2 ($in.^2$)
$F = \sqrt{\left(\frac{k}{k-1}\right)\left(r^{2/k}\right)\left[\frac{1-(r)^{\frac{k-1}{k}}}{1-r}\right]}$ or is obtained from Figure 9.9.1.2-1
k = ratio of specific heats, c_p/c_v
M = molecular weight
P = inlet pressure, MPa (psi)
P_o = discharge pressure, MPa (psi)
Q = m^3/hr at 101 kPa and 20°C (ft^3/hr at 14.7 psi and 60°F)
r = pressure ratio, P_o/P
T = temperature, K (°R)
W = kg/hr (lb/hr)

(b) The average of the coefficients of discharge, K_D, of the tests required shall be multiplied by 0.90 and their product shall be the coefficient K of that design. The coefficient of the design shall not be greater than 0.878 (the product of 0.90 × 0.975).

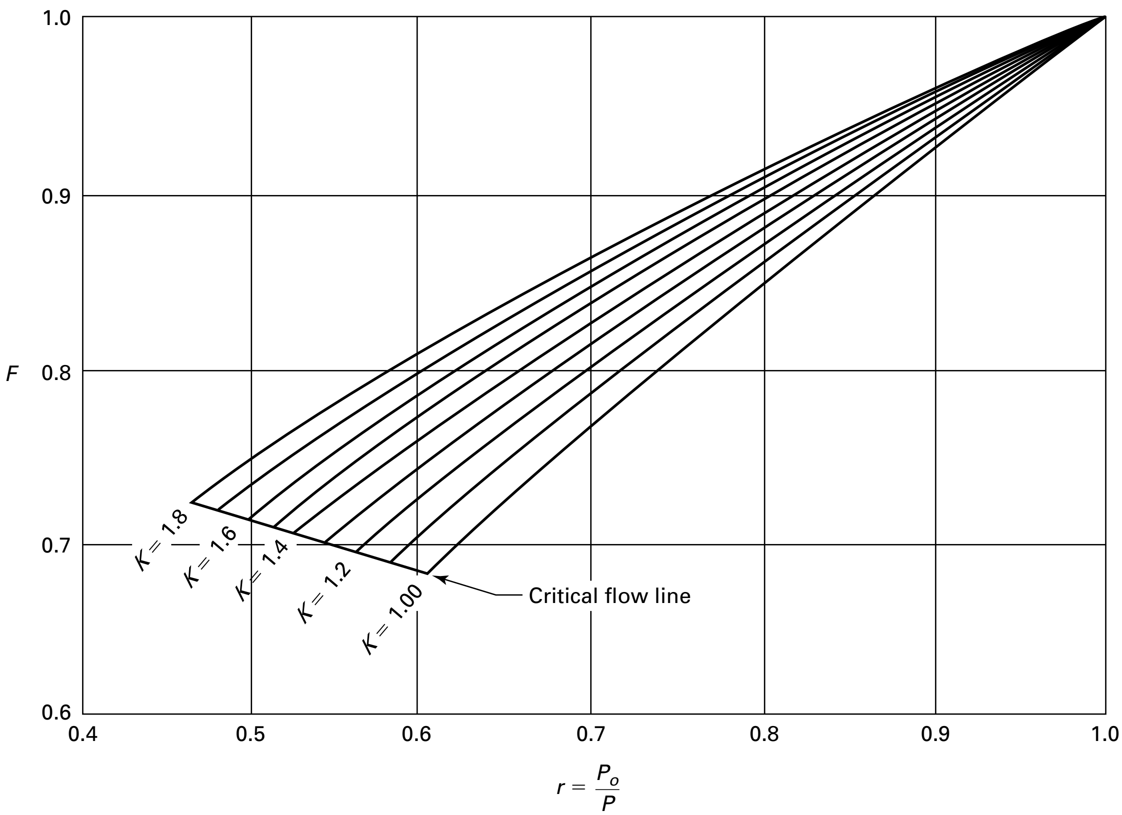
9.9.2 Vacuum Pressure Relief Valves

(a) Capacity tests may be conducted by pressurizing the valve instead of using a vacuum, provided the following conditions are met:

(1) Inlet conditions of the valve (not the vessel) are known.

(2) The inlet pressure is not greater than 35 kPa (5 psi).

Figure 9.9.1.2-1
Values of *F* for Nonchoking Flow



(3) The direction of flow through the valve is the same on pressure as is experienced on vacuum.

(b) Tests shall be conducted at twice the set pressure or 7 kPa (1 psi), whichever is greater.

9.9.2.1 Vacuum Valve Design Certification by the Four-Device Method. Four valves of each combination of pipe size and orifice size shall be tested. These four valves shall be set at pressures that cover the appropriate range of pressures for which the valves are to be used or set within the range of the test facility. The slope of each test shall be calculated and averaged, where slope is defined as the measured capacity divided by the quantity

$$F\left[P(P - P_o)\right]^{1/2}$$

where

$$F = \sqrt{\left(\frac{k}{k-1}\right)\left(r^{2/k}\right)\left[\frac{1-(r)^{\frac{k-1}{k}}}{1-r}\right]}$$

k = ratio of specific heats, c_p/c_v
P = inlet pressure
P_o = discharge pressure
r = pressure ratio, P_o/P

If any of the experimentally determined slopes fall outside of a range of ±5% of the average slope, the unacceptable valves shall be replaced by two valves of the same size and set pressure. Following the test of these valves, a new average slope shall be determined, excluding the replaced valve test results. If any individual slope is now outside of the ±5% range, then the tests shall be considered unsatisfactory and shall be cause for the ASME Designated Organization to refuse certification of the particular valve design.

The certified capacity shall be 90% of the average slope multiplied by the quantity $F[P(P - P_o)]^{1/2}$.

9.9.2.2 Vacuum Valve Family Certification by the Coefficient of Discharge Method. A coefficient, K, may be established for a specific vacuum relief valve design in accordance with 9.7.6, except the equations in this paragraph shall be used.

For each design, three valves of three different sizes, a total of nine valves, shall be tested. Each valve of a given size shall be set at a different pressure. Tests shall be made on each relief valve to determine its lift, opening and closing pressures, and actual capacity. A coefficient of discharge, K_D, shall be established for each run, as follows:

$$K_D = \frac{\text{actual flow}}{\text{theoretical flow}} = \text{coefficient of discharge}$$

where actual flow is determined quantitatively by test, and theoretical flow is calculated from the appropriate equation for the test fluid. The following equation may be used for other than saturated steam flow:

(SI Units)

$$W = 55.8\,FA\left[\frac{MP(P - P_o)}{T}\right]^{1/2}$$

$$Q = 1\,320\,FA\left[\frac{P(P - P_o)}{MT}\right]^{1/2}$$

(U.S. Customary Units)

$$W = 735\,FA\left[\frac{MP(P - P_o)}{T}\right]^{1/2}$$

$$Q = 279{,}000\,FA\left[\frac{P(P - P_o)}{MT}\right]^{1/2}$$

where

A = flow area, mm^2 (in.^{2})

F = $\sqrt{\left(\frac{k}{k-1}\right)\left(r^{2/k}\right)\left[\frac{1-(r)^{\frac{k-1}{k}}}{1-r}\right]}$ or is obtained from 9.9.1

k = ratio of specific heats, c_p/c_v

M = molecular weight

P = inlet pressure, MPa (psi)

P_o = discharge pressure, MPa (psi)

Q = m^3/hr at 0.101 MPa and 15°C (ft^3/hr at 14.7 psi and 60°F)

r = pressure ratio, P_o/P

T = temperature, K (°R)

W = kg/hr (lb/hr)

The average of the coefficients of discharge, K_D, of the tests required shall be multiplied by 0.90, and their product shall be the coefficient K of that design. The coefficient of the design shall not be greater than 0.878 (the product of 0.9 × 0.975).

9.9.3 Flow Model Testing of Valve Capacity in Excess of Test Facility Limits

(a) For valve designs with a single orifice size whose capacity exceeds the capacity limits of the test facility, the certified capacity may be based on a flow coefficient, K, determined from blocked open flow tests with the valve disk fixed at the minimum design value. Four tests shall be performed at four different pressures as outlined in 9.7.5 or 9.9.1.1.

(b) When test facility limitations make it impossible to perform capacity tests of the full-scale pressure relief valves, alternative methods in 9.8(b) and 9.8(c) may be used.

The relieving capacity of valve designs certified by use of flow models shall be established by the coefficient of discharge method similar to that outlined in 9.7.6 or 9.9.1.2, with each flow model being flow tested at three different pressures.

The orifice area for flow models shall be such that for designs where choked-flow conditions are expected, the model flow area shall ensure that choked flow in the model is attained.

(c) The function of each design to be certified by flow model testing shall be demonstrated by test.

9.9.4 Demonstration of Function

(a) General. For Section III (NV Designator) pressure relief valves, demonstration-of-function tests shall be conducted. Such tests may be performed in conjunction with the capacity certification tests outlined in 9.9 or as separate tests using production valves.

(b) Number of Valves to Be Tested

(1) For a design being certified including one single valve (see 9.7.3), that valve shall be tested. If two valves are being constructed, two valves of the specific inlet size, orifice size, and design shall be tested. Should additional valves of the same design be constructed at a later date, the results of the tests on the original valve or valves may be included, as applicable.

(2) For a design being certified by the three-device method (see 9.7.4), three sample valves shall be tested.

(3) For a design being certified by the four-valve method (see 9.7.5), three sample valves, each set at a different set pressure, shall be tested.

(4) For a design being certified by the coefficient of discharge method (see 9.7.6), the function of three valves in three different sizes shall be demonstrated by test.

(c) Test Location and Class-Specific Methods. These tests shall be conducted at a place where the testing facilities, methods, and procedures provide for sufficient testing capacity and range of fluid properties so that the testing requirements of this paragraph are met. The tests shall be performed to the satisfaction of a representative from an ASME Designated Organization and shall show that the valves will open at set pressure within the required opening-pressure tolerance, will achieve full lift, and will reclose within required blowdown specification.

(1) Class 1 Construction. For Class 1 construction, the following additional requirements apply:

(-a) The three valves selected shall envelop the largest and smallest combination of inlet size and orifice size of the specific design.

(-b) The NV Certificate Holder shall specify the range of pressures, temperatures, and other fluid conditions for which the valves are to be tested. The range shall be sufficient to cover all expected operating fluid conditions. Additionally, tests shall include the range of inlet pressure losses and discharge back pressure conditions for which the valves are expected to be used.

(2) Class 2 and Class 3 Construction. If required due to test facility limitations, these tests may be conducted at reduced-flow capabilities. Measurement of valve blowdown may not be possible.

(d) Data Report Form. The NV Certificate Holder shall document in the "Remarks" section of the Data Report Form NV-1 (see Section III Appendices, Mandatory Appendix V) that the requirements of 9.9.4 have been met.

PART 10
AUTHORIZATION TO USE THE ASME CERTIFICATION MARK

10.1 CERTIFICATION MARK

Each pressure relief device to which the Certification Mark and appropriate Designator (see Figure 10.1-1) will be applied shall be fabricated or assembled by a Manufacturer or Assembler, as applicable, holding a valid Certificate of Authorization, and capacity certified in accordance with the requirements of ASME CA-1 and this Section.

10.2 CERTIFICATES OF AUTHORIZATION

(a) A Certificate of Authorization to use the Certification Mark and HV, UV, UD, UV3, UD3, TV, or TD Designator will be granted by the Society in accordance with the provisions of ASME CA-1. Stamps for applying the Certification Mark shall be obtained from the Society.

(b) Any organization desiring a Certificate of Authorization shall apply to ASME in accordance with the certification process of ASME CA-1. Authorization to use Certification Marks may be granted, renewed, suspended, or withdrawn as specified in ASME CA-1.

10.3 DESIGNATED OVERSIGHT

The Manufacturer or Assembler shall comply with the requirements of ASME CA-1 for Designated Oversight by use of a Certified Individual (CI).

10.4 QUALITY MANAGEMENT SYSTEM

Any Manufacturer or Assembler holding or applying for a Certificate of Authorization shall demonstrate a quality management system that meets the requirements of ASME CA-1 and establishes that all ASME BPVC requirements, including material, design, manufacture, and examination, will be met. The quality management system shall be in accordance with the requirements of Mandatory Appendix III. Certificates of Authorization shall be endorsed to indicate the scope of activity authorized.

10.5 EVALUATION OF THE QUALITY MANAGEMENT SYSTEM

(a) The issuance or renewal of a Certificate of Authorization is based on ASME's evaluation and approval of the quality management system and shall be in accordance with ASME CA-1.

(b) Before issuance or renewal of a Certificate of Authorization for use of the Designator, the pressure relief device Manufacturer's or Assembler's facilities and organization are subject to a review by a representative from an ASME Designated Organization.

(c) Certificates of Authorization are valid for the period given in ASME CA-1.

(d) Any changes made to the quality management system shall be made and accepted in accordance with the requirements specified in ASME CA-1.

10.6 CERTIFIED INDIVIDUAL (CI)

(a) General. A CI meeting the requirements of ASME QAI-1 shall provide oversight to ensure that each use of the Certification Mark and appropriate Designator on a pressure relief device is in accordance with the requirements of this Section, and that each use of the Certification Mark and appropriate Designator is documented on the appropriate Certificate of Conformance, as indicated in the table below. (See Nonmandatory Appendix C for Forms.)

Certification Mark Designator	Certificate of Conformance Form
HV	HV-1
UV	UV-1
UD	UD-1
UV3	K-4
UD3	K-5
TV	TV-1
TD	TD-1

(b) Requirements for the CI. The CI shall

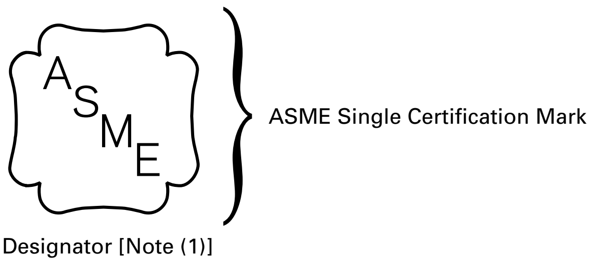
(1) be qualified and certified by the Certificate Holder. Qualifications shall include the following as a minimum:

(-a) knowledge of the requirements of this Section for the application of the Certification Mark with applicable Designator

(-b) knowledge of the Certificate Holder's Quality Management System

(-c) training commensurate with the scope, complexity, or special nature of the activities for which the CI will provide oversight

Figure 10.1-1
ASME Certification Mark With Designator



NOTE: (1) The appropriate Certification Mark Designator shall be placed beneath the Certification Mark.

(2) comply with the National Board "Rules for Certified Individuals" and hold a valid National Board Certification for the specific ASME BPVC Section activities the CI undertakes

(3) have a record maintained by the Certificate Holder containing objective evidence of the qualifications of the CI and the training provided

(4) have sufficient and well-defined responsibility, authority, and organizational freedom to perform the duties in (c)

(c) Duties of the Certified Individual. The CI shall

(1) verify that each item to which the Certification Mark is applied meets all the applicable requirements of this Section and has a current capacity certification for the applicable Designator

(2) review the documentation for each lot of items to be stamped to verify, for the lot, that requirements of this Section have been completed

(3) sign the appropriate Certificate of Conformance form prior to release of control of the item or items

10.7 CERTIFICATE OF CONFORMANCE (23)

(a) The appropriate Certificate of Conformance [see 10.6(a)] shall be filled out by the Manufacturer or Assembler and signed by the CI. Multiple pressure relief devices may be recorded as a single entry, provided the devices are identical and are produced in the same lot.

(b) The Manufacturer's or Assembler's written quality management system shall include requirements for completion and retention of the appropriate Certificate of Conformance form.

PART 11
REQUIREMENTS FOR OPEN FLOW PATHS OR VENTS

11.1 APPLICABILITY

Flow paths or vents that open directly or indirectly to the atmosphere may be used as the sole pressure-relieving device as permitted by the referencing Code or Standard.

PART 12
INSTALLATION

12.1 APPLICABILITY

Pressure relief devices shall be installed in accordance with the equipment's code or standard unless the code or standard has also adopted by reference specific requirements of Part 12. For installation requirements not addressed by the code or standard, the guidance in this Part may be used.

12.2 GENERAL

(a) Pressure relief devices shall be installed to minimize the possibility that they will be damaged or otherwise rendered inoperable during expected operating and relieving conditions.

(b) The pressure relief devices on all pressurized equipment shall be so installed that their proper functioning will not be hindered by the nature of the pressurized equipment's contents.

(c) The selection of the pressure relief device or the installation design shall not allow accumulation of rainwater, snow, ice, or debris in the discharge system.

(d) Materials of construction for the relief system shall be selected to minimize deterioration from exposure to the ambient atmosphere and system contents.

12.3 LOCATION

(a) Pressure relief devices shall be selected and located based on normal operation and potential overpressure scenarios. Each installation shall meet the overpressure limits of the referencing Code or Standard.

(1) Normally, pressure relief devices for relief of compressible fluids should be connected to the vapor space above any contained liquid or to piping connected to the vapor space, and pressure relief devices for liquid should be connected below the liquid level.

(2) Alternate connections may be used depending on the selected device and the overpressure scenarios.

(b) Consideration should be given to pressure relief device proximity to the protected equipment or system to ensure pressure during a relief event remains below the maximum allowed relief pressure.

(c) The relief device should be installed in the cleanest portion of the process to avoid plugging, fouling, or other conditions that would adversely affect the operability of the relief device.

(d) Consideration should be given to the pressurized equipment internals and possible obstructions to the relief path.

(e) Pressure relief device testing, inspection, replacement, and repair should be a design consideration for the pressure relief system, including the location of components such as the pressure relief devices, stop valves, telltales and pressure gages.

12.4 RUPTURE DISK INSTALLATION

For rupture disks that are marked with only a lot number in accordance with 4.7.1: Following the installation of the disk, the metal tag shall be sealed to the installation in a manner that will prevent removal of the disk without breaking the seal. The seal shall identify the organization responsible for performing the installation.

12.5 INLET PIPING

(a) The Designer shall consider the effects of the pressure drop during venting in the pressure relief system piping when specifying the set pressures and flow capacities of pressure relief valves and non-reclosing devices.

(b) The pressure drop through the upstream system to the pressure relief valve shall not reduce the relieving capacity below that required to prevent the pressure from exceeding its maximum allowed relief pressure or adversely affect the proper operation, including stability, of the pressure relief valve.

(c) The opening through all equipment nozzles, pipe, fittings, and non-reclosing pressure relief devices (if installed) between the pressurized equipment and its pressure relief valve shall have an area at least equal to the pressure relief valve inlet area.

(d) The design of the inlet line and connection to the pressurized equipment should consider stresses caused by discharge reactive forces and static loads from the relief device.

12.6 MOUNTING OF TWO OR MORE REQUIRED DEVICES

(a) When two or more relief devices are installed on the same line to the equipment being protected, the pressure drop through the upstream system while all devices are relieving shall not reduce the relieving capacity below that

required to prevent the pressure from exceeding its maximum allowed relief pressure.

(b) If one or more pressure relief valves are used, the upstream system shall not adversely affect the proper operation, including stability.

(c) For pressure relief valves, consideration should be given to staggering the set pressures to improve valve stability during operation.

12.7 ORIENTATION OF PRESSURE RELIEF VALVES

Spring-loaded pressure relief valves should be installed in the upright position with the spindle vertical.

12.8 DISCHARGE PIPING

(a) The size of the discharge lines shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the pressure relief devices below that required to properly protect the pressurized equipment, or adversely affect the proper operation of the pressure relief devices.

(b) The design of the discharge system and associated supports should consider stresses caused by discharge reactive forces and static loads on the relief device.

(c) Discharge lines from pressure relief devices shall be designed to facilitate drainage or fitted with drains to prevent liquid from lodging in the discharge side of the pressure relief device, and such lines shall lead to a safe place of discharge.

(d) When multiple pressure relief devices can discharge through a common stack or vent path, the maximum back pressure that can exist at the exit of each pressure relief device during simultaneous releases shall not impair its operation or limit its capacity below that required to simultaneously protect each pressurized equipment.

12.9 STOP VALVES

See Nonmandatory Appendix B for guidance on the use of stop valves in pressure-relieving systems.

PART 13
RULES FOR OVERPRESSURE PROTECTION BY SYSTEM DESIGN

13.1 GENERAL

(a) The rules of this Part are applicable only when specified by the referencing Code or Standard.

(b) Pressurized equipment may be provided with overpressure protection by system design in lieu of a pressure relief device or pressure relief devices if all provisions of this Part are satisfied.

13.2 PRESSURIZED EQUIPMENT FOR WHICH THE PRESSURE IS SELF-LIMITING

The decision to limit the pressure by system design is the responsibility of the user. The user shall request that the Manufacturer's Data Report state that overpressure protection is provided by system design per 13.2. Pressurized equipment does not require a pressure relief device if the pressure is self-limiting (e.g., the maximum discharge pressure of a pump or compressor), this pressure is less than or equal to the maximum allowable working pressure (MAWP) of the pressurized equipment at the coincident temperature, and the following conditions are met:

(a) The user shall conduct a detailed analysis to identify and examine all potential overpressure scenarios. The "Causes of Overpressure" described in ANSI/API Standard 521 shall be considered. Other standards or recommended practices that are more appropriate to the specific application may also be considered. A multidisciplinary team experienced in methods such as hazards and operability analysis (HazOp); failure modes, effects, and criticality analysis (FMECA); "what-if" analysis; or other equivalent methodology shall establish that there are no sources of pressure that can exceed the MAWP at the coincident temperature.

(b) The results of the analysis shall be documented and signed by the individual in responsible charge of the management of the operation of the pressurized equipment. This documentation shall include the following, as a minimum:

(1) detailed process flow diagrams (PFDs) and piping and instrument flow diagrams (P&IDs) showing all pertinent elements of the system associated with the pressurized equipment

(2) a description of all operating and upset scenarios, including scenarios involving fire and those that result from operator error, equipment malfunctions, and instrumentation malfunctions

(3) an analysis showing the maximum coincident pressure and temperature that can result from each of the scenarios listed in (2) do not exceed the MAWP at that temperature

13.3 PRESSURIZED EQUIPMENT FOR WHICH THE PRESSURE IS NOT SELF-LIMITING

If the pressure is not self-limiting, pressurized equipment may be protected from overpressure by system design or by a combination of overpressure by system design and pressure relief devices, if the following conditions are met. The rules below are not intended to allow for normal operation above the MAWP at the coincident temperature.

(a) The pressurized equipment is not exclusively in air, water, or steam service except where any of the following apply:

(1) These services are critical to preventing the release of fluids that may result in safety or environmental concerns.

(2) Failure or premature opening of the pressure relief device would result in an unacceptably high probability of failure or damage to the pressurized equipment or other equipment in the system.

(3) Failure or premature opening of the pressure relief device would result in significant operational upset(s).

(b) The decision to limit the overpressure by system design is the responsibility of the user. The user shall request that the Manufacturer's Data Report state that overpressure protection is provided by system design per 13.3 if no pressure relief device compliant with the requirements of this Section for UV-designated pressure relief devices is to be installed. If no pressure relief device is to be installed, acceptance of the jurisdiction may be required.

(c) The user shall conduct a detailed analysis to identify and examine all scenarios that could result in an overpressure condition and magnitude of the overpressure. The "Causes of Overpressure" as described in ANSI/API Standard 521 shall be considered. Other standards or recommended practices that are more appropriate to the specific

application may also be considered. A multidisciplinary team experienced in methods such as hazards and operability analysis (HazOp); failure modes, effects, and criticality analysis (FMECA); "what-if" analysis; or other equivalent methodology shall conduct the analysis.

(d) The overpressure scenario shall be readily apparent so that operators or protective instrumentation will take corrective action to prevent operation above the MAWP at the coincident temperature.

(e) There shall be no credible overpressure scenario in which the pressure exceeds that specified by the referencing Standard for vessels with overpressure protection by system design where the pressure is not self-limiting at or below the vessel MAWP. For example, Section VIII, Division 1 specifies 116% of the MAWP times the ratio of the allowable stress value at the temperature of the overpressure scenario to the allowable stress value at the design temperature. The overpressure limit shall not exceed the vessel test pressure. Credible events or scenario analysis as described in WRC Bulletin 498 shall be considered.

(f) The results of the analysis shall be documented and signed by the individual in responsible charge of the management of the operation of the pressurized equipment. This documentation shall include the following, as a minimum:

(1) detailed process flow diagrams (PFDs) and piping and instrument flow diagrams (P&IDs) showing all pertinent elements of the system associated with the pressurized equipment

(2) a description of all operating and upset scenarios, including those involving fire and those that result from operator error, and equipment and/or instrumentation malfunctions

(3) a detailed description of any safety-critical instrumentation used to limit the system pressure, including the identification of all truly independent redundancies and a reliability evaluation (qualitative or quantitative) of the overall safety system

(4) an analysis showing the maximum pressure that can result from each of the scenarios described in (2)

MANDATORY APPENDIX I
DEFINITIONS

I-1 INTRODUCTION

This Appendix contains definitions of terms generally used in this Section. These terms define pressure relief devices and their functional and operational characteristics and standardize the terminology covering such devices, their characteristics, and testing methods. These definitions and terms shall take precedence should there be any discrepancy with the referenced material for the construction of pressure relief devices.

(23) I-2 DEFINITIONS OF TERMS

Assembler: an organization that holds an ASME Certificate of Authorization to apply the Certification Mark and is responsible for assembly, adjustment, testing, sealing, and shipping of pressure relief devices certified under this Section.

ASME Designated Organization: an entity appointed by ASME to perform an administrative activity in accordance with an applicable code or standard. (ASME CA-1)

ASME Designee: an individual authorized by ASME to perform administrative functions on its behalf. (ASME CA-1)

back pressure: the pressure existing at the outlet of a pressure relief device due to pressure in the discharge system. Back pressure includes built-up back pressure and superimposed back pressure.

built-up back pressure: pressure existing at the outlet of a pressure relief device caused by the flow through that device into a discharge system.

superimposed back pressure: the static pressure existing at the outlet of a pressure relief device at the time the device is required to operate. It is the result of pressure in the discharge system from other sources.

variable back pressure: a superimposed back pressure that will vary with time.

bench testing: testing of a pressure relief device on a test stand using an external pressure source with or without an auxiliary lift device to determine some or all its operating characteristics.

blowdown pressure: the value of decreasing inlet static pressure at which no further discharge is detected at the outlet of a pressure relief valve after the valve reseats after having been subjected to a pressure equal to or above the relieving pressure. Usually expressed as a percentage of set pressure or in pressure units.

body: a pressure-retaining or pressure-containing member of a pressure relief device that supports the parts of the valve assembly and has provision(s) for connecting to the primary and/or secondary pressure source(s). Also called valve body.

bonnet: a component of a direct spring-loaded valve or of a pilot in a pilot-operated valve that supports the spring. It may or may not be pressure containing.

bore area: the minimum cross-sectional flow area of a nozzle (see Figure I-2-1).

bore diameter: the minimum diameter of a nozzle.

breaking pin: the load-carrying element of a breaking pin non-reclosing pressure relief device.

breaking pressure: the value of inlet static pressure at which a breaking pin or shear pin device functions.

buckling pin: the load-carrying element of a buckling pin or rupture pin non-reclosing pressure relief device.

burst pressure: the value of inlet static pressure at which a rupture disk device functions.

Certificate of Authorization: a document issued by the Society that authorizes the use of the ASME Certification Mark and appropriate Designator for a specified time and for a specified scope of activity.

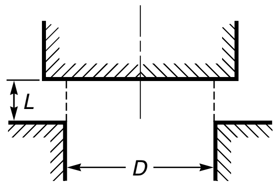
Certificate of Compliance: a document that states that the material represented has been manufactured, sampled, tested, and inspected in accordance with the requirements of the material specification (including year of issue) and any other requirements specified in the purchase order or contract shown on the certificate, and has been found to meet such requirements. This document may be combined with a Material Test Report as a single document.

Certification Designator (Designator): the symbol used in conjunction with the Certification Mark for the scope of activity described in a Manufacturer's Certificate of Authorization.

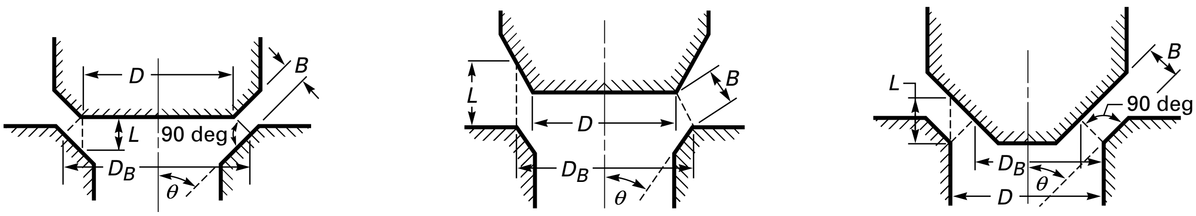
Certification Mark: an ASME symbol identifying a product as meeting ASME BPVC requirements.

Certification Mark stamp: a metallic stamp issued by the Society for use in impressing the Certification Mark.

Figure I-2-1
Typical Curtain Areas of Pressure Relief Devices

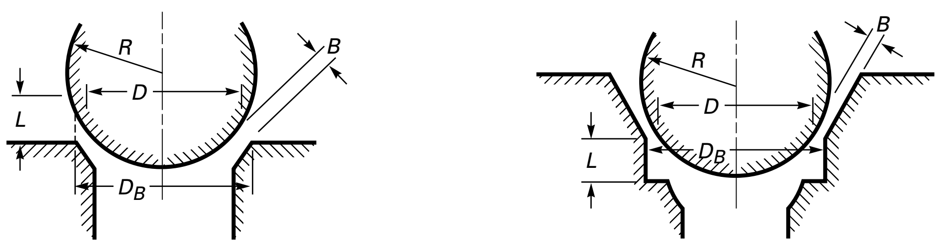


(a) Flat-Seated Valve [Note (1)]



(b-1) **(b-2)** **(b-3)**

(b) Bevel-Seated Valves [Note (2)]



(c-1) **(c-2)**

(c) Radial-Seated Valves [Note (2)]

Legend:

B = slant height of frustum of cone
D = seat diameter = smallest diameter at which seat touches disk
D_B = other diameter of frustum of cone
L = lift
R = radius
Θ = seat angle = angle of seating surface with axis of valve

GENERAL NOTE: Curtain area is the discharge area unless the disk attains sufficient lift for the valve bore to become the controlling area. See I-2, definitions of *actual discharge area*, *bore area*, and *curtain area*.

NOTES:

(1) Curtain area = surface of cylinder = πDL.

(2) Curtain area = surface of frustum of cone = $\pi B \frac{D + D_B}{2}$.

certified flow resistance, K_R: a dimensionless factor used to calculate the velocity head loss that results from the presence of a non-reclosing pressure relief device in a pressure relief system.

chatter: abnormal rapid reciprocating motion of the movable parts of a pressure relief valve in which the disk contacts the seat.

coefficient of discharge: the ratio of the measured relieving capacity to the theoretical relieving capacity.

coincident pressure and temperature: combination of concurrent pressure and temperature that is coincident with a specific operating, design, or relieving condition

combination device: one non-reclosing pressure relief device in series with one pressure relief valve.

compressibility factor: the ratio of the specific volume of a given fluid at a particular temperature and pressure to the specific volume of that fluid as calculated by ideal gas laws at that temperature and pressure.

curtain area: the area of the cylindrical or conical discharge opening between the seating surfaces created by the lift of the disk above the seat (see Figure I-2-1).

design pressure: the pressure used in the design of a pressure relief device or component together with the coincident design metal temperature, for determining the minimum permissible thickness or physical characteristics of the device, different zones of the device, or device components.

discharge area: see below.

actual discharge area: the measured minimum cross-sectional area that determines the flow through a valve.

effective discharge area: a nominal or computed area of flow through a pressure relief valve, differing from the actual discharge area, for use in recognized flow formulas to determine the capacity of a pressure relief valve.

field testing: testing of a pressure relief device installed on a system to determine some or all of its operating characteristics. Field testing may be accomplished by either of the following methods:

in-place testing: testing of a pressure relief device installed on but not protecting a system, using an external pressure source, with or without an auxiliary lift device to determine some or all of its operating characteristics.

in-service testing: testing of a pressure relief device installed on and protecting a system, using system pressure or an external pressure source, with or without an auxiliary lift device to determine some or all of its operating characteristics.

flow capacity: the relieving capacity of a pressure relief device measured at the flow-rating pressure, expressed in gravimetric or volumetric units.

flow capacity testing: testing of a pressure relief device to determine its operating characteristics, including measured relieving capacity.

flow-rating pressure: the inlet stagnation pressure at which the relieving capacity of a pressure relief device is measured.

full-area stop valve: a valve in which the flow area of the valve is equal to or greater than the inlet flow area of the pressure relief device

fusible plug device: a device designed to function by the yielding or melting of a plug, at a predetermined temperature, that supports a pressure-containing member or contains pressure by itself.

gag: a device used on reclosing pressure relief devices to prevent the device from opening.

gas: a fluid that undergoes a significant change in density as it flows through the pressure relief device.

inlet area: the cross-sectional flow area at the inlet opening of a pressure relief device.

inlet size: the nominal pipe size of the inlet of a pressure relief valve, unless otherwise designated.

lift: the actual travel of the disk from closed position to the position reached when the valve is at flow-rating pressure.

lifting device (or lever): a device to apply an external force to the stem of a pressure relief valve to manually operate the valve at some pressure below the set pressure.

liquid: a fluid that does not undergo a significant change in density through the pressure relief device.

lot of rupture disks: those disks manufactured of the same material, at the same time, and of the same size, thickness, type, heat, and manufacturing process, including heat treatment.

Manufacturer: an organization that holds an ASME Certificate of Authorization to apply the Certification Mark and is responsible for design, material selection, capacity certification, manufacture of component parts, assembly, adjustment, testing, sealing, and shipping of pressure relief devices certified under this Section.

manufacturing design range: a range of pressure within which the marked burst pressure must fall to be acceptable for a particular requirement as agreed upon between the rupture disk Manufacturer and the user or the user's designated agent.

Manufacturer's standard rupture disk holder: the structure that encloses and clamps the rupture disk into position and includes at least one proprietary high-pressure tube-fitting connection.

marked breaking pressure: the value of pressure marked on a breaking pin or shear pin device or its nameplate.

marked burst pressure: the value of pressure marked on the rupture disk device or its nameplate or on the tag of the rupture disk, indicating the burst pressure at the coincident disk temperature.

marked set pressure: the value of pressure marked on the pressure relief device or its nameplate, indicating the nominal pressure at which the device opens.

material: any substance or product form covered by a specification in Section II, Part A, B, or C. Also, any other substance or product form permitted for use in pressure relief device construction by this Section.

material manufacturer: the organization that is responsible for the production of products meeting the requirements of the material specification, and that accepts the responsibility for any statements or data in any required Certificate of Compliance or Material Test Report representing the material.

Material Test Report: a document in which the results of tests, examinations, repairs, or treatments required by the material specification to be reported are recorded, including those of any supplementary requirements or other requirements stated in the order for the material. This document may be combined with a Certificate of Compliance as a single document. When preparing a Material Test Report, a material manufacturer may transcribe data produced by other organizations, provided the material manufacturer accepts responsibility for the accuracy and authenticity of the data.

minimum net flow area: the calculated net area after a complete activation of the rupture disk or pin device with appropriate allowance for any structural members that may reduce the net flow area through the device.

normal operating condition: a sustained or expected condition that is a stable mode of operation of the equipment or system being protected.

opening pressure: the value of increasing inlet static pressure of a pressure relief valve at which there is a measurable lift or at which the discharge becomes continuous as determined by seeing, feeling, or hearing.

operating pressure: the normal or expected pressure of the fluid in the system or vessel during operation.

operating temperature: the normal or expected temperature of the fluid in the system or vessel during operation. Also called working temperature.

orifice area: see *effective discharge area*.

outlet size: the nominal pipe size of the outlet of a pressure relief valve, unless otherwise designated.

overpressure: a pressure increase over the set pressure of a pressure relief device, usually expressed as a percentage of set pressure.

pilot: the pressure- or vacuum-sensing component of a pilot-operated pressure relief valve that controls the opening and closing of the main relieving valve.

pin temperature: the specified temperature of the pin when an emergency condition exists and the pin is expected to actuate.

piston: the moving element in the main relieving valve of a pilot-operated, piston-type pressure relief valve that contains the seat that forms the primary pressure containment zone when the piston is in contact with the nozzle.

popping pressure: the value of increasing inlet static pressure at which the disk moves in the opening direction at a faster rate as compared with corresponding movement at higher or lower pressures.

pressure-containing member: a component that is exposed to and contains pressure.

pressure relief device: a general term for a device designed to prevent pressure or vacuum from exceeding a predetermined value by the transfer of fluid during emergency or abnormal conditions.

reclosing relief device: a pressure relief device designed to actuate and reclose after operating.

pressure relief valve (PRV): a pressure relief device designed to actuate on inlet static pressure and reclose after normal conditions have been restored. It may be one of the following types and have one or more of the following design features:

balanced direct spring-loaded PRV: a direct spring-loaded pressure relief valve that incorporates means of minimizing the effect of back pressure on the operational characteristics (opening pressure, closing pressure, and relieving capacity).

conventional direct spring-loaded PRV: a direct spring-loaded pressure relief valve whose operational characteristics are directly affected by changes in the back pressure.

direct spring-loaded PRV: a pressure relief valve in which the disk is held closed by a spring.

full-bore PRV: a pressure relief valve in which the bore area is equal to the flow area at the inlet to the valve, and there are no protrusions in the bore.

full-lift PRV: a pressure relief valve in which the actual discharge area is the bore area.

internal spring PRV: a direct spring-loaded pressure relief valve whose spring and all or part of the operating mechanism is exposed to the system pressure when the valve is in the closed position.

low-lift PRV: a pressure relief valve in which the actual discharge area is the curtain area. Also called a restricted-lift PRV.

pilot-operated PRV: a pressure relief valve in which the disk is held closed by system pressure, and the holding pressure is controlled by a pilot valve actuated by system pressure.

power-actuated PRV: a pressure relief valve actuated by an externally powered control device.

reduced-bore PRV: a pressure relief valve in which the flow path area below the seat is less than the flow area at the inlet to the valve.

relief valve: a spring-loaded pressure relief valve actuated by the static pressure upstream of the valve. The valve opens normally in proportion to the pressure increase over the opening pressure. A relief valve is used primarily with incompressible fluids.

safety relief valve: a pressure relief valve characterized by rapid opening (popping) or by gradual opening that is generally proportional to the increase in pressure. It can be used for compressible or incompressible fluids.

safety valve: a pressure relief valve characterized by rapid opening (popping) and normally used to relieve compressible fluids

temperature and pressure relief valve: a pressure relief valve that may be actuated by pressure at the valve inlet or by temperature at the valve inlet.

non-reclosing relief device: a pressure relief device designed to actuate and remain open after operation. A manual resetting means may be provided. A non-reclosing device may be one of the following types and have one or more of the following design features:

breaking pin device: a device designed to function by the breakage of a load-carrying section of a pin that supports a pressure-containing member.

buckling pin device: a device designed to function by the buckling of an axially loaded compressive pin that supports a pressure-containing member.

direct spring-loaded device: a device actuated by static differential pressure or static inlet pressure in which the disk is held closed by a spring. Upon actuation, the disk is held open by a latching mechanism.

full-bore device: a device in which the flow path area below the seat is equal to the flow path area of the inlet to the device.

full-lift device: a device in which the actual discharge area is independent of the lift of the disk.

low-lift device: a device in which the actual discharge area is dependent on the lift of the disk.

pin device: a device actuated by static differential pressure or static inlet pressure and designed to function by the activation of a load-bearing section of a pin that supports a pressure-containing member. A pin is the load-bearing element of a pin device. A pin device housing is the structure that encloses the pressure-containing members.

pilot-operated device: a device in which the disk is held closed by system pressure and the holding pressure is controlled by a pilot actuated by system pressure. The pilot may consist of one of the non-reclosing relief devices listed above.

reduced-bore device: a device in which the flow path area below the seat is less than the flow path area of the inlet to the device.

rupture disk device: a device containing a disk that ruptures when the static differential pressure between the upstream and downstream side of the disk reaches a predetermined value. A rupture disk device includes a rupture disk, the rupture disk holder, and all other components that are required for the device to function in the prescribed manner.

shear pin device: a device designed to function by the shearing of a load-carrying member that supports a pressure-containing member.

pressure relief system: the fluid flow path and its associated equipment for relieving excessive pressure from the pressurized equipment to final point of discharge. The associated equipment typically includes one or more pressure relief devices, piping, and piping components, and may include a muffler, liquid separator, scrubber, thermal oxidizer, flare, and/or other equipment necessary to safely discharge the effluent.

pressure-retaining member: a component that holds pressure-containing members together but is not exposed to the pressure.

pressurized equipment: equipment designed to operate with internal pressure that is above and/or below atmospheric pressure, such as, but not limited to, vessels, boilers, tanks, and piping.

rated pressure: the pressure at which a nonreclosing pressure relief device operates to allow relief of pressure at the specified temperature.

rated relieving capacity: that portion of the measured relieving capacity permitted by the applicable code or regulation to be used as a basis for the application of a pressure relief device.

referencing Code or Standard: the code or standard that adopts requirements of Section XIII by reference.

relieving conditions: the inlet pressure and temperature on a pressure relief device during an overpressure condition. The relieving pressure is equal to the valve set pressure or burst (or the rupture disk burst pressure) plus the overpressure. (The temperature of the flowing fluid at relieving conditions may be higher or lower than the operating temperature.)

relieving pressure: set pressure plus overpressure.

reseating pressure: the value of decreasing inlet static pressure at which no further leakage is detected after closing of the pressure relief valve.

rupture disk: the pressure-containing element in a rupture disk device that is designed to burst at its rated pressure at a specified temperature.

rupture disk holder: the structure that clamps a rupture disk in position.

seat: the pressure-sealing surfaces of the fixed and moving pressure-containing components.

secondary pressure: the pressure existing in the passage between the actual discharge area and the valve outlet in a pressure relief valve.

set pressure: the value of increasing (or decreasing) inlet static pressure at which a pressure relief device displays one of the operational characteristics as defined under *breaking pressure*, *burst pressure*, *opening pressure*, *popping pressure*, or *start-to-leak pressure*. (The applicable operating characteristic for a specific device design is specified by the device Manufacturer.)

shear pin: the load-carrying element of a shear pin device.

simmer: the audible or visible escape of fluid between the seat and disk at an inlet static pressure below the popping pressure and at no measurable capacity. Can also be a warning that the pressure relief device is about to relieve. Simmer applies to safety or safety relief valves on compressible fluid service.

specified disk temperature: the specified temperature of the disk at which the disk is expected to burst.

spring: the element in a pressure relief valve that provides the force to keep the disk on the nozzle.

start-to-leak pressure: the value of increasing inlet static pressure at which the first bubble occurs when a pressure relief valve is tested by means of air under a specified water seal on the outlet.

test pressure: see below.

cold differential test pressure (CDTP): the inlet static pressure at which a pressure relief valve is adjusted to open on the test stand. This test pressure includes corrections for service conditions of superimposed back pressure and/or temperature.

leak test pressure: the specified inlet static pressure at which a quantitative seat leakage test is performed in accordance with a standard procedure.

two-phase: term used to describe a fluid that contains a combination of both liquid and gas phases in a single flow stream.

user: the organization that purchases the finished equipment for its own use or as an agent for the owner. The user's designated agent may be either a design agency specifically engaged by the user, the Manufacturer of a system for a specific service that includes a pressure relief device as a part and that is purchased by the user, or an organization that offers the equipment for sale or lease for specific services.

yoke: a pressure-retaining component in a pressure relief device that supports the spring in a pressure relief valve or pin in a non-reclosing device but does not enclose them from the surrounding ambient environment.

MANDATORY APPENDIX II
ADHESIVE ATTACHMENT OF NAMEPLATES

II-1 SCOPE

This Appendix covers minimum requirements for the use of adhesive systems for the attachment of nameplates. The use of adhesive-backed nameplates shall

(a) be limited to pressure-sensitive acrylic adhesives that have been preapplied by the nameplate manufacturer to a nominal thickness of at least 0.13 mm (0.005 in.) and that are protected with a moisture-stable liner

(b) be used on pressure relief devices with design temperatures within the range of −40°C to 150°C (−40°F to 300°F)

(c) be applied to clean, bare metal surfaces, with attention being given to removal of antiweld spatter compound that may contain silicone

(d) have been prequalified as outlined in II-2

(e) be used within 2 yr of its initial application on the nameplate

II-2 NAMEPLATE APPLICATION PROCEDURE QUALIFICATION

(a) The Manufacturer's quality control system (see Mandatory Appendix III) shall define that written procedures, acceptable to the ASME Designated Organization, for the application of adhesive-backed nameplates shall be prepared and qualified.

(b) Each procedure for the attachment of nameplates by use of pressure-sensitive acrylic adhesive systems shall be qualified for outdoor exposure in accordance with UL 969, and the following additional requirements:

(1) Width of nameplate test strip shall not be less than 25 mm (1 in.).

(2) Nameplates shall have an average adhesion of not less than 1.4 N·mm (8 lbf-in.) of width after all exposure conditions, including low temperature.

(c) The application procedure qualification shall include the following essential variables, based on the adhesive and nameplate manufacturer's recommendations, where applicable:

(1) description of the pressure-sensitive acrylic adhesive system used, including generic composition.

(2) the qualified temperature range [the cold-box test temperature shall be −40°C (−40°F) for all applications].

(3) materials of the nameplate and substrate when the mean coefficient of expansion at the design temperature of one material is less than 85% of that for the other material.

(4) finish of the nameplate and substrate surfaces.

(5) the nominal thickness and modulus of elasticity at application temperature of the nameplate when nameplate preforming is used. A change of more than 25% in the value of N will require requalification:

$$N = t^2 \times M$$

where

M = nameplate modulus of elasticity at application temperature, $N{\cdot}m^2$ (psi)
N = force, N (lbf)
t = nameplate nominal thickness, mm (in.)

(6) the qualified range of preformed nameplate and companion substrate contour combinations when preforming is used.

(7) cleaning requirements for the substrate.

(8) application temperature range and application pressure technique.

(9) application steps and safeguards.

(d) Any change to the variables in (c) shall require requalification.

(e) Each lot or package of nameplates shall be identified with the adhesive application date.

II-3 REFERENCES

UL-969. Standard for Marking and Labeling Systems. Underwriters Laboratories.

MANDATORY APPENDIX III QUALITY CONTROL SYSTEM

III-1 GENERAL

(a) The Manufacturer or Assembler shall have and maintain a quality control system that will establish that all ASME BPVC requirements, including those for material, design, manufacture, and examination (by the Manufacturer or Assembler), and inspection (by the ASME Designee) of relief devices, will be met. The quality control system shall include duties of a Certified Individual (CI), as required by this Section. The CI authorized to provide oversight may also serve as the Certificate Holder's authorized representative responsible for signing Certificates of Conformance. Provided that ASME BPVC requirements are suitably identified, the system may include provisions for satisfying any requirements of the Manufacturer, Assembler, or user that exceed minimum ASME BPVC requirements, and may include provisions for quality control of non-Code work. In such systems, the Manufacturer or Assembler may make changes in parts of the system that do not affect the ASME BPVC requirements without securing acceptance by the ASME Designee. Before implementation, revisions to quality control systems of Manufacturers and Assemblers of pressure relief devices shall have been found acceptable by an ASME Designee if such revisions affect ASME BPVC requirements.

(b) The system that the Manufacturer or Assembler uses to meet the requirements of this Section must be one suitable for their own circumstances. The necessary scope and detail of the system shall depend on the complexity of the work performed and on the size and complexity of the Manufacturer's or Assembler's organization.

(c) A written description of the system the Manufacturer or Assembler will use to produce an ASME BPVC item shall be available for review. Depending upon the circumstances, the description may be brief or voluminous.

(d) The written description may contain information of proprietary nature relating to the Manufacturer's or Assembler's processes. Therefore, the ASME BPVC does not require any distribution of this information except to the ASME Designee. It is intended that information learned about the system in connection with evaluation will be treated as confidential and that all loaned descriptions will be returned to the Manufacturer or Assembler upon completion of the evaluation.

III-2 OUTLINE OF FEATURES INCLUDED IN THE QUALITY CONTROL SYSTEM

Paragraphs III-2.1 through III-2.14 provide guidance on some of the features that should be covered in the written description of the quality control system; the information is equally applicable to both shop and field work.

III-2.1 Authority and Responsibility

The authority and responsibility of those in charge of the quality control system shall be clearly established. Persons performing quality control functions shall have sufficient and well-defined responsibility, and the authority and organizational freedom to identify quality control problems and to initiate, recommend, and provide solutions.

III-2.2 Organization

An organization chart showing the relationship between management and engineering, purchasing, manufacturing, inspection, and quality control is required to reflect the actual organization. The purpose of this chart is to identify and associate the various organizational groups with the particular function for which they are responsible. The ASME BPVC does not intend to encroach on the Manufacturer's or Assembler's right to establish, and from time to time to alter, whatever form of organization the Manufacturer or Assembler considers appropriate for its ASME BPVC work.

III-2.3 Drawings, Design Calculations, and Specifications Control

The Manufacturer's or Assembler's quality control system shall provide procedures that will ensure that the latest applicable drawings, design calculations, specifications, and instructions required by the ASME BPVC, as well as authorized changes, are used for manufacture, assembly, examination, inspection, and testing.

III-2.4 Material Control

The Manufacturer or Assembler shall include a system of receiving control that will ensure that the material received is properly identified and has documentation, including required material certifications or material test reports, to satisfy ASME BPVC requirements as ordered. The system material control shall ensure that only the intended material is used in ASME BPVC construction.

III-2.5 Examination and Inspection Program

The Manufacturer's or Assembler's quality control system shall describe the manufacture, assembly, and inspection operations, including examinations and the stages at which specific inspections are to be performed.

III-2.6 Correction of Nonconformities

There shall be a system for correction of nonconformities. A nonconformity is any condition that does not comply with the applicable rules of this Section. Nonconformities must be corrected or eliminated in some way before the completed pressure relief device can be considered to comply with this Section.

III-2.7 Welding

The quality control system shall include provisions for indicating that welding conforms to requirements of Section IX as supplemented by this Section.

III-2.8 Nondestructive Examination

The quality control system shall include provisions for identifying nondestructive examination (NDE) procedures the Manufacturer will apply to conform with requirements of this Section. Section V, Article 1 shall be applied for the qualification of NDE procedures and for the certification of NDE personnel unless otherwise specified in this Section.

III-2.9 Heat Treatment

The quality control system shall provide controls to ensure that heat treatments as required by the rules of this Section are applied. It shall indicate the means by which the Inspector for the ASME Designated Organization may verify that these requirements have been met. This may be by review of heat treatment time–temperature records or by other methods, as appropriate.

III-2.10 Calibration of Measurement and Test Equipment

The Manufacturer or Assembler shall have a system for the calibration of examination, measuring, and testing equipment used in fulfillment of requirements of this Section.

(23) III-2.11 Records Retention

The Manufacturer or Assembler shall have a system for the maintenance of Certificates of Conformance and records as required by this Section.

(a) The Manufacturer or Assembler shall maintain the following documents for a period of at least 3 yr:

(1) manufacturing drawings
(2) design calculations including any applicable Proof Test Reports
(3) Material Test Reports and/or Material Certifications
(4) Welding Procedure Specifications and Procedure Qualification Records
(5) Welding or Welding Operator Performance Qualification Records
(6) nondestructive examination reports
(7) heat treatment records and test results
(8) postweld heat treatment records
(9) nonconformance and disposition records
(10) transfer form, if applicable

(b) The Manufacturer or Assembler shall maintain the Manufacturer's Certificate of Conformance for a period of at least 5 yr.

III-2.12 Sample Forms

The forms used in the quality control system and any detailed procedures for their use shall be available for review. The written description shall make necessary references to these forms.

III-2.13 Inspection of Pressure Relief Devices (23)

(a) Inspection of manufacturing or assembly of pressure relief devices shall be by a representative of an ASME Designated Organization, as described in this Section.

(b) The written description of the quality control system shall include reference to the CI and ASME Designee.

(c) The Manufacturer or Assembler shall make available to the ASME Designee, at the Manufacturer's or Assembler's plant, a current copy of the written description of the applicable quality control system.

(d) The Manufacturer's or Assembler's quality control system shall provide for the ASME Designee to have access to all drawings, calculations, specifications, procedures, process sheets, repair procedures, records, test results, and any other documents as necessary for the Designee to perform the Designee's duties in accordance with this Section. The Manufacturer or Assembler may provide such access either by making their own files of such documents available to the ASME Designee or by providing copies.

III-2.14 Certifications

(a) The Certificate of Compliance and the Material Test Report may be combined as a single document. The preparing organization accepts responsibility for the accuracy and authenticity of the data.

(b) Methods other than written signature may be used for indicating certifications, authorizations, and approval where allowed and as described elsewhere in this Section. If such alternative methods are used, controls and

safeguards shall be provided and described to ensure the integrity of the certification, authorization, and approval.

MANDATORY APPENDIX IV
CAPACITY CONVERSION

IV-1 INTRODUCTION

(a) The capacity of a pressure relief device in terms of a gas or vapor other than the medium for which the device was officially rated shall be determined by application of the equations given in IV-2(a) and IV-2(b).

(b) If the actual discharge area of the pressure relief device, A, and the coefficient of discharge, K, are not known, the official rated capacity of the pressure relief device, which is marked on the device, can be used to determine the overall value of KA, as follows:

Official Rating in Steam

$$KA = \frac{W_s}{C_N P}$$

Official Rating in Air

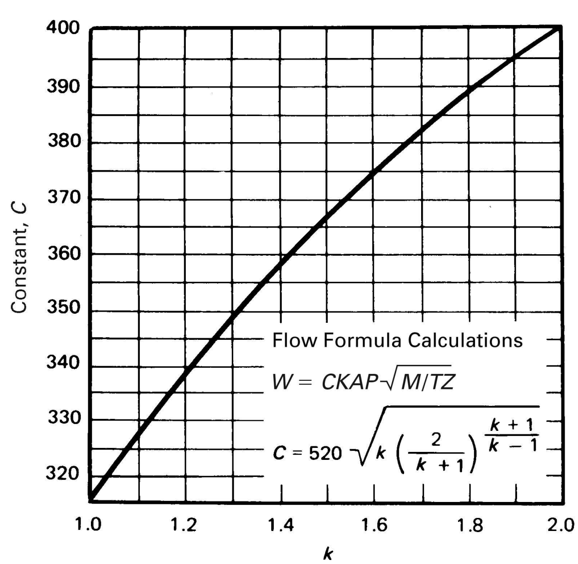
$$KA = \frac{W_a}{CP}\sqrt{\frac{T}{M}}$$

where

A = actual discharge area of the pressure relief device, mm^2 (in.^{2})
C = constant for gas or vapor, which is function of the ratio of specific heats, $k = c_p/c_v$ [see Figure IV-1-1M (Figure IV-1-1)]
C_N = Napier constant
= 5.25 for SI calculations
= 51.5 for U.S. Customary calculations
K = coefficient of discharge (see 9.7.6)
M = molecular weight (see Table IV-3-1)
P = (set pressure × 1.10) + atmospheric pressure, MPa$_{abs}$ (psia)
T = absolute gas temperature at the inlet, K (°R)
K = °C + 273
°R = °F + 460
W_a = rated capacity at inlet temperature, converted to kg/h of air at 20°C (lbm/hr of air at 60°F)
W_s = rated capacity, kg/h (lbm/hr) of steam

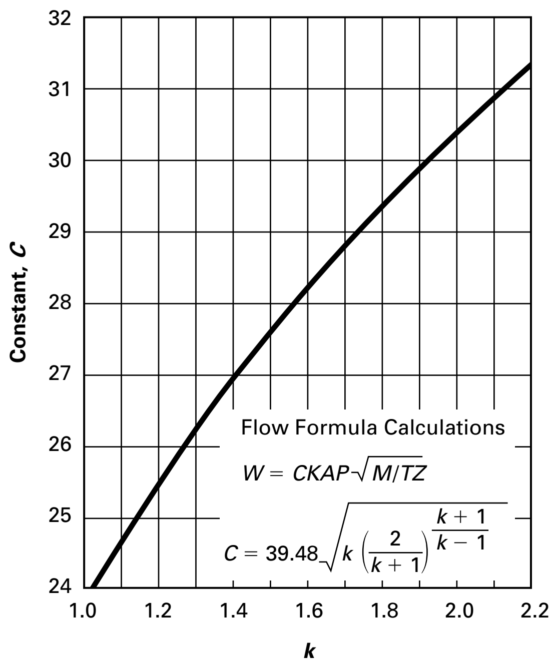
This value for KA is then substituted into the equations given in IV-2(a) and IV-2(b) to determine the capacity of the pressure relief device in terms of the new gas or vapor.

Figure IV-1-1M
Constant, C, for Gas or Vapor Related to Ratio of Specific Heats ($k = c_p/c_v$)



k	Constant, C	k	Constant, C	k	Constant, C
1.001	315	1.26	343	1.52	366
1.02	318	1.28	345	1.54	368
1.04	320	1.30	347	1.56	369
1.06	322	1.32	349	1.58	371
1.08	324	1.34	351	1.60	372
1.10	327	1.36	352	1.62	374
1.12	329	1.38	354	1.64	376
1.14	331	1.40	356	1.66	377
1.16	333	1.42	358	1.68	379
1.18	335	1.44	359	1.70	380
1.20	337	1.46	361	2.00	400
1.22	339	1.48	363	2.20	412
1.24	341	1.50	364	...	...

Figure IV-1-1
Constant, C, for Gas or Vapor Related to Ratio of Specific Heats ($k = c_p/c_v$)



k	Constant, C	k	Constant, C	k	Constant, C
1.001	23.95	1.26	26.05	1.52	27.80
1.02	24.12	1.28	26.20	1.54	27.93
1.04	24.30	1.30	26.34	1.56	28.05
1.06	24.47	1.32	26.49	1.58	28.17
1.08	24.64	1.34	26.63	1.60	28.29
1.10	24.81	1.36	26.76	1.62	28.40
1.12	24.97	1.38	26.90	1.64	28.52
1.14	25.13	1.40	27.03	1.66	28.63
1.16	25.29	1.42	27.17	1.68	28.74
1.18	25.45	1.44	27.30	1.70	28.86
1.20	25.60	1.46	27.43	2.00	30.39
1.22	25.76	1.48	27.55	2.20	31.29
1.24	25.91	1.50	27.68	. . .	. . .

IV-2 EQUATIONS FOR DETERMINING CAPACITY

For all equations, nomenclature is as defined in IV-1(b) and as noted below.

(a) For steam

$$W_s = C_N KAP$$

where

C_N = 5.25 for SI calculations
= 51.5 for U.S. Customary calculations

(b) The following equations are for low-pressure gases and vapors (gases or vapors at pressures less than two-thirds of their critical pressure):

(1) For air

$$W_a = CKAP\sqrt{\frac{M}{T}}$$

where

C = 27.03 for SI calculations
= 356 for U.S. Customary calculations
M = 28.97 (see Table IV-3-1)
T = 293K for SI calculations when W_a is the rated capacity
= 520°R for U.S. Customary calculations when W_a is the rated capacity

(2) For any gas or vapor with linear thermodynamic properties through the device

$$W = CKAP\sqrt{\frac{M}{TZ}}$$

where

W = flow of any gas or vapor, kg/h (lbm/hr)
Z = compressibility factor

(c) The equation in (b)(2) may also be used when the required flow of any gas or vapor is known and it is necessary to compute the rated capacity of steam or air.

(d) For hydrocarbon vapors, where the actual value of k is not known, the conservative value k = 1.00 has been commonly used and the equation becomes

$$W = CKAP\sqrt{\frac{M}{T}}$$

where

C = 24 for SI calculations
= 315 for U.S. Customary calculations

(e) For gas pressure service above the pressure limits given in IV-1, and for liquid service, additional consideration shall be given to the fact that the actual flow capacity of a given pressure relief device may be influenced by any of the following:

(1) fluid conditions close to or above the critical point

(2) liquid flashing to vapor and other phase changes that may occur and cause a two-phase or multiphase flow regime in the device

(3) conditions in which decomposition reactions occur and the chemical composition of the resulting fluid cannot be definitively established

The user or the user's designated agent shall be responsible for establishing a procedure for sizing and/or flow capacity conversion based on the pressure relief device geometry, as well as the change in fluid conditions and fluid properties during flow through the device and all associated piping. This procedure shall address the effects of phase changes at particular points in the device, as appropriate. If necessary, sizing may be determined on an empirical basis by actual capacity tests with the process in question at expected relieving conditions. The user shall be responsible for providing or approving the assumptions and calculations used in all flow capacity conversions.

(f) The saturated water capacity of a pressure relief device currently rated under Part 9 can be determined from Figure IV-2-1M (Figure IV-2-1), as described in (1) and (2) below. However, since the saturated water capacity is configuration sensitive, the following method applies only to those pressure relief devices that have a nozzle-type construction (throat-to-inlet-diameter ratio of 0.25 to 0.80 with a continuously contoured change) and that have exhibited a coefficient K_D in excess of 0.90. No saturated water rating shall apply to other types of construction. The method is as follows:

(1) Enter the graph in Figure IV-2-1M (Figure IV-2-1) at the set pressure of the device.

(2) Move vertically upward to the saturated water line, and read horizontally to determine the relieving capacity. This capacity is the theoretical, isentropic value arrived at by assuming equilibrium flow and calculated values for the critical pressure ratio.

NOTE: The Manufacturer, user, and Inspector are all cautioned that for the rating determined as described in (1) and (2) to apply, the device shall be continuously subjected to saturated water. If after initial relief the flow fluid changes to quality steam, the device shall be rated as per dry saturated steam. Devices installed on vessels or lines containing steam–water mixture shall be rated on dry saturated steam.

IV-3 CAPACITY CONVERSION EXAMPLES

Table IV-3-1 lists the molecular weights for common gases and vapors, which are used in the examples.

IV-3.1 Example 1

GIVEN: A pressure relief device bears a certified capacity rating of 1 370 kg/h (3,020 lbm/hr) of steam for a pressure setting of 1.40 MPa (200 psi).

PROBLEM: What is the relieving capacity of that device in terms of air at 40°C (100°F) for the same pressure setting?

SOLUTION:

(a) For steam

$$W_s = C_N KAP$$

(SI Units)

$$W_s = 5.25KAP$$

$$1\,370 = 5.25KAP$$

$$KAP = \frac{1\,370}{5.25} = 261$$

(U.S. Customary Units)

$$W_s = 51.5KAP$$

$$3{,}020 = 51.5KAP$$

$$KAP = \frac{3{,}020}{51.5} = 58.5$$

(b) For air

$$W_a = CKAP\sqrt{\frac{M}{T}}$$

(SI Units)

$$\begin{aligned} W_a &= 27.03KAP\sqrt{\frac{28.97}{40+273}} \\ &= (27.03)(261)\sqrt{\frac{28.97}{313}} \\ &= 2\,146\text{ kg/h} \end{aligned}$$

(U.S. Customary Units)

$$\begin{aligned} W_a &= 356KAP\sqrt{\frac{28.97}{100+460}} \\ &= (356)(58.5)\sqrt{\frac{28.97}{560}} \\ &= 4{,}750\text{ lbm/hr} \end{aligned}$$

Figure IV-2-1M
Flow Capacity Curve for Rating Nozzle-Type Pressure Relief Devices on Saturated Water (Based on 10% Overpressure)

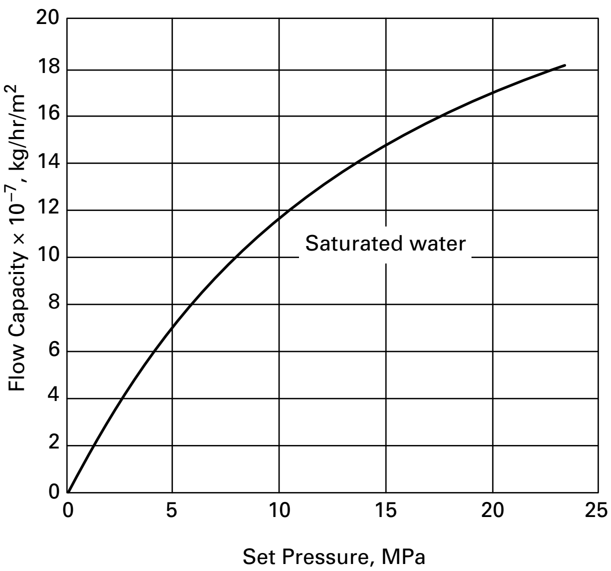


Figure IV-2-1
Flow Capacity Curve for Rating Nozzle-Type Pressure Relief Devices on Saturated Water (Based on 10% Overpressure)

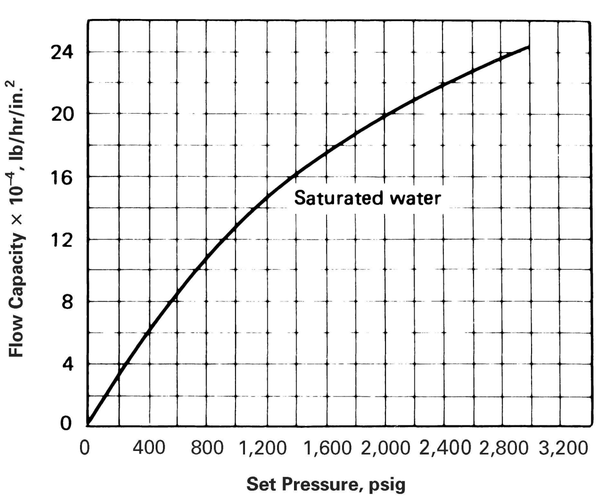


Table IV-3-1
Molecular Weights of Gases and Vapors

Gas or Vapor	Molecular Weight	Gas or Vapor	Molecular Weight
Air	28.97	Freon 22	86.48
Acetylene	26.04	Freon 114	170.90
Ammonia	17.03	Hydrogen	2.02
Butane	58.12	Hydrogen sulfide	34.08
Carbon dioxide	44.01	Methane	16.04
Chlorine	70.91	Methyl chloride	50.48
Ethane	30.07	Nitrogen	28.02
Ethylene	28.05	Oxygen	32.00
Freon 11	137.371	Propane	44.09
Freon 12	120.9	Sulfur dioxide	64.06

IV-3.2 Example 2

GIVEN: It is required to relieve 2,270 kg/h (5,000 lbm/hr) of propane from a pressure vessel through a pressure relief device set to relieve at a pressure of P_s [in megapascals (pounds force per square inch)] and with an inlet temperature at 50°C (125°F).

PROBLEM: What total capacity in kilograms (pounds mass) of steam per hour must the pressure relief device be capable of providing?

SOLUTION:

(a) For propane

$$W = CKAP\sqrt{\frac{M}{T}}$$

The value of C is not definitely known. Use the conservative value: C = 24 for SI units (315 for U.S. Customary units).

(SI Units)

$$2\,270 = 24KAP\sqrt{\frac{44.09}{50 + 273}}$$

$$KAP = 256.0$$

(U.S. Customary Units)

$$5{,}000 = 315KAP\sqrt{\frac{44.09}{125 + 460}}$$

$$KAP = 57.7$$

(b) For steam

(SI Units)

$$\begin{aligned} W_s &= 5.25KAP = 5.25 \times 256.0 \\ &= 1\,344 \text{ kg/h set to relieve at } P_s\text{, MPa} \end{aligned}$$

(U.S. Customary Units)

$$\begin{aligned} W_s &= 51.5\,KAP = 51.5 \times 57.7 \\ &= 2{,}970 \text{ lbm/hr set to relieve at } P_s\text{, psi} \end{aligned}$$

IV-3.3 Example 3

GIVEN: It is required to relieve 450 kg/h (1,000 lbm/hr) of ammonia from a pressure vessel at 65°C (150°F).

PROBLEM: What is the required total capacity in kilograms (pounds mass) of steam per hour at the same pressure setting?

SOLUTION:

(a) For ammonia

$$W = CKAP\sqrt{\frac{M}{T}}$$

The Manufacturer and the user agree to use k = 1.33; interpolated from Figure IV-1-1M (Figure IV-1-1), C = 26.56 for SI units (350 for U.S. Customary units).

(SI Units)

$$450 = 26.56KAP\sqrt{\frac{17.03}{65 + 273}}$$

$$KAP = 75.48$$

(U.S. Customary Units)

$$1{,}000 = 350KAP\sqrt{\frac{17.03}{150 + 460}}$$

$$KAP = 17.10$$

(b) For steam

(SI Units)

$$\begin{aligned} W_s &= 5.25KAP = 5.25 \times 75.48 \\ &= 396 \text{ kg/h} \end{aligned}$$

(U.S. Customary Units)

$$\begin{aligned} W_s &= 51.5KAP = 51.5 \times 17.10 \\ &= 880 \text{ lbm/hr} \end{aligned}$$

IV-3.4 Example 4

GIVEN: A pressure relief device bearing a certified rating of 285 m^3/min (10,000 ft^3/min) of air at 20°C (60°F) and 101.3 kPa_{abs} (14.7 psia) (atmospheric pressure). The weight of dry air at atmospheric pressure is 1.225 kg/m^3 (0.0766 lbm/ft^3).

PROBLEM: What is the flow capacity of this device in kilograms (pounds mass) of saturated steam per hour for the same pressure setting?

SOLUTION:

(a) For air

(1) Convert the certified rated capacity to kilograms per hour (pounds mass per hour).

$$\begin{aligned} W_a = {} & \text{rated capacity in m}^3\text{/min} \left(\text{ft}^3\text{/min}\right) \\ & \times \text{weight of dry air at atmospheric pressure} \times \text{min/hr} \end{aligned}$$

(SI Units)

$$W_a = 285 \times 1.225 \times 60 = 20\,947 \text{ kg/h}$$

(U.S. Customary Units)

$$W_a = 10{,}000 \times 0.0766 \times 60 = 45{,}960 \text{ lbm/hr}$$

(2) Determine *KAP.*

(SI Units)

$$20\,947 = 27.03KAP\sqrt{\frac{28.97}{20 + 273}}$$

$$KAP = 2\,464$$

(U.S. Customary Units)

$$45{,}960 = 356KAP\sqrt{\frac{28.97}{60 + 460}}$$

$$KAP = 546$$

(b) For steam

(SI Units)

$$\begin{aligned} W_s &= 5.25KAP = 5.25 \times 2\,464 \\ &= 12\,939 \text{ kg/h} \end{aligned}$$

(U.S. Customary Units)

$$\begin{aligned} W_s &= 51.5KAP = 51.5 \times 546 \\ &= 28{,}119 \text{ lbm/hr} \end{aligned}$$

NOTE: Before the capacity of a pressure relief device is converted from any gas to steam, the requirements of 9.7.1 must be met.

IV-4 EQUATIONS FOR CONVERSION (INCOMPRESSIBLE FLUIDS)

(a) General. The capacity of a pressure relief valve in terms of a nonflashing liquid other than the fluid for which the valve was officially rated shall be determined by the following equation:

$$W_t = CKA\sqrt{(P - P_d)\rho}$$

where

A = actual discharge area of valve, mm^2 (in.^{2})
C = 5.092 for SI units
= 2,407 for U.S. Customary units
K = coefficient of discharge
P = (set pressure × 1.10) + atmospheric pressure, MPa$_{abs}$ (psia)
P_d = pressure at discharge from valve, MPa$_{abs}$ (psia)
W_t = rated capacity, kg/h (lb/hr) of any liquid
ρ = density of liquid at value inlet conditions, kg/m^3 (lb/ft^3)

Knowing the rated capacity of a pressure relief valve stamped with a liquid capacity, it is possible to determine the overall value of *KA* in the following equation where the value of the individual terms is not known:

(SI Units)

$$KA = \frac{W_w \times 60}{5.092\sqrt{(P - 0.1014)(998)}}$$

(US Customary Units)

$$KA = \frac{W_w \times 500}{2{,}407\sqrt{(P - 14.7)(62.3)}}$$

where

W_w = rated capacity, kg/h (lb/hr) of water at 21.1°C (70°F)

(b) Example

GIVEN: A pressure relief valve bears a certified rating of 5 678 L/min (1,500 gpm) water at 21.1°C (70°F) with a set pressure of 0.827 MPag (120 psig).

PROBLEM: What is the the flow capacity of this pressure relief valve in liters (gallons) of kerosene (specific gravity = 0.82) per minute at the same pressure rating?

SOLUTION:

(1) For water at 21.1°C (70°F)

(SI Units)

$$KA = \frac{W_w \times 60}{5.092\sqrt{(P - 0.1014)(998)}}$$

$$KA = \frac{5\,678 \times 60}{5.092\sqrt{(1.0111 - 0.1014)(998)}} = 2\,220.5$$

(US Customary Units)

$$KA = \frac{W_w \times 500}{2{,}407\sqrt{(P - 14.7)(62.3)}}$$

$$KA = \frac{1{,}500 \times 500}{2{,}407\sqrt{(146.7 - 14.7)(62.3)}} = 3.436$$

(2) For kerosene

(SI Units)

$$W_l = 3.108(2\,220.5)\sqrt{\frac{(1.0111 - 0.1014)}{0.82}}$$

$$W_l = 6\,274.5 \text{ L/min}$$

(U.S. Customary Units)

$$W_l = 38(3.436)\sqrt{\frac{(146.7 - 14.7)}{0.82}}$$

$$W_l = 1{,}656.60 \text{ gpm}$$

NONMANDATORY APPENDIX A
GUIDANCE FOR THE USE OF U.S. CUSTOMARY AND SI UNITS IN THE ASME BOILER AND PRESSURE VESSEL CODE

A-1 USE OF UNITS IN EQUATIONS

The equations in this Section are suitable for use with either the U.S. Customary or the SI units provided in 1.5, or with the units provided in the nomenclatures associated with the equations. It is the responsibility of the individual and organization performing the calculations to ensure that appropriate units are used. Either U.S. Customary or SI units may be used as a consistent set. When it is necessary to convert from one system of units to another, the units shall be converted to at least three significant figures for use in calculations and other aspects of construction.

A-2 GUIDELINES USED TO DEVELOP SI EQUIVALENTS

The following guidelines were used to develop SI equivalents:

(a) U.S. Customary units are placed in parentheses after the SI units in the text.

(b) In general, both SI and U.S. Customary tables are provided if interpolation is expected. The table designation (i.e., table number) is the same for both the SI and U.S. Customary tables, with the addition of an "M" after the table number for the SI table. In the text, references to a table use the primary table number followed by the secondary table number in parentheses. For some small tables, where interpolation is not required, U.S. Customary units are placed in parentheses after the SI units.

(c) Separate SI versions of graphical information (charts) are provided, except that if both axes are dimensionless, a single figure (chart) is used.

(d) In most cases, conversions of units in the text were done using hard SI conversion practices, with some soft conversions on a case-by-case basis, as appropriate. This was implemented by rounding the SI values to the number of significant figures of implied precision in the existing U.S. Customary units. For example, 3,000 psi has an implied precision of one significant figure. Therefore, the conversion to SI units would typically be to 20 000 kPa. This is a difference of about 3% from the "exact" or soft conversion of 20 684.27 kPa. However, the precision of the conversion was determined by the Committee on a case-by-case basis. More significant digits were included in the SI equivalent if there was any question. The values of allowable stress in Section II, Part D generally include three significant figures.

(e) Minimum thickness and radius values that are expressed in fractions of an inch were generally converted according to the following table:

Fraction, in.	Proposed SI Conversion, mm	Difference, %
1/32	0.8	−0.8
3/64	1.2	−0.8
1/16	1.5	5.5
3/32	2.5	−5.0
1/8	3	5.5
5/32	4	−0.8
3/16	5	−5.0
7/32	5.5	1.0
1/4	6	5.5
5/16	8	−0.8
3/8	10	−5.0
7/16	11	1.0
1/2	13	−2.4
9/16	14	2.0
5/8	16	−0.8
11/16	17	2.6
3/4	19	0.3
7/8	22	1.0
1	25	1.6

(f) For nominal sizes that are in even increments of inches, even multiples of 25 mm were generally used. Intermediate values were interpolated rather than converting and rounding to the nearest mm. See examples in the following table. [Note that this table does not apply to nominal pipe sizes (NPS), which are covered below.]

Size, in.	Size, mm
1	25
1 1/8	29
1 1/4	32
1 1/2	38
2	50

Table continued

Size, in.	Size, mm
2¼	57
2½	64
3	75
3½	89
4	100
4½	114
5	125
6	150
8	200
12	300
18	450
20	500
24	600
36	900
40	1 000
54	1 350
60	1 500
72	1 800

Size or Length, ft	Size or Length, m
3	1
5	1.5
200	60

(g) For nominal pipe sizes, the following relationships were used:

U.S. Customary Practice	SI Practice	U.S. Customary Practice	SI Practice
NPS ⅛	DN 6	NPS 20	DN 500
NPS ¼	DN 8	NPS 22	DN 550
NPS ⅜	DN 10	NPS 24	DN 600
NPS ½	DN 15	NPS 26	DN 650
NPS ¾	DN 20	NPS 28	DN 700
NPS 1	DN 25	NPS 30	DN 750
NPS 1¼	DN 32	NPS 32	DN 800
NPS 1½	DN 40	NPS 34	DN 850
NPS 2	DN 50	NPS 36	DN 900
NPS 2½	DN 65	NPS 38	DN 950
NPS 3	DN 80	NPS 40	DN 1 000
NPS 3½	DN 90	NPS 42	DN 1 050
NPS 4	DN 100	NPS 44	DN 1 100
NPS 5	DN 125	NPS 46	DN 1 150
NPS 6	DN 150	NPS 48	DN 1 200
NPS 8	DN 200	NPS 50	DN 1 250
NPS 10	DN 250	NPS 52	DN 1 300
NPS 12	DN 300	NPS 54	DN 1 350
NPS 14	DN 350	NPS 56	DN 1 400
NPS 16	DN 400	NPS 58	DN 1 450
NPS 18	DN 450	NPS 60	DN 1 500

(h) Areas in square inches (in.^{2}) were converted to square millimeters (mm^2), and areas in square feet (ft^2) were converted to square meters (m^2). See examples in the following table:

Area (U.S. Customary)	Area (SI)
1 in.^{2}	650 mm^2
6 in.^{2}	4 000 mm^2
10 in.^{2}	6 500 mm^2
5 ft^2	0.5 m^2

(i) Volumes in cubic inches (in.^{3}) were converted to cubic millimeters (mm^3), and volumes in cubic feet (ft^3) were converted to cubic meters (m^3). See examples in the following table:

Volume (U.S. Customary)	Volume (SI)
1 in.^{3}	16 000 mm^3
6 in.^{3}	100 000 mm^3
10 in.^{3}	160 000 mm^3
5 ft^3	0.14 m^3

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

Pressure (U.S. Customary)	Pressure (SI)
0.5 psi	3 kPa
2 psi	15 kPa
3 psi	20 kPa
10 psi	70 kPa
14.7 psi	101 kPa
15 psi	100 kPa
30 psi	200 kPa
50 psi	350 kPa
100 psi	700 kPa
150 psi	1 MPa
200 psi	1.5 MPa
250 psi	1.7 MPa
300 psi	2 MPa
350 psi	2.5 MPa
400 psi	3 MPa
500 psi	3.5 MPa
600 psi	4 MPa
1,200 psi	8 MPa
1,500 psi	10 MPa

(k) Material properties that are expressed in psi or ksi (e.g., allowable stress, yield and tensile strength, elastic modulus) were generally converted to MPa to three significant figures. See example in the following table:

Strength (U.S. Customary)	Strength (SI)
95,000 psi	655 MPa

(l) In most cases, temperatures (e.g., for PWHT) were rounded to the nearest 5°C. Depending on the implied precision of the temperature, some were rounded to the nearest 1°C or 10°C or even 25°C. Temperatures colder than 0°F (negative values) were generally rounded to the nearest 1°C. The examples in the table below were created by rounding to the nearest 5°C, with one exception:

Temperature, °F	Temperature, °C
70	20
100	38
120	50
150	65
200	95
250	120
300	150
350	175
400	205
450	230
500	260
550	290
600	315
650	345
700	370
750	400
800	425
850	455
900	480
925	495
950	510
1,000	540
1,050	565
1,100	595
1,150	620
1,200	650
1,250	675
1,800	980
1,900	1 040
2,000	1 095
2,050	1 120

A-3 SOFT CONVERSION FACTORS

The following table of "soft" conversion factors is provided for convenience. Multiply the U.S. Customary value by the factor given to obtain the SI value. Similarly, divide the SI value by the factor given to obtain the U.S. Customary value. In most cases it is appropriate to round the answer to three significant figures.

U.S. Customary	SI	Factor	Notes
in.	mm	25.4	...
ft	m	0.3048	...
in.^{2}	mm^2	645.16	...
ft^2	m^2	0.09290304	...
in.^{3}	mm^3	16,387.064	...
ft^3	m^3	0.02831685	...
U.S. gal	m^3	0.003785412	...
U.S. gal	liters	3.785412	...
psi	MPa (N/mm^2)	0.0068948	Used exclusively in equations
psi	kPa	6.894757	Used only in text and for nameplate
psi	bar	0.06894757	...
ft-lb	J	1.355818	...
°F	°C	$\frac{5}{9}$ × (°F − 32)	Not for temperature difference
°F	°C	$\frac{5}{9}$	For temperature differences only
°R	K	$\frac{5}{9}$	Absolute temperature
lbm	kg	0.4535924	...
lbf	N	4.448222	...
in.-lb	N·mm	112.98484	Use exclusively in equations
ft-lb	N·m	1.3558181	Use only in text
$ksi\sqrt{in.}$	$MPa\sqrt{m}$	1.0988434	...
Btu/hr	W	0.2930711	Use for boiler rating and heat transfer
lb/ft^3	kg/m^3	16.018463	...

NONMANDATORY APPENDIX B
STOP VALVES USED IN PRESSURE RELIEF SYSTEMS

B-1 INTRODUCTION

This Appendix provides guidance for the installation and use of stop valves in pressure relief systems. The use of stop valves in pressure relief systems is determined by the equipment's code or standard. Where their use is permitted, stop valves shall be installed in accordance with the equipment's code or standard unless the code or standard has also adopted by reference this Appendix. In addition, the use of stop valves may involve jurisdictional approval. Where a code, standard, or jurisdictional authority does not address the use of stop valves, the guidance in this Appendix may be used. In these situations, substitute the term "pressurized equipment" for "vessel(s)."

B-2 STOP VALVES LOCATED IN THE RELIEF PATH

(a) Stop valves may be located within the relief path as provided for in B-6 through B-9 but only when specified by the user. The responsibilities of the user are summarized in B-4. The specific requirements in B-6 through B-9 are not intended to allow for normal operation above the pressurized equipment's maximum allowable working pressure (MAWP).

(b) The pressure relief path shall be designed such that the pressure in the equipment being protected does not exceed its MAWP before the pressure at the pressure relief device reaches its set pressure and the pressure does not exceed the pressurized equipment's maximum permissible relief pressure of the governing code.

B-3 DEFINITIONS

administrative controls: procedures that, in combination with mechanical locking elements, are intended to ensure that personnel actions do not compromise the overpressure protection of the equipment. They include, as a minimum, documented operation and maintenance procedures, and the training of operator and maintenance personnel in these procedures.

full-area stop valve: a valve in which the flow area of the valve is equal to or greater than the inlet flow area of the pressure relief device.

management system: the collective application of administrative controls, valve operation controls, and valve failure controls in accordance with the applicable requirements of this Section.

mechanical locking elements: elements that when installed on a stop valve provide a physical barrier to the operation of the stop valve such that the stop valve is not capable of being operated unless a deliberate action is taken to remove or disable the element. Such elements, when used in combination with administrative controls, ensure that the equipment overpressure protection is not compromised by personnel actions. Examples of mechanical locking elements include locks (with or without chains) on the stop valve handwheels, levers, or actuators, and plastic or metal straps (car seals) that are secured to the valve in such a way that the strap must be broken to operate the stop valve.

pressure relief path: path consisting of all equipment, pipe, fittings, and valves in the flow path between any protected equipment and its pressure-relieving device, and between the pressure-relieving device and the discharge point of the relieving stream. Stop valves within a pressure relief path include, but are not limited to, those located directly upstream and downstream of the pressure relief device (PRD) that may be provided exclusively for PRD maintenance.

valve failure controls: measures taken in valve design, configuration, and/or orientation for the purpose of preventing an internal failure of a stop valve from closing and blocking the pressure relief path. An example of valve failure controls is the installation of gate valves with the valve stem oriented at or below the horizontal position.

valve operation controls: devices used to ensure that stop valves within the pressure relief path are in their proper (open/closed) position. They include the following:

(a) mechanical interlocks designed to prevent valve operations that could result in the blocking of a pressure relief path before an alternative pressure relief path is put into service. Mechanical interlocks include physical linkages such as shafts or levers between stop valves and key-based interlocking systems.

(b) instrumented interlocks that function in a way similar to mechanical interlocks, except that instrument permissives and/or overrides are used instead of

mechanical linkages or devices to prevent valve positions that block the pressure relief path.

(c) three-way valves designed to prevent a flow path from being blocked unless another flow path is simultaneously opened.

B-4 RESPONSIBILITIES

The user has the responsibility to establish and maintain a management system that ensures a vessel is not operated without overpressure protection. These responsibilities include, but are not limited to, the following:

(a) deciding and specifying whether the overpressure protection system will allow the use of stop valve(s) located in the relief path

(b) establishing the pressure relief philosophy and the administrative controls requirements

(c) establishing the required level of reliability, redundancy, and maintenance of instrumented interlocks, if used

NOTE: The procedures contained in IEC 61508 or ISA S-84 may be used for the purpose and analysis described in (c).

(d) establishing procedures to ensure that the equipment is adequately protected against overpressure

(e) ensuring that authorization to operate identified valves is clear and that personnel are adequately trained for this task

(f) establishing management systems to ensure that administrative controls are effective

(g) establishing the analysis procedures and basis to be used in determining the potential levels of pressure if the stop valves were closed

(h) ensuring that the analysis described in (g) is conducted by personnel who are qualified and experienced with the analysis procedure

(i) ensuring that the other system components are acceptable for the potential levels of pressure established in (g)

(j) ensuring that the results of the analysis described in (g) are documented and are reviewed and accepted in writing by the individual responsible for operation of the vessel and valves

(k) ensuring that the administrative controls are reviewed and accepted in writing by the individual responsible for operation of the vessel and valves

B-5 PROCEDURES AND MANAGEMENT SYSTEMS

(a) Procedures shall specify that valves requiring mechanical locking elements and/or valve operation controls and/or valve failure controls shall be documented and clearly identified as such.

(b) The management system shall document the administrative controls (training and procedures), the valve controls, and the performance of the administrative controls in an auditable form for management review.

B-6 STOP VALVES IN SYSTEMS WITH PRESSURE FROM AN OUTSIDE SOURCE

A vessel or system for which the pressure originates from an outside source exclusively may have individual pressure-relieving devices on each vessel or connected to any point on the connecting piping, or on any one of the vessels to be protected. Under any such arrangement, there may be stop valve(s) between any vessel and the pressure-relieving devices, and these stop valves need not have any administrative controls, valve operation controls, or valve failure controls, provided that the stop valves also isolate the vessel from the source of pressure.

B-7 STOP VALVES UPSTREAM OR DOWNSTREAM OF THE PRESSURE RELIEF DEVICE

Full-area stop valves may be provided upstream and/or downstream of the pressure-relieving device exclusively for the purpose of inspection, testing, and repair of the pressure-relieving device or discharge header isolation, provided that, as a minimum, the following requirements are met:

(a) Administrative controls are provided to prevent unauthorized valve operation.

(b) Valves are provided with mechanical locking elements.

(c) Valve failure controls are provided to prevent accidental valve closure due to mechanical failure.

(d) Procedures are in place to provide pressure relief protection during the time when the system is isolated from its pressure relief path. These procedures shall ensure that when the system is isolated from its pressure relief path, an authorized person shall continuously monitor the pressure conditions of the vessel and shall be capable of responding promptly with documented, predefined actions, either stopping the source of overpressure or opening alternative means of pressure relief. This authorized person shall be dedicated to this task and shall have no other duties when performing this task.

(e) The system shall be isolated from its pressure relief path only for the time required to test, repair, and/or replace the pressure relief device.

B-8 STOP VALVES IN THE PRESSURE RELIEF PATHS HANDLING PROCESS FLOW

Stop valves, excluding remotely operated valves and process control valves, may be provided in the relief path where there is normally a process flow, provided the requirements in (a) through (c), as a minimum, are met. These requirements are based on the potential overpressure scenarios involving accidental closure of a single stop valve within the relief path [see B-3.4(g)]. The accidental closure of these stop valves in the pressure relief system need not be considered as a condition for establishing the pressurized equipment's design pressure in accordance with the referencing Code or Standard.

(a) The flow resistance of the valve in the full open position does not reduce the relieving capacity below that required by the requirements of the referencing Code or Standard.

(b) The closure of the valve will be readily apparent to the operators such that corrective action, in accordance with documented operating procedures, is required.

(c) One of the following conditions shall be met:

(1) If the pressure due to closure of the valve cannot exceed the multiple relief device maximum allowed relief pressure, such as 116% of MAWP for Section VIII, Division 1 or Division 2 vessels, then no administrative controls, mechanical locking elements, valve operation controls, or valve failure controls are required.

(2) If the pressure due to closure of the valve cannot exceed the value calculated in (-a) or (-b), then administrative controls and mechanical locking elements are required as a minimum.

(-a) the documented vessel test pressure multiplied by the ratio of the stress value at the design temperature to the stress value at the test temperature

(-b) if the governing code or standard permits the vessel test pressure to be calculated on a value greater than the vessel design pressure, then, in addition to being multiplied by the ratio in (-a), the test pressure shall be multiplied by the ratio of nominal thickness minus the corrosion allowance to the nominal thickness

(3) If the pressure due to closure of the valve could exceed the pressure indicated in (2), then the user shall do one of the following:

(-a) Eliminate the stop valve.

(-b) Apply administrative controls, mechanical locking elements, valve failure controls, and valve operation controls.

(-c) Provide a pressure relief device to protect the equipment that could be overpressured due to closure of the stop valve.

B-9 STOP VALVES IN THE RELIEF PATHS WHERE FIRE IS SOURCE OF OVERPRESSURE

Full-area stop valves located in the relief path of equipment where there is normally process flow and where fire is the only potential source of overpressure do not require physical elements such as locks or car seals, valve operation controls, or valve failure controls, provided the user has documented operating procedures requiring that equipment isolated from its pressure relief path is depressurized and free of liquids.

NONMANDATORY APPENDIX C
GUIDE TO MANUFACTURER'S AND ASSEMBLER'S CERTIFICATES OF CONFORMANCE FOR PRESSURE RELIEF DEVICES

C-1 INTRODUCTION

This Appendix contains copies of the Manufacturer's and Assembler's Certificate of Conformance forms (see Table C-1-1) and associated guides for completing the forms. The instructions in the guides are keyed to the forms in the following manner:

(a) Circled numbers on each form refer to the items listed in the associated guide. The parenthesized numbers in the guide correspond to the circled numbers on the form.

(b) Numbers without circles appearing in the guide identify specific lines on the associated Manufacturer's or Assembler's Certificate of Conformance form.

Forms in this Appendix may be obtained from the ASME website at https://www.asme.org/codes-standards/publications-information/asme-data-report-forms.

C-2 CERTIFICATE OF CONFORMANCE FORMS

The Certificate of Conformance forms begin on the next page.

Table C-1-1
Summary of Certificate of Conformance Forms

Certification Designator	Type of Certificate of Conformance	Form	Guide
HV	Manufacturer or Assembler	HV-1	Table C-2-1
UV	Manufacturer or Assembler	UV-1	Table C-2-2
UD	Manufacturer	UD-1	Table C-2-2
UV3	Manufacturer or Assembler	K-4	Table C-2-3
UD3	Manufacturer	K-5	Table C-2-4
TV	Manufacturer or Assembler	TV-1	Table C-2-5
TD	Manufacturer	TD-1	Table C-2-5

FORM HV-1 MANUFACTURER'S CERTIFICATE OF CONFORMANCE FOR PRESSURE RELIEF VALVES
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section XIII

1. Manufactured by ______ (1) ______

2. Table of Code symbol stamped items:

I.D. #	Date	Cert. #	Qty.	Type	Size (NPS)	Set Pressure	Capacity	Test Fluid	Date Code	CI Name	CI Signature
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

3. Remarks ______ (18) ______

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the pressure relief valves conform with the requirements of Section XIII of the ASME BOILER AND PRESSURE VESSEL CODE.

HV Certificate of Authorization No. ______ (14) ______ Expires ______ (15) ______

Date ______ (16) ______ Signed ______ (17) ______ Name ______ (17) ______

(Responsible representative) (manufacturer)

(07/21)

(23)

Table C-2-1
Guide for the Preparation of Manufacturer's Certificate of Conformance Form HV-1

Reference to Circled Numbers in Form HV-1	Instructions
(1)	Name and address of Manufacturer.
(2)	Pressure relief valve Manufacturer's unique identification number, such as serial number, work order number, or lot number.
(3)	The date of completion of production of the pressure relief valve.
(4)	The NB Certification Number.
(5)	The quantity of identical valves for this line item.
(6)	The Manufacturer's Design or Type Number as marked on the nameplate.
(7)	The inlet size of the pressure relief valve (NPS).
(8)	The nameplate set pressure of the pressure relief valve.
(9)	The nameplate capacity of the pressure relief valve.
(10)	The fluid used for testing the pressure relief valve.
(11)	The year built or the pressure relief valve Manufacturer's date code.
(12)	The name of the Certified Individual.
(13)	The signature of the Certified Individual. Required for each line item.
(14)	The number of the pressure relief valve Manufacturer's Certificate of Authorization.
(15)	Expiration date of the pressure relief valve Manufacturer's Certificate of Authorization.
(16)	Date signed by the pressure relief valve Manufacturer's authorized representative.
(17)	The Certificate of Shop Compliance block is to show the name of the Manufacturer as it appears on the ASME Code Certificate of Authorization. This shall be signed in accordance with the organizational authority defined in the quality control system (see Mandatory Appendix III).
(18)	Include any applicable remarks (referencing the identification number) that may pertain, such as identification of a Code Case that requires marking on the device.

GENERAL NOTE: Any quantity to which units apply shall be entered with the chosen units.

FORM UV-1 MANUFACTURER'S OR ASSEMBLER'S CERTIFICATE OF CONFORMANCE FOR PRESSURE RELIEF VALVES

As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section XIII

1. Manufactured (or assembled) by ______ (1) ______

2. Table of Certification Mark stamped items:

I.D. #	Year Built	NB Cert. #	Qty.	Type	Size	Set Pressure	Capacity	Test Fluid	Date	CI Name	CI Signature
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

3. Remarks ______ (14) ______

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the pressure relief devices conform with the requirements of Section XIII of the ASME BOILER AND PRESSURE VESSEL CODE.

UV Certificate of Authorization No. ______ (15) ______ Expires ______ (16) ______

Date ______ (17) ______ Signed ______ (18) ______ Name ______ (18) ______

(Responsible representative) (Manufacturer or Assembler)

(07/21)

FORM UD-1 MANUFACTURER'S CERTIFICATE OF CONFORMANCE FOR NONRECLOSING PRESSURE RELIEF DEVICES

As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section XIII

1. Manufactured by ______ ①

2A. Table of Certification Mark stamped activation components:

Lot #	Year Built	NB Cert. #	Qty.	Activation Component Material	Type	Size	Marked Burst or Set Pressure	Specified Temp.	Min. Net Flow Area	Certified Flow Resistance	Capacity	Date	CI Name	CI Signature
②	③	④	⑤	⑲	⑥	⑦	⑳	㉑	㉒	㉓	⑨	⑪	⑫	⑬

2B. Table of Certification Mark stamped nonreclosing pressure relief device holder or body:

Year Built	Qty.	Holder or Body Material	Type	Size	Pin to Pin Device Identifier	Date	CI Name	CI Signature
③	⑤	⑲	⑥	⑦	㉔	⑪	⑫	⑬

3. Remarks ______ ⑭

______

______

______

______

______

______

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the rupture disk or pin devices conform with the requirements of Section XIII of the ASME BOILER AND PRESSURE VESSEL CODE.

UD Certificate of Authorization No. ______ ⑮ ______ Expires ______ ⑯ ______

Date ______ ⑰ ______ Signed ______ ⑱ ______ Name ______ ⑱ ______

(Responsible representative) (Manufacturer)

(07/21)

Table C-2-2 Supplementary Instructions for the Preparation of Manufacturer's or Assembler's Certificate of Conformance Forms UV-1 and UD-1

(23)

Reference to Circled Numbers in Forms UV-1 and UD-1	Instructions
(1)	Name and address of Manufacturer or Assembler.
(2)	Pressure relief device Manufacturer's or Assembler's unique identification number, such as serial number, work order number, or lot number.
(3)	The year built or the pressure relief device Manufacturer's or Assembler's date code.
(4)	The NB Certification Number.
(5)	The quantity of identical devices for this line item.
(6)	The Manufacturer's Design or Type Number as marked on the nameplate.
(7)	The inlet size of the pressure relief device.
(8)	The nameplate set pressure of the pressure relief device.
(9)	The nameplate capacity of the pressure relief device, as applicable.
(10)	The fluid used for testing the pressure relief device.
(11)	The date of completion of production of the pressure relief device.
(12)	The name or unique ID stamp of the Certified Individual.
(13)	The signature of the Certified Individual. Required for each line item.
(14)	Include any applicable remarks (referencing the identification number) that may pertain, such as identification of a Code Case that requires marking on the device.
(15)	The number of the pressure relief device Manufacturer's or Assembler's Certificate of Authorization.
(16)	Expiration date of the pressure relief device Manufacturer's or Assembler's Certificate of Authorization.
(17)	Date signed by the pressure relief device Manufacturer's or Assembler's authorized representative.
(18)	The Certificate of Compliance block is to show the name of the Manufacturer or Assembler as it appears on the ASME Code Certificate of Authorization. This shall be signed in accordance with the organizational authority defined in the quality control system (see Mandatory Appendix III).
(19)	The material of the activation component and/or activation component holder or body, as applicable.
(20)	The marked burst or set pressure of the rupture disk or pin.
(21)	The specified temperature of the rupture disk or pin.
(22)	The minimum net flow area of the rupture disk or pin device, as applicable.
(23)	The certified flow resistance of the device, K_{RG}, K_{RL}, and/or K_{RGL} (one or more, as applicable).
(24)	Pin-to-pin device identifier, as applicable.

GENERAL NOTE: Any quantity to which units apply shall be entered with the chosen units.

(23)

FORM K-4 MANUFACTURER'S OR ASSEMBLER'S CERTIFICATE OF CONFORMANCE FOR PRESSURE RELIEF VALVES

As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section XIII

1. Manufactured (or assembled) by ______ (1) ______

2. Table of Certification Marked items:

I.D. #	Date	Cert. #	Qty.	Type	Size	Set Pressure	Capacity	Test Fluid	Date Code	CI Name	CI Signature
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

3. Remarks ______ (14) ______

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the pressure relief valves conform with the requirements of Section XIII of the ASME BOILER AND PRESSURE VESSEL CODE.

UV3 Certificate of Authorization No. ______ (15) ______ Expires ______ (16) ______

Date ______ (17) ______ Signed ______ (18) ______ (Responsible representative) Name ______ (18) ______ (Manufacturer or Assembler)

(07/23)

Table C-2-3 Supplementary Instructions for the Preparation of Manufacturer's or Assembler's Certificate of Conformance Form K-4

(23)

Reference to Circled Numbers in Form K-4	Instructions
(1)	Name and address of Manufacturer or Assembler.
(2)	Pressure relief valve Manufacturer's or Assembler's unique number, such as serial number, work order number, or lot number.
(3)	The date of completion of production of the pressure relief valve.
(4)	The NB Certification Number.
(5)	The quantity of identical valves for this line item.
(6)	The Manufacturer's Design or Type Number as marked on the nameplate.
(7)	The inlet size of the pressure relief valve.
(8)	The nameplate set pressure of the pressure relief valve.
(9)	The nameplate capacity of the pressure relief valve.
(10)	The fluid used for testing the pressure relief valve.
(11)	The year built or the pressure relief valve Manufacturer's or Assembler's date code.
(12)	The name of the Certified Individual.
(13)	The signature of the Certified Individual. Required for each line item.
(14)	Include any applicable remarks (referencing the identification number) that may pertain, such as identification of a Code Case that requires marking on the device.
(15)	The number of the pressure relief valve Manufacturer's or Assembler's Certificate of Authorization.
(16)	Expiration date of the pressure relief valve Manufacturer's or Assembler's Certificate of Authorization.
(17)	Date signed by the pressure relief valve Manufacturer's or Assembler's responsible representative.
(18)	The Certificate of Compliance block is to show the name of the Manufacturer or Assembler as it appears on the ASME Code Certificate of Authorization. This shall be signed in accordance with the organizational authority defined in the quality control system (see Mandatory Appendix III).

GENERAL NOTE: Any quantity to which units apply shall be entered with the chosen units.

(23)

FORM K-5 MANUFACTURER'S CERTIFICATE OF CONFORMANCE FOR RUPTURE DISK DEVICES

As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section XIII

1. Manufactured by ______ (1) ______

2A. Table of Certification Marked rupture disks:

Lot #	Year Built	NB Cert. #	Qty.	Disk Material	Type	Size	Marked Burst Pressure	Specified Disk Temp.	Holder Type	Date	CI Name	CI Signature
(2)	(3)	(4)	(5)	(18)	(6)	(7)	(8)	(9)	(6)	(10)	(11)	(12)

2B. Table of Certification Marked rupture disk holders:

Year Built	NB Cert. #	Qty.	Holder Material	Type	Size	Date	CI Name	CI Signature
(3)	(4)	(5)	(18)	(6)	(7)	(10)	(11)	(12)

3. Remarks ______ (13) ______

______

______

______

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the rupture disk devices conform with the requirements of Section XIII of the ASME BOILER AND PRESSURE VESSEL CODE.

UD3 Certificate of Authorization No. ______ (14) ______ Expires ______ (15) ______

Date ______ (16) ______ Signed ______ (17) ______ (Responsible representative) Name ______ (17) ______ (Manufacturer)

(07/23)

Table C-2-4
Supplementary Instructions for the Preparation of Manufacturer's Certificate of Conformance Form K-5 (23)

Reference to Circled Numbers in Form K-5	Instructions
(1)	Name and address of Manufacturer.
(2)	Pressure relief device Manufacturer's unique number, such as serial number, work order number, or lot number.
(3)	The year built or the device Manufacturer's date code.
(4)	The NB Certification Number.
(5)	The quantity of identical devices for this line item.
(6)	The Manufacturer's Design or Type Number as marked on the nameplate.
(7)	The inlet size of the device.
(8)	The marked burst pressure of the device.
(9)	The specified disk temperature.
(10)	The date of completion of production of the pressure relief device.
(11)	The name or unique ID stamp of the Certified Individual.
(12)	The signature of the Certified Individual. Required for each line item.
(13)	Include any applicable remarks (referencing the identification number) that may pertain, such as identification of a Code Case that requires marking on the device.
(14)	The number of the pressure relief device Manufacturer's Certificate of Authorization.
(15)	Expiration date of the pressure relief device Manufacturer's Certificate of Authorization.
(16)	Date signed by the pressure relief device Manufacturer's authorized representative.
(17)	The Certificate of Compliance block is to show the name of the Manufacturer as it appears on the ASME Code Certificate of Authorization. This shall be signed in accordance with the organizational authority defined in the quality control system (see Mandatory Appendix III).
(18)	The material of the rupture disk and/or holder, as applicable.

GENERAL NOTE: Any quantity to which units apply shall be entered with the chosen units.

FORM TV-1 MANUFACTURER'S OR ASSEMBLER'S CERTIFICATE OF CONFORMANCE FOR PRESSURE RELIEF VALVES

As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section XIII

Page ______ of ______

1. Manufactured (or assembled) by ______ (1) ______

2. Table of Certification Mark stamped items:

I.D. #	Year Built	NB Cert. #	Qty.	Type	Size	Set Pressure	Capacity	Test Fluid	Date	CI Name	CI Signature
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

3. Remarks ______ (14) ______

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the pressure relief devices conform with the requirements of Section XIII of the ASME BOILER AND PRESSURE VESSEL CODE.

TV Certificate of Authorization No. ______ (15) ______ Expires ______ (16) ______

Date ______ (17) ______ Signed ______ (18) ______ Name ______ (18) ______

(Responsible representative) (Manufacturer or Assembler)

(07/21)

FORM TD-1 MANUFACTURER'S CERTIFICATE OF CONFORMANCE FOR NONRECLOSING PRESSURE RELIEF DEVICES
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section XIII

Page ______ of ______

1. Manufactured by ____________ (1) ____________

2A. Table of Certification Mark stamped activation components:

Lot #	Year Built	NB Cert. #	Qty.	Activation Component Material	Type	Size	Marked Burst or Set Pressure	Specified Temp.	Min. Net Flow Area	Certified Flow Resistance	Capacity	Date	CI Name	CI Signature
(2)	(3)	(4)	(5)	(19)	(6)	(7)	(20)	(21)	(22)	(23)	(9)	(11)	(12)	(13)

2B. Table of Certification Mark stamped nonreclosing pressure relief device holder or body:

Year Built	Qty.	Holder or Body Material	Type	Size	Pin to Pin Device Identifier	Date	CI Name	CI Signature
(3)	(5)	(19)	(6)	(7)	(24)	(11)	(12)	(13)

3. Remarks ____________ (14) ____________

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the rupture disk or pin devices conform with the requirements of Section XIII of the ASME BOILER AND PRESSURE VESSEL CODE.

TD Certificate of Authorization No. ______ (15) ______ Expires ______ (16) ______

Date ______ (17) ______ Signed ______ (18) ______ (Responsible representative) Name ______ (18) ______ (Manufacturer)

(07/21)

(23)

Table C-2-5
Supplementary Instructions for the Preparation of Manufacturer's or Assembler's Certificate of Conformance Forms TV-1 and TD-1

Reference to Circled Numbers in Forms TV-1 and TD-1	Instructions
(1)	Name and address of Manufacturer or Assembler.
(2)	Pressure relief device Manufacturer's or Assembler's unique identification number, such as serial number, work order number, or lot number.
(3)	The year built or the pressure relief device Manufacturer's or Assembler's date code.
(4)	The NB Certification Number.
(5)	The quantity of identical devices for this line item.
(6)	The Manufacturer's Design or Type Number as marked on the nameplate.
(7)	The inlet size of the pressure relief device.
(8)	The nameplate set pressure of the pressure relief device.
(9)	The nameplate capacity of the pressure relief device, as applicable.
(10)	The fluid used for testing the pressure relief device.
(11)	The date of completion of production of the pressure relief device.
(12)	The name or unique ID stamp of the Certified Individual.
(13)	The signature of the Certified Individual. Required for each line item.
(14)	Include any applicable remarks (referencing the identification number) that may pertain, such as identification of a Code Case that requires marking on the device.
(15)	The number of the pressure relief device Manufacturer's or Assembler's Certificate of Authorization.
(16)	Expiration date of the pressure relief device Manufacturer's or Assembler's Certificate of Authorization.
(17)	Date signed by the pressure relief device Manufacturer's or Assembler's authorized representative.
(18)	The Certificate of Compliance block is to show the name of the Manufacturer or Assembler as it appears on the ASME Code Certificate of Authorization. This shall be signed in accordance with the organizational authority defined in the quality control system.
(19)	The material of the activation component and/or activation component holder or body, as applicable.
(20)	The marked burst or set pressure of the rupture disk or pin.
(21)	The specified temperature of the rupture disk or pin.
(22)	The minimum net flow area of the rupture disk or pin device, as applicable.
(23)	The certified flow resistance of the device, K_{RG}, K_{RL}, and/or K_{RGL} (one or more, as applicable).
(24)	Pin-to-pin device identifier, as applicable.

GENERAL NOTE: Any quantity to which units apply shall be entered with the chosen units.

2023 ASME Boiler and Pressure Vessel Code

AN INTERNATIONAL CODE

The ASME Boiler and Pressure Vessel Code (BPVC) is a globally recognized and trusted source of technical requirements and guidance for the design, construction, and certification of boilers, pressure vessels, and nuclear components. With each new edition, the Code continues to evolve, introducing new technologies and processes to promote safety across pressure equipment applications and disciplines. Developed through a rigorous consensus process and fueled by the foresight of leading industry experts from around the world, the ASME BPVC is an ever-evolving set of standards that meets the needs of a changing world.

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ISBN 978-0-7918-7590-2
9 780791 875902
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