PART 1
GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 INTRODUCTION

1.1.1.1 This Division contains mandatory requirements, specific prohibitions, and nonmandatory guidance for the design, materials, fabrication, examination, inspection, testing, and certification of pressure vessels and their associated pressure relief devices.

1.1.1.2 The Code does not address all aspects of these activities. Those aspects that are not specifically addressed should not be considered prohibited and shall be addressed by appropriate engineering judgment. Engineering judgment shall be consistent with the philosophy of this Division, and such judgments shall never be used to overrule mandatory requirements or specific prohibitions of this Division.

1.1.2 ORGANIZATION

1.1.2.1 The requirements of this Division are contained in the nine Parts listed below. Each of these Parts and Annexes is composed of paragraphs that are identified by an alphanumeric numbering system in accordance with the ISO Standard Template for the Preparation of Normative-Type Documents. References to paragraphs are made directly by reference to the paragraph number. For example, the Scope is referenced as 1.2.

(a) Part 1 – General Requirements, provides the scope of this division and establishes the extent of coverage
(b) Part 2 – Responsibilities and Duties, sets forth the responsibilities of the user and Manufacturer, and the duties of the Inspector
(c) Part 3 – Materials Requirements, provides the permissible materials of construction, applicable material specification and special requirements, physical properties, allowable stresses, and design fatigue curves
(d) Part 4 – Design by Rule Requirements, provides requirements for design of vessels and components using rules
(e) Part 5 – Design by Analysis Requirements, provides requirements for design of vessels and components using analytical methods
(f) Part 6 – Fabrication Requirements, provides requirements governing the fabrication of vessels and parts
(g) Part 7 – Examination and Inspection Requirements, provides requirements governing the examination and inspection of vessels and parts
(h) Part 8 – Pressure Testing Requirements, provides pressure testing requirements
(i) Part 9 – Pressure Vessel Overpressure Protection, provides rules for pressure relief devices

1.1.2.2 Mandatory and nonmandatory requirements are provided as normative and informative annexes, respectively, to the specific Part under consideration. The Normative Annexes address specific subjects not covered elsewhere in this Division and their requirements are mandatory when the subject covered is included in construction under this Division. Informative Annexes provide information and suggested good practices.

1.1.2.3 The materials, design, fabrication, examination, inspection, testing, and certification of pressure vessels and their associated pressure relief devices shall satisfy all applicable Parts and Normative Annexes shown above in order to qualify the construction in accordance with this Division.

1.1.3 DEFINITIONS

The definitions for the terminology used in this Part are contained in Annex 1-B.

1.2 SCOPE

1.2.1 OVERVIEW

1.2.1.1 In the scope of this Division, pressure vessels are containers for the containment of pressure, either internal or external. This pressure may be obtained from an external source or by the application of heat from a direct or indirect source as a result of a process, or any combination thereof.
(b) The Manufacturer of parts of a vessel to be completed in the field by some other party stamps these parts in accordance with Code rules and supplies the Form A-2 Manufacturer’s Partial Data Report to the other party. The other party, who must hold a valid U2 Certificate of Authorization, makes the final assembly, performs the required NDE, performs the final pressure test, completes the Form A-1 or Form A-1P Manufacturer’s Data Report, and stamps the vessel.

(c) The field portion of the work is completed by a holder of a valid U2 Certificate of Authorization other than the vessel Manufacturer. The Certificate holder performing the field work is required to supply a Form A-2 Manufacturer’s Partial Data Report covering the portion of the work completed by his organization (including data on the pressure test if conducted by the Certificate holder performing the field work) to the Manufacturer responsible for the Code vessel. The vessel Manufacturer applies his Certification Mark with U2 Designator in the presence of a representative from his Inspection Agency and completes the Form A-1 or Form A-1P Manufacturer’s Data Report with his Inspector.

1.2.6.2 In all three alternatives, the party completing and signing the Form A-1 or Form A-1P Manufacturer’s Data Report assumes full Code responsibility for the vessel. In all three cases, each Manufacturer’s Quality Control System shall describe the controls to assure compliance by each Certificate holder.

1.2.7 PRESSURE RELIEF DEVICES

The scope of this Division includes provisions for pressure relief devices necessary to satisfy the requirements of Part 9.

1.3 STANDARDS REFERENCED BY THIS DIVISION

(a) Throughout this Division, references are made to various standards, such as ASME standards, which describe parts or fittings or which establish dimensional limits for pressure vessel parts. These standards, with the year of the acceptable edition, are listed in Table 1.1.

(b) Rules for the use of these standards are stated elsewhere in this Division.

1.4 UNITS OF MEASUREMENT

(a) Either U.S. Customary, SI, or any local customary units may be used to demonstrate compliance with requirements of this edition related to materials, fabrication, examination, inspection, testing, certification, and overpressure protection.

(b) A single system of units shall be used for all aspects of design except where otherwise permitted by this Division. When components are manufactured at different locations where local customary units are different than those used for the general design, the local units may be used for the design and documentation of that component within the limitations given in (c). Similarly, for proprietary components or those uniquely associated with a system of units different than that used for the general design, alternate units may be used for the design and documentation of that component within the limitations given in (c).

(c) For any single equation, all variables shall be expressed in a single system of units. Calculations using any material data published in this Division or Section II, Part D (e.g., allowable stresses, physical properties, external pressure design factor B) shall be carried out in one of the standard units given in Table 1.2. 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 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.

(d) Production, measurement and test equipment, drawings, welding procedure specifications, welding procedure and performance qualifications, and other fabrication documents may be in U.S. Customary, SI or local customary units in accordance with the fabricator’s practice. When values shown in calculations and analysis, fabrication documents or measurement and test equipment are in different units, any conversions necessary for verification of Code compliance and to 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

(e) Conversion of units, using the precision specified above shall be performed to assure that dimensional consistency is maintained. Conversion factors between U.S. Customary and SI units may be found in Annex 1-C. 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 Authorized Inspector or Certified Individual.

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

(h) All entries on a Manufacturer’s Data Report and data for Code-required nameplate marking shall be in units consistent with the fabrication drawings for the component using U. S. Customary, SI, or local customary units. Units (either primary or alternative) may be shown parenthetically. Users of this Code are cautioned that the receiving Jurisdiction should be contacted to ensure the units are acceptable.

1.5 TOLERANCES

The Code 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.

1.6 TECHNICAL INQUIRIES

A procedure for submittal of Technical Inquiries to the ASME Boiler and Pressure Vessel Code Committee is contained in the front matter.

1.7 TABLES

<table>
<thead>
<tr>
<th>Table 1.1</th>
<th>Year of Acceptable Edition of Referenced Standards in This Division</th>
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<tbody>
<tr>
<td><strong>Marking and Labeling Systems</strong></td>
<td>ANSI/UL-969 Latest edition</td>
</tr>
<tr>
<td><strong>Fitness-For-Service</strong></td>
<td>API 579-1/ASME 2016</td>
</tr>
<tr>
<td><strong>Materials and Fabrication of 21/4Cr–1Mo, 21/4Cr–1Mo–1/4V, 3Cr–1Mo, and 3Cr–1Mo–1/4V Steel Heavy Wall Pressure Vessels for High-Temperature, High-Pressure Hydrogen Service</strong></td>
<td>API RP 934-A 2008 (2012 Addendum)</td>
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<tr>
<td><strong>Seat Tightness of Pressure Relief Valves</strong></td>
<td>API Standard 527 2014, Fourth edition</td>
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<tr>
<td><strong>Fired Heaters for General Refinery Service</strong></td>
<td>API Standard 560 Latest edition</td>
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<tr>
<td><strong>Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)</strong></td>
<td>ASME/ANSI B18.2.2 Latest edition</td>
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<tr>
<td><strong>Unified Inch Screw Threads (UN and UNR Thread Form)</strong></td>
<td>ASME B1.1 Latest edition</td>
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<tr>
<td><strong>Metric Screw Threads — M Profile</strong></td>
<td>ASME B1.13M Latest edition</td>
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<tr>
<td><strong>Pipe Threads, General Purpose, Inch</strong></td>
<td>ASME B1.20.1 Latest edition</td>
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<tr>
<td><strong>Metric Screw Threads — MJ Profile</strong></td>
<td>ASME B1.21M Latest edition</td>
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<td><strong>Pipe Flanges and Flanged Fittings, NPS 1/2 Through NPS 24 Metric/Inch Standard</strong></td>
<td>ASME B16.5 2013</td>
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<tr>
<td><strong>Factory Made Wrought Steel Buttwelding Fittings</strong></td>
<td>ASME B16.9 Latest edition</td>
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<tr>
<td><strong>Forged Steel Fittings, Socket-Welding and Threaded</strong></td>
<td>ASME B16.11 Latest edition</td>
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<tr>
<td><strong>Metallic Gaskets for Pipe Flanges — Ring Joint, Spiral-Wound and Jacketed</strong></td>
<td>ASME B16.20 Latest edition</td>
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<tr>
<td><strong>Large Diameter Steel Flanges, NPS 26 Through NPS 60 Metric/Inch Standard</strong></td>
<td>ASME B16.47 2017</td>
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<td><strong>Metric Heavy Hex Screws</strong></td>
<td>ASME B18.2.3.3M Latest edition</td>
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<tr>
<td><strong>Metric Hex Bolts</strong></td>
<td>ASME B18.2.3.5M Latest edition</td>
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<tr>
<td><strong>Metric Heavy Hex Bolts</strong></td>
<td>ASME B18.2.3.6M Latest edition</td>
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<tr>
<td><strong>Metric Fasteners for Use in Structural Applications</strong></td>
<td>ASME B18.2.6M Latest edition</td>
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<tr>
<td><strong>Conformity Assessment Requirements</strong></td>
<td>ASME CA-1 Latest edition</td>
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<tr>
<td><strong>Guidelines for Pressure Boundary Bolted Flange Joint Assembly</strong></td>
<td>ASME PCC-1 2013</td>
</tr>
<tr>
<td><strong>Repair of Pressure Equipment and Piping</strong></td>
<td>ASME PCC-2 2018</td>
</tr>
</tbody>
</table>

**Pressure Relief Devices**

| **ASME PTC-25 2014** |

Qualifications for Authorized Inspection

Standard Practice for Quantitative Measurement and Reporting of Hypoeutectoid Carbon and Low-Alloy Steel Phase Transformations

Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings

ASTM E125 1963 (R2008)

[Note (1)]
1-B.2.16 Manufacturer – the organization responsible for construction of a pressure vessel, vessel component, or part of the organization responsible for the manufacture of pressure relief devices in accordance with the rules of this Division and who holds an ASME Certificate of Authorization to apply the Certification Mark to such an item.

1-B.2.17 Material – any substance or product form covered by a material specification in Section II Part A, B, or C or any other substance or product form permitted for use in pressure vessel construction by this Division.

1-B.2.18 Material Manufacturer – the organization responsible for the production of products meeting the requirements of the material specification and accepting the responsibility for any statements or data in any required Certificate of Compliance or Material Test Report representing the material.

1-B.2.19 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 (see 1-B.2.4) as a single document.

1-B.2.20 User – the organization that purchases the finished pressure vessel 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 which includes a pressure vessel as a part and which is purchased by the user, or an organization which offers pressure vessels for sale or lease for specific services.
(h) Loads and Load Cases

(1) The user shall specify all expected loads and load case combinations as listed in 4.1.5.3.
(2) These loading data may be established by:
   (-a) Calculation
   (-b) Experimental methods
   (-c) Actual experience measurement from similar units
   (-d) Computer analysis
   (-e) Published data

(i) Overpressure Protection

(1) The user shall be responsible for the design, construction and installation of the overpressure protection system unless it is delegated to the Manufacturer. This system shall meet the requirements of Part 9.
(2) The type of overpressure protection intended for the vessel shall be documented in the User’s Design Specification as follows (see 9.1):
   (-a) Type of overpressure protection system (e.g., type of pressure relief valve, rupture disc, etc.)
   (-b) System design (see 9.7)
(3) The user shall state if jurisdictional acceptance is required prior to operation of the vessel.

2.2.3.2 Additional Requirements. The user shall state what additional requirements are appropriate for the intended vessel service such as:
(a) Additional requirements such as non-destructive examination, restricted chemistry, or heat treatments
(b) Type of weld joints and the extent of required nondestructive examinations
(c) Nonmandatory or optional provisions of this Division that are considered to be mandatory for the subject vessel
(d) Any special requirements for marking and their location (see 4.1 and Annex 2-F)
(e) Requirements for seals and/or bolting for closures and covers
(f) Additional requirements relating to erection loadings
(g) Any agreements which resolve the problems of operation and maintenance control unique to the particular pressure vessel. See also 2.2.3.1(f)(4)(-c).
(h) Specific additional requirements relating to pressure testing such as:
   (1) Fluid properties and test temperature limits
   (2) Position of vessel and support/foundation adequacy if field hydrostatic testing is required
   (3) Location: Manufacturer’s facility or on-site
   (4) Cleaning and drying
   (5) Selection of pressure test method, see 8.1.1
   (6) Application of paints, coatings and linings, see 8.1.2(e)

2.3 MANUFACTURER’S RESPONSIBILITIES

2.3.1 CODE COMPLIANCE

2.3.1.1 The Manufacturer is responsible for the structural and pressure-retaining integrity of a vessel or part thereof, as established by conformance with the requirements of the rules of this Division and the requirements in the User’s Design Specification.

2.3.1.2 The Manufacturer completing any vessel or part marked with the Certification Mark with the U2 Designator and class or the Certification Mark with the PRT Designator in accordance with this Division has the responsibility to comply with all the applicable requirements of this Division and, through proper certification, to ensure that any work by others also complies with the requirements of this Division. The Manufacturer shall certify compliance with these requirements by completing a Manufacturer’s Data Report (see 2.3.4).

2.3.1.3 A single Manufacturer’s Design Report may be completed and certified to document more than one pressure vessel that is to be located in a single, specific jurisdiction, provided that the details of design and construction demonstrate that the environmental requirements and jurisdictional regulatory authority applied for each installation location are the same or more conservative than required.

2.3.2 MATERIALS SELECTION

2.3.2.1 When generic material types (i.e., carbon steel or Type 304 Stainless Steel) are specified, the Manufacturer shall select the appropriate material from Part 3, considering information provided by the user per 2.2.3.1(g)(3).

2.3.2.2 Any material substitutions by the Manufacturer are subject to approval of the user.
Items below to be completed for all vessels where applicable.

19. Nozzles inspection and safety valve openings

<table>
<thead>
<tr>
<th>Purpose (Inlet, Outlet, Drain, etc.)</th>
<th>No.</th>
<th>Diam. or Size</th>
<th>Type</th>
<th>Material</th>
<th>Nom. Thk.</th>
<th>Reinforcement Material</th>
<th>How Attached</th>
<th>Location</th>
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20. Body Flanges

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<tr>
<th>Body Flanges on Shells</th>
<th>No.</th>
<th>Type</th>
<th>ID</th>
<th>OD</th>
<th>Flange Thk</th>
<th>Min Hub Thk</th>
<th>Material</th>
<th>How Attached</th>
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<th>Body Flanges on Heads</th>
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<th>Flange Thk</th>
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21. Support Skirt

- Lugs
- Legs
- Other
- Attached

Yes or no  No.  No.  Describe  Where and how

22. Service: Fatigue analysis required

Yes or no  Describe contents or service

Remarks:

CERTIFICATION OF DESIGN

User’s Design Specification on file at
Manufacturer’s Design Report on file at
Manufacturer’s Design Report certified by PE State Reg. No.

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 2.

“U2” Certificate of Authorization No. expires Date Co. name Signed Manufacturer Representative

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by have inspected the pressure vessel described in this Manufacturer’s Data Report on and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 2. By signing this certificate neither the Inspector nor his employer makes any warranty, express or implied, concerning the pressure vessel described in this Manufacturer’s Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date Signed Commissions National Board Authorized Inspector Commission number

07/17
1. Manufactured and certified by
   (Name and address of Manufacturer)

2. Manufactured for
   (Name and address of Purchaser)

3. Location of installation
   (Name and address)

4. Type
   (Horizontal or vertical) (Gasketed, semiweld, brazed)
   (Manufacturer’s serial no.) (CRN) (Drawing no.)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Code, Section VIII, Division 2.

6. Endplates:
   (a) (Fixed material)
   (b) (Movable material)
   (c) (Other material)

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7. Frame compression bolts and nuts
   (Quantity, diameter, material specification, and grade)

8. Impact test
   (Indicate YES and the component(s) impact tested, or NO)

9. Heat transfer plates
   (Plate model) (Material specification and grade) (Thickness) (Maximum plate count for frame assembly)
   (Quantity of plates at shipment) (Minimum tightening dimension) (Maximum tightening dimension)

10. Chamber 1, MAWP
    at max. temp
    MDMT at
    Hydro/pneu. test press.

11. Chamber 2, MAWP
    at max. temp
    MDMT at
    Hydro/pneu. test press.

12. Nozzles, connections, inspections, and safety valve openings:

<table>
<thead>
<tr>
<th>Purpose (Inlet, Outlet, Drain, etc.)</th>
<th>Qty.</th>
<th>Dia. or Size</th>
<th>Type</th>
<th>Material</th>
<th>Flange Rating</th>
<th>Nozzle Thickness</th>
<th>How Attached</th>
<th>Location (Insp./Open.)</th>
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13. Supports:
    Lugs
    Legs
    Feet
    Others
    Attached

14. Service: Fatigue analysis required
    (Yes or No)

15. Remarks:

(07/17)
Items below to be completed for all vessels where applicable

20. Nozzles inspection and safety valve openings

<table>
<thead>
<tr>
<th>Purpose (Inlet, Outlet, Drain, etc)</th>
<th>No.</th>
<th>Diam. or Size</th>
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<th>Nom. Thk.</th>
<th>Reinforcement Material</th>
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Remarks:

Body Flanges on Shells

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<th>No.</th>
<th>Type</th>
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<th>OD</th>
<th>Flange Thk</th>
<th>Min Hub Thk</th>
<th>Material</th>
<th>How Attached</th>
<th>Location</th>
<th>Num &amp; Size</th>
<th>Bolting Material</th>
<th>Washer (OD, ID, thk)</th>
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22. Support Skirt Lugs Legs Other Attached

Yes or No

No. Legs Other Describe Attached

Where and how

Remarks:

(07/17)
ANNEX 2-E
QUALITY CONTROL SYSTEM

(Normative)

2-E.1 GENERAL

2-E.1.1 The Manufacturer shall have and maintain a Quality Control System that will establish that all Code requirements, including material, design, fabrication, examination (by the Manufacturer), and inspection of vessels and vessel parts (by the Inspector), will be met. Provided that Code requirements are suitably identified, the system may include provisions for satisfying any requirements by the Manufacturer or user that exceed minimum Code requirements and may include provisions for quality control of non-Code work. In such systems, the Manufacturer of vessels and vessel parts may make changes in parts of the system that do not affect the Code requirements without securing acceptance by the Inspector (see 2.1.1). When revisions are made to Quality Control Systems of Manufacturers of pressure relief valves, they must be accepted by the ASME Designated Organization before implementation if such revisions affect Code requirements.

2-E.1.2 The system that the Manufacturer uses to meet the requirements of this Division shall be one suitable for the Manufacturer’s 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 organization. A written description of the system the Manufacturer will use to produce a Code item shall be available for review. Depending upon the circumstances, the description may be brief or extensive.

2-E.1.3 The written description may contain information of a proprietary nature relating to the Manufacturer’s processes. Therefore, the Code does not require any distribution of this information except for the Inspector’s or ASME designee’s copy as covered by 2-E.15.3 and 2-E.16.3. It is intended that information learned about the system in connection with the evaluation will be treated as confidential and that all loaned descriptions will be returned to the Manufacturer upon completion of the evaluation.

2-E.1.4 The Quality Control System of UV Certificate holders shall be in accordance with the requirements of Division 1.

2-E.2 OUTLINE OF FEATURES INCLUDED IN THE QUALITY CONTROL SYSTEM

The following is a guide to some of the features which should be covered in the written description of the Quality Control System and is equally applicable to both shop and field work.

(a) The information associated with 2.3 and Annex 7-A.

(b) The complexity of the work includes factors such as design simplicity versus complexity, the types of materials and welding procedures used, the thickness of materials, the types of nondestructive examinations applied, and whether heat treatments are applied.

(c) The size and complexity of the Manufacturer’s organization includes factors such as the number of employees, the experience level of employees, the number of vessels produced, and whether the factors defining the complexity of the work cover a wide or narrow range.

2-E.3 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, the authority, and the organizational freedom to identify quality control problems and to initiate, recommend, and provide solutions.
2-E.12 CALIBRATION OF MEASUREMENT AND TEST EQUIPMENT

The Manufacturer shall have a system for the calibration of examination, measuring, and test equipment used in fulfillment of requirements of this Division.

2-E.13 RECORDS RETENTION

The Manufacturer shall have a system for the maintenance of Data Reports and records as required by this Division. Requirements for maintenance of records are given in 2-C.3. Additionally, retained records as required by this Division and the Quality Control System shall be made available to the Authorized Inspector Supervisors or to review teams designated by ASME.

2-E.14 SAMPLE FORMS

The forms used in this 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.

2-E.15 INSPECTION OF VESSELS AND VESSEL PARTS

2-E.15.1 Inspection of vessels and vessel parts shall be by the Inspector as defined in 2.4.

2-E.15.2 The written description of the Quality Control System shall include reference to the Inspector.

2-E.15.3 The Manufacturer shall make available to the Inspector, at the Manufacturer’s plant or construction site, a current copy of the written description of the Quality Control System.

2-E.15.4 The Manufacturer’s Quality Control System shall provide for the Inspector at the Manufacturer’s plant to have access to the User’s Design Specification, the Manufacturer’s Design Report, and all drawings, calculations, specifications, procedures, process sheets, repair procedures, records, test results, and other documents as necessary for the Inspector to perform his duties in accordance with this Division. The Manufacturer may provide such access either to his own files of such documents or by providing copies to the Inspector.

2-E.16 INSPECTION OF PRESSURE RELIEF VALVES

2-E.16.1 Inspection of pressure relief valves shall be by a designated representative of ASME, as described in Part 9.

2-E.16.2 The written description of the Quality Control System shall include reference to the ASME designee.

2-E.16.3 The valve Manufacturer shall make available to the ASME designee, at the Manufacturer’s plant, a current copy of the written description of the applicable Quality Control System.

2-E.16.4 The valve Manufacturer’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 his duties in accordance with this Division. The Manufacturer may provide such access either to his own files of such documents or by providing copies to the designee.

Moved to Section XIII. See Annex 9-B for a complete cross-reference list.
ANNEX 2-G

OBTAINING AND USING CERTIFICATION MARK STAMPS

(Normative)

2-G.1 CERTIFICATION MARK

A Certificate of Authorization to use the Certification Mark with the U2, PRT, or UV Designator (see https://www.asme.org/shop/certification-accreditation) shown in Annex 2-F will be granted by ASME pursuant to the provisions of the following paragraphs. Stamps for applying the Certification Mark shall be obtained from ASME.

2-G.2 APPLICATION FOR CERTIFICATE OF AUTHORIZATION

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.

2-G.3 ISSUANCE OF AUTHORIZATION

A Certificate of Authorization shall be issued in accordance with ASME CA-1.

2-G.4 DESIGNATED OVERSIGHT

The Manufacturer shall comply with the requirements of ASME CA-1 for designated oversight by use of an Authorized Inspection Agency.

2-G.5 QUALITY CONTROL SYSTEM

Any Manufacturer holding or applying for a Certificate of Authorization shall demonstrate a Quality Control System that meets the requirements of ASME CA-1 and Annex 2-E.

2-G.6 EVALUATION OF THE QUALITY CONTROL SYSTEM

2-G.6.1 The issuance or renewal of a Certificate of Authorization is based upon ASME’s evaluation and approval of the Quality Control System, and shall be in accordance with ASME CA-1.

2-G.6.2 Before issuance or renewal of a Certificate of Authorization for use of the Certification Mark with the U2 Designator and class or the Certification Mark with the PRT Designator, the Manufacturer’s facilities and organization are subject to a joint review by a representative of his Authorized Inspection Agency and an individual certified as an ASME designee who is selected by the concerned legal jurisdiction. For those areas where there is no jurisdiction or where a jurisdiction does not choose to select an ASME designee to review a Manufacturer’s facility, an ASME designee selected by ASME shall perform that function. Where the jurisdiction is the Manufacturer’s Inspection Agency, the jurisdiction and the ASME designee shall make the joint review and joint report.

2-G.6.3 Before issuance or renewal of a Certificate of Authorization for use of the Certification Mark with the UV Designator, the valve Manufacturer’s facilities and organization are subject to a review by an ASME designee.
6.7.9.3 **Requirements for Tapered Threaded Openings.** Tapered threaded openings shall meet the limitations and requirements of 4.5.3.1(c).

6.7.9.4 **Seal Welding of Threaded Openings.** When piping or fittings are installed in threaded openings and seal welding is employed, the work shall be performed and examined at the vessel Manufacturer’s plant and included in the certification. Seal welding shall comply with 6.7.7.

6.7.10 **INSPECTION, EXAMINATION, AND TESTING**

6.7.10.1 The rules in the following paragraphs apply specifically to the inspection, examination, and testing of forged vessels and their component parts. These rules shall be used to supplement the applicable requirements and examination in Part 7.

(a) All forged vessels shall be examined as manufacturing proceeds to ensure freedom from loose scale, gouges or grooves, and cracks or seams. After fabrication has passed the machining stage, the vessel body shall be measured at suitable intervals along its length to get a record of variations in wall thickness, and the nozzles for connecting piping and other important details shall be checked for conformity to the design dimensions.

(b) Surfaces that are not to be machined shall be carefully examined for visible defects such as seams, laps, or folds. On surfaces to be machined, the examination shall be made after machining. Regions from which defective material has been removed shall be examined after removal and again after any necessary repair.

6.7.10.2 **Forged Parts.**

(a) Partial Data Reports Required – When welding is used in the fabrication of forged parts completed elsewhere, the manufacturer of the forged parts shall furnish a Partial Data Report, Form A-2.

(b) Identification and Certification – All parts forgings completed elsewhere shall be marked with the forging manufacturer’s name and the forging identification, including material designation. Should identifying marks be obliterated in the fabrication process, and for small parts, other means of identification shall be used. The forging manufacturer shall furnish reports of chemical and mechanical properties of the material and certification that each forging conforms to all requirements of Part 3.

(c) Welded Repairs and Their Certification – Welded repairs to parts forgings need not be inspected by an Authorized Inspector at the plant of the forging manufacturer, but the forging manufacturer shall obtain the approval of the vessel Manufacturer and furnish a report of the extent and location of such repairs, together with certification that they were made in accordance with all other requirements of 6.7.8.4, as applicable. If desired, welding repairs of forgings made elsewhere may be made, examined, and tested at the shop of the vessel Manufacturer.

6.7.10.3 **Check of Heat Treatment and Postweld Heat Treatment.** The Inspector shall check the provisions made for heat treatment to ensure that the heat treatment is carried out in accordance with the provisions of 6.7.6. The Inspector shall also ensure that postweld heat treatment is done after repair welding when required under the rules of 6.7.8.3(b).

6.7.10.4 **Inspection of Test Specimens and Witnessing Tests.**

(a) Test Specimens – When test specimens are to be taken under the applicable material specifications, the Inspector may witness the selection, identifying stamping, and testing of these specimens.

(b) Tests and Retests – Tests and retests shall be made in accordance with the requirements of the material specification.

6.7.11 **STAMPING AND REPORTS FOR FORGED VESSELS**

6.7.11.1 **Stamping Requirements.** The rules of Part 2 shall apply to forged vessels as far as practicable. Vessels constructed of liquid quenched and tempered material, other than austenitic steels, shall be stamped on the thickened head, using low stress stamps as commercially available unless a nameplate is used.

6.7.11.2 **Information Required on Data Reports for Integrally Forged Vessels.** Data reports for integrally forged vessels shall include the heat number or numbers of the metal in the ingot from which the vessel was forged and the test results obtained for the forging.

6.7.12 **PRESSURE RELIEF DEVICES**

The provisions for pressure relief devices of Part 9 shall apply without supplement.
PART 9
PRESSURE VESSEL OVERPRESSURE PROTECTION

9.1 GENERAL REQUIREMENTS

(a) This Part provides the requirements for pressure relief devices used to protect against overpressure in pressure vessels constructed to the requirements of this Division. It establishes the type, quantity, and settings of acceptable devices and the relieving capacity requirements for the applicable pressure vessels. Also provided are the requirements for capacity certification testing, as well as for obtaining and using the Certification Mark for pressure relief devices. In addition, this Part provides the requirements for installation of these pressure relief devices.

(b) Unless otherwise defined in this Division, the definitions relating to pressure relief devices in Section 2 of ASME PTC 25 shall apply.

9.1.1 PROTECTION AGAINST OVERPRESSURE

(a) All pressure vessels within the scope of this Division, irrespective of size or pressure, shall be provided with protection against overpressure in accordance with the requirements of this Part.

(b) The vessel Manufacturer need not supply pressure relief devices or other overpressure protection. It is the responsibility of the user to ensure that the required pressure relief devices and/or overpressure protection are properly installed and in place prior to initial operation.

(c) Pressure relief devices for vessels that are to operate completely filled with liquid shall be designed for liquid service, unless the vessel is otherwise protected against overpressure.

(d) The protective devices provided in accordance with (a) need not be installed directly on a pressure vessel when the source of pressure is external to the vessel and is under such positive control that the pressure in the vessel cannot exceed the maximum allowable working pressure (MAWP) at the operating temperature except as permitted in Section VIII, Division 1. Note that pressure-reducing valves and similar mechanical or electrical control instruments, except for pilot-operated pressure relief valves, are not considered as sufficiently positive in action to prevent excess pressures from being developed.

(e) Pressure-relieving devices shall be constructed, located, and installed so that they are readily accessible for testing, inspection, replacement, and repair and so that they cannot be readily rendered inoperative (see Annex 9.A for the use of stop valves), and should be selected on the basis of their intended service.

(f) It is the responsibility of the user or his/her designated agent to size and select the pressure relief device(s) or overpressure protection provisions based on its intended service. Intended service considerations shall include, but not necessarily be limited to the following:

1. Normal operating and upset conditions
2. Fluids
3. Fluid phases

9.1.2 TYPES OF OVERPRESSURE PROTECTION

(a) All pressure relief devices listed in Section VIII, Division 1 and bearing either the Certification Mark with the UV or UD Designator are permissible.

(b) Pressure relief valves certified for a steam discharging capacity under the provisions of Section 1, and bearing the official Certification Mark of Section 1 for safety valves, may be used on pressure vessels constructed to this Division. The rated capacity in terms of other fluids shall be determined by the method of conversion given in Section VIII, Division 1, Appendix 11.

(c) Where overpressure protection is provided by means other than the use of pressure relief devices, the requirements of 9.7 shall be followed.

9.1.3 REQUIRED RELIEVING CAPACITY AND ALLOWABLE OVERPRESSURE

(a) Relieving capacity and allowable overpressure shall be in accordance with the requirements specified in Section VIII, Division 1.
Where overpressure protection is provided by means other than the use of pressure relief devices, the requirements of 9.7 shall be followed and the allowable overpressure (accumulation) shall not exceed the maximum allowable working pressure.

### 9.1.4 PRESSURE SETTING OF PRESSURE RELIEF DEVICES

All pressure relief devices shall follow all requirements of Section VIII, Division 1 for pressure setting including tolerances.

### 9.2 PRESSURE RELIEF VALVES

Except as permitted by 9.1.2(b), safety, safety relief, relief and pilot-operated pressure relief valves shall be as defined in Section VIII, Division 1, and shall meet all requirements of Section VIII, Division 1.

### 9.3 NONRECLOSING PRESSURE RELIEF DEVICES

#### 9.3.1 RUPTURE DISK DEVICES

Rupture disk devices and rupture disk holders shall be as defined in Section VIII, Division 1, and shall meet all requirements for application, burst pressure, certification and installation of Section VIII, Division 1.

#### 9.3.2 BREAKING PIN DEVICES

##### 9.3.2.1 General

Breaking pin devices and breaking pin housings shall be as defined in Section VIII, Division 1, and shall meet all requirements for application, break pressure and certification of flow capacity of Section VIII, Division 1.

##### 9.3.2.2 Determination of Rated Flow Capacity

The capacity of a pressure relief valve and breaking pin combination based on an in-service fluid or in-service conditions different from those of the certification tests shall be calculated using the conversion methods provided in Section VIII, Division 1, Appendix 11.

#### 9.3.3 SPRING LOADED NONRECLOSING PRESSURE RELIEF DEVICES

Spring loaded nonreclosing pressure relief devices shall be as defined in Section VIII, Division 1, and shall meet all requirements for application, set pressure, capacity certification and tolerance of Section VIII, Division 1.

### 9.4 CALCULATION OF RATED CAPACITY FOR DIFFERENT RELIEVING PRESSURES AND/OR FLUIDS

#### 9.4.1 GENERAL

Determination of rated capacity of a pressure relief device at relieving pressures other than 110% of set pressure shall be performed in accordance with the requirements of Section VIII, Division 1.

#### 9.4.2 PRORATING OF CERTIFIED CAPACITY FOR DIFFERENT PressURES

Determination of the relieving capacity of a pressure relief device for in-service fluids other than steam or air shall be determined by the conversion method of Section VIII, Division 1, Appendix 11.

#### 9.4.3 CONVERSION OF CERTIFIED CAPACITY FOR DIFFERENT IN-SERVICE FLUIDS

The relieving capacity of a pressure relief device for in-service fluids other than steam or air shall be determined by the method of conversion given in Section VIII, Division 1, Mandatory Appendix 11.

### 9.5 MARKING AND STAMPING

Except as permitted by 9.1.2(b), all pressure relief devices used shall be marked and stamped in accordance with the requirements of Section VIII, Division 1.
9.6 PROVISIONS FOR INSTALLATION OF PRESSURE-RELIEVING DEVICES

9.6.1 GENERAL
Pressure-relief-device-installation-shall-comply-with-Section-VIII,-Division-1.

9.6.2 INLET PIPING FOR PRESSURE RELIEF DEVICES
The design of inlet piping for pressure-relief devices shall be in accordance with the requirements of Section VIII, Division 1. Additional guidance is provided in Annex 9.A.

9.6.3 DISCHARGE LINES FROM PRESSURE RELIEF DEVICES
The design of discharge piping from pressure-relief devices shall be in accordance with the requirements of Section VIII, Division 1. Additional guidance is provided in Annex 9.A.

9.6.4 PRESSURE DROP, NONRECLOSING PRESSURE RELIEF DEVICES
Piping, valves and fittings, and vessel components comprising part of a nonreclosing device pressure-relieving system shall be sized to prevent the vessel pressure from rising above the allowable overpressure.

9.7 OVERPRESSURE PROTECTION BY DESIGN
A pressure vessel may be provided with overpressure protection by system design in lieu of a pressure relief device or pressure-relief devices if all provisions of Section VIII, Division 1, UG-140 are satisfied.
PART 9
PRESSURE VESSEL OVERPRESSURE PROTECTION

NOTE: All Division 2 pressure relief device requirements have been transferred from Part 9 to Section XIII, and the remaining Division 2 overpressure protection requirements have been restructured within Part 9. See Annex 9-B for a complete cross-reference list.

9.1 GENERAL REQUIREMENTS

(a) This Part provides the acceptable methods and requirements for overpressure protection for pressure vessels constructed to the requirements of this Division. Acceptable methods include pressure relief devices, open flow paths, and overpressure protection by system design. It establishes the type, quantity and settings of acceptable pressure relief devices and relieving capacity requirements including maximum allowed relieving pressures. Unless otherwise specified, the required pressure relief devices shall be constructed, capacity certified, and bear the ASME Mark in accordance with Section XIII. In addition, this Part provides requirements for installation of pressure relief devices.

(b) All pressure vessels within the scope of this Division, irrespective of size or pressure, shall be provided with protection against overpressure in accordance with the requirements of this Part or with overpressure protection by system design.

(c) Pressure relief devices for vessels that are to operate completely filled with liquid shall be designed for liquid service, unless the vessel is otherwise protected against overpressure.

(d) Unless otherwise defined in this Division, the definitions relating to pressure relief devices in Section XIII shall apply.

9.2 RESPONSIBILITIES

(a) It is the user’s or his designated agent’s responsibility to determine the required relief rate, size and select the device, and design the relief system.

(b) It is the responsibility of the user to ensure that the required overpressure protection is properly installed prior to initial operation.

(c) It is the responsibility of the user or his designated agent to size and select the pressure relief device(s) or overpressure protection provisions based on its intended service. Intended service considerations shall include, but not necessarily be limited to the following:

1. Normal operating and upset conditions
2. Fluids
3. Fluid phases

(d) The overpressure protection system need not be supplied by the vessel Manufacturer.

9.3 DETERMINATION OF PRESSURE RELIEVING REQUIREMENTS

(a) It is the user’s or his designated agent’s responsibility to identify all potential overpressure scenarios and the method of overpressure protection used to mitigate each
scenario.

(b) The aggregate capacity of the pressure relief devices connected to any vessel or system of vessels for the release of a liquid, air, steam, or other vapor shall be sufficient to carry off the maximum quantity that can be generated or supplied to the attached equipment without permitting a rise in pressure within the vessel of more than that specified in 9.4.

(c) Vessels connected together by a system of adequate piping not containing valves which can isolate any vessel, and those containing valves in compliance with Section XIII, Nonmandatory Appendix B, may be considered as one unit in figuring the required relieving capacity of pressure relief devices to be furnished.

(d) Heat exchangers and similar vessels shall be protected with a pressure relief device of sufficient capacity to avoid overpressure in case of an internal failure.

(e) The rated pressure-relieving capacity of a pressure relief valve for other than steam, water or air shall be determined by the method of conversion given in Section XIII, Mandatory Appendix IV.

(f) The relieving capacity of a pressure relief device for compressible fluids may be prorated at any relieving pressure greater than $1.10p$, as permitted under 9.4, by applying a multiplier to the official relieving capacity as follows:

(U.S. Customary Units)

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

(SI Units)

$$\frac{P + 101}{1.10p + 101}$$

Where

$P$ = relieving pressure, psig (kPa gage)

$p$ = set pressure, psig (kPa gage)

For steam pressures above 1,500 psig (10 MPa gage), the above multiplier is not applicable. For steam valves with relieving pressures greater than 1,500 psig (10 MPa gage) and less than or equal to 3,200 psig (22.1 MPa gage), the capacity at relieving pressures greater than $1.10p$ shall be determined using the equation for steam and the correction factor for high pressure steam in Section XIII, 9.7.6.4 with the permitted absolute relieving pressure and the coefficient $K$ for that valve design.
9.4 OVERPRESSURE LIMITS

(a) When a pressure relief device is provided, it shall prevent the pressure from rising more than 10% or 3 psi (20 kPa), whichever is greater, above the maximum allowable working pressure except as permitted in (1) and (2) below and 9.4(c). (See 9.6 for pressure settings.)

(1) When multiple pressure relief devices are provided and set in accordance with 9.6(a) they shall prevent the pressure from rising more than 16% or 4 psi (30 kPa), whichever is greater, above the maximum allowable working pressure.

(2) When a pressure vessel can be exposed to fire or other unexpected sources of external heat, the pressure relief device(s) shall be capable of preventing the pressure from rising more than 21% above the maximum allowable working pressure. Supplemental pressure relief devices shall be installed to protect against this source of excessive pressure if the pressure relief devices used to satisfy the capacity requirements of (a) and (a)(1) have insufficient capacity to provide the required protection. See Annex 9, 9-A.9 for cases where the metal temperature due to fire or other sources of external heat can cause vessel failure prior to reaching the MAWP.

(3) Pressure relief devices, intended primarily for protection against exposure of a pressure vessel to fire or other unexpected sources of external heat installed on vessels having no permanent supply connection and used for storage at ambient temperatures of nonrefrigerated liquefied compressed gases, are excluded from the requirements of (1) and (2) above, provided:

(-a) the pressure relief devices are capable of preventing the pressure from rising more than 20% above the maximum allowable working pressure of the vessels;

(-b) the set pressure marked on these devices shall not exceed the maximum allowable working pressure of the vessels;

(-c) the vessels have sufficient ullage to avoid a liquid full condition;

(-d) the maximum allowable working pressure of the vessels on which these pressure relief devices are installed is greater than the vapor pressure of the stored liquefied compressed gas at the maximum anticipated temperature that the gas will reach under atmospheric conditions; and

(-e) pressure relief valves used to satisfy these provisions also comply with the requirements of 9.6(e), Section XIII, 3.9(e)(5) and Section XIII, Table 9.7.2-1 for fire.

(b) For vessels that utilize overpressure protection by system design the overpressure limits shall be per 9.5(e).

(c) The aggregate capacity of the open flow paths, or vents, shall be sufficient to prevent overpressure in excess of those specified in (a). When the MAWP is 15 psi (105 kPa) or less, in no case shall the pressure be allowed to rise more than 21% above the MAWP.

9.5 PERMITTED PRESSURE RELIEF DEVICES AND METHODS

Protection against overpressure shall be provided by pressure relief devices, open flow paths or system design or a combination thereof in accordance with this paragraph.
(a) Pressure Relief Valves

(1) Pressure relief valves bearing the ASME Certification Mark with the UV Designator in accordance with Section XIII shall be of the direct spring-loaded or pilot operated type.

(2) Pressure relief valves certified for a steam discharging capacity under the provisions of Section I and bearing the Certification Mark and V Designator for pressure relief valves may be used on pressure vessels constructed to this Division. The rated capacity in terms of other fluids shall be determined by the method of conversion given in Section XIII, Mandatory Appendix IV. [See Section XIII, 9.2.3.]

(b) Nonreclosing Pressure Relief Devices

(1) Rupture disks bearing the ASME Certification Mark with the UD Designator in accordance with Section XIII may be used as the sole pressure-relieving device for overpressure protection.

NOTE: When rupture disk devices are used, it is recommended that the design pressure of the vessel be sufficiently above the intended operating pressure to provide sufficient margin between operating pressure and rupture disk bursting pressure to prevent premature failure of the rupture disk due to fatigue or creep.

Application of rupture disk devices to liquid service should be carefully evaluated to assure that the design of the rupture disk device and the dynamic energy of the system on which it is installed will result in sufficient opening of the rupture disk.

(2) A pin device bearing the ASME Certification Mark with the UD Designator in accordance with Section XIII may be used as the sole pressure-relieving device for overpressure protection.

(3) Spring-Loaded Nonreclosing Pressure Relief Device

(-a) A spring-loaded nonreclosing pressure relief device, pressure actuated by means which permit the spring-loaded portion of the device to open at the specified set pressure and remain open until manually reset, may be used. Such a device may not be used in combination with any other pressure relief device.

(-b) The calculated capacity rating of a spring-loaded nonreclosing pressure relief device shall not exceed a value based on the applicable theoretical formula (see Section XIII, 9.7.6.4) for the various media, multiplied by: \( K = \text{coefficient} = 0.62 \). The area \( A \) (square inches) in the theoretical formula shall be the flow area through the minimum opening of the spring-loaded nonreclosing pressure relief device.

(-c) In lieu of the method of capacity rating in (-b) above, a Manufacturer may have the capacity of a spring-loaded nonreclosing pressure relief device design certified in general accordance with the procedures of Section XIII, Part 9, as applicable.
(c) Combination of Devices

(1) The following combinations of devices may be used provided they meet the requirements of Section XIII, Part 8.
   (-a) A rupture disk device installed between a pressure relief valve and the vessel.
   (-b) A rupture disk device installed on the outlet side of a pressure relief valve which is opened by direct action of the pressure in the vessel.
   (-c) A pin device installed between a pressure relief valve and the vessel.

(2) A pin device shall not be installed on the outlet side of a pressure relief valve that is opened by direct action of the pressure in the vessel.

(3) Spring-loaded nonreclosing pressure relief devices may not be used in combination with any other pressure relief device.

NOTE: Use of nonreclosing pressure relief devices of some types may be advisable on vessels containing substances that may render a pressure relief valve inoperative, where a loss of valuable material by leakage should be avoided, or where contamination of the atmosphere by leakage of noxious fluids must be avoided. The use of rupture disk devices may also be advisable when very rapid rates of pressure rise may be encountered.

(d) Open Flow Paths

(1) Flow paths or vents, open directly or indirectly to the atmosphere may be used as the sole pressure relieving device on a vessel.

(2) 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 piping and piping components including the exit nozzle on the vessels, 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 in this method.

(e) Overpressure Protection by System Design

Overpressure protection by system design in accordance with Section XIII, Part 13 is permitted.

(1) For vessels with overpressure protection by system design where the pressure is self-limited at or below the vessel MAWP, (see Section XIII, 13.2), there shall be no credible overpressure scenario in which the pressure exceeds the maximum allowable working pressure (MAWP) of the pressurized equipment at the coincident temperature.

(2) For vessels with overpressure protection by system design where the pressure is not self-limited at or below the vessel MAWP, (see Section XIII, 13.3), there shall be no credible overpressure scenario in which the pressure exceeds 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 vessel design temperature. The overpressure limit shall not exceed the vessel test pressure.

9.6 PRESSURE SETTINGS AND PERFORMANCE REQUIREMENTS

(a) When a single pressure relief device is used, the set pressure marked on the device shall not exceed the maximum allowable working pressure of the vessel. When the required capacity is provided in more than one pressure relief device, only one pressure relief device need be set at or below the maximum allowable working pressure, and the additional pressure relief devices may be set to open at higher pressures but in no case at a pressure higher than 105% of the maximum allowable working pressure, except as provided in (b) below.

(b) For pressure relief devices permitted in 9.4(a)(2) as protection against excessive pressure caused by exposure to fire or other sources of external heat, the device marked set pressure shall not exceed 110% of the maximum allowable working pressure of the vessel. If such a pressure relief device is used to meet the requirements of both 9.4(a) and 9.4(a)(2), the device marked set pressure shall not be over the maximum allowable working pressure.

(c) The pressure relief device set pressure shall include the effects of static head and constant back pressure.

(d) The set pressure tolerance for pressure relief valves shall not exceed ±2 psi (15 kPa) for pressures up to and including 70 psi (500 kPa) and ±3% for pressures above 70 psi (500 kPa), except as covered in (e) below.

(e) The set pressure tolerance of pressure relief valves which comply with 9.4(a)(3) shall be within −0%, +10%.

(f) The burst pressure tolerance for rupture disk devices at the specified disk temperature shall not exceed ±2 psi (15 kPa) of marked burst pressure up to and including 40 psi (300 kPa) and ±5% of marked burst pressure above 40 psi (300 kPa).

(g) The set pressure tolerance for pin devices shall not exceed ±2 psi (15 kPa) of marked set pressure up to and including 40 psi (300 kPa) and ±5% of marked set pressures above 40 psi (300 kPa) at specified pin temperature

(h) The tolerance of spring-loaded nonreclosing pressure relief devices opening point shall not exceed ±5%.

9.7 INSTALLATION

(a) Pressure relief devices shall be constructed, located, and installed so that they are readily accessible for testing, inspection, replacement, and repair and so that they cannot be readily rendered inoperative (see Annex 9-A).

(b) The pressure relief devices required in 9.1(b) need not be installed directly on a pressure vessel when either of the following conditions apply:

(1) the source of pressure is external to the vessel and is under such positive control that the pressure in the vessel cannot exceed the maximum allowable working pressure at the
operating temperature except as permitted in 9.4(a) above, or under the conditions set forth in Annex 9-A.

(2) there are no intervening stop valves between the vessel and the pressure relief device or devices except as permitted under 9.7(f).

NOTE: Pressure reducing valves and similar mechanical or electrical control instruments, except for pilot-operated pressure relief valves as permitted in 9.5(a), are not considered as sufficiently positive in action to prevent excess pressures from being developed.

(c) Pressure relief devices intended for relief of compressible fluids shall be connected to the vessel in the vapor space above any contained liquid or to piping connected to the vapor space in the vessel which is to be protected. Pressure relief devices intended for relief of liquids shall be connected below the liquid level. Alternative connection locations are permitted, depending on the potential vessel overpressure scenarios and the type of relief device selected, provided the requirements of 9.2(b) and 9.4(a) are met.

(d) The opening through all pipe, fittings, and nonreclosing pressure relief devices (if installed) between a pressure vessel and its pressure relief valve shall have at least the area of the pressure relief valve inlet. The characteristics of this upstream system shall be such that the pressure drop will not reduce the relieving capacity below that required or adversely affect the proper operation of the pressure relief valve.

(e) The opening in the vessel wall shall be designed to provide unobstructed flow between the vessel and its pressure relief device (see Annex 9-A).

(f) When two or more required pressure relief devices are placed on one connection, the inlet internal cross sectional area of this connection shall be either sized to avoid restricting flow to the pressure relief devices or made at least equal to the combined inlet areas of the safety devices connected to it. The flow characteristics of the upstream system shall satisfy the requirements of (d) and (e) above. (See Annex 9-A.)

(g) There shall be no intervening stop valves between the vessel and its pressure relief device or devices, or between the pressure relief device or devices and the point of discharge, except:

(1) when these stop valves are so constructed or positively controlled that the closing of the maximum number of block valves possible at one time will not reduce the pressure-relieving capacity provided by the unaffected pressure relief devices below the required relieving capacity; or

(2) under conditions set forth in Section XIII, Nonmandatory Appendix B.

(h) The pressure relief devices on all vessels shall be so installed that their proper functioning will not be hindered by the nature of the vessel’s contents.

(i) Discharge lines from pressure relief devices shall be designed to facilitate drainage or shall be 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. 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 vessel, or adversely affect the proper operation of the pressure relief devices. [See Section XIII, 3.2.2(a) and Annex 9-A.]
(j) For rupture disks that are marked with only a lot number in accordance with Section XIII, 4.7.2, 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.

(k) Piping, valves and fittings, and vessel components comprising part of a nonreclosing device pressure-relieving system shall be sized to prevent the vessel pressure from rising above the allowable overpressure.

(l) Additional guidance is provided in Annex 9-A.
ANNEX 9-A
BEST PRACTICES FOR THE INSTALLATION AND OPERATION OF PRESSURE RELIEF DEVICES

(Informative)

9-A.1 INTRODUCTION

This Annex provides additional guidance for design of pressure relief device installations. This Annex is a supplement to the installation requirements provided in Part 9. Note that there may be jurisdictional requirements related to the installation of pressure relief devices.

9-A.2 PROVISIONS FOR THE INSTALLATION OF STOP VALVES IN THE RELIEF PATH

9-A.2.1 GENERAL

The general provisions for the installation of pressure-relieving devices are covered in 9.6. The following paragraphs contain requirements for system and stop valve design when stop valves are to be located within the relief path. These stop valves are sometimes necessary for the continuous operation of processing equipment of such a complex nature that shutdown of any part of it is not feasible or not practical. The requirements cover stop valves provided upstream and downstream of pressure relief valves, provided in the relief path where there is normally a process flow and in a relief path where fire is the only potential source of overpressure.

9-A.2.2 STOP VALVES LOCATED IN THE RELIEF PATH

9-A.2.2.1 General

(a) A stop valve(s) located within the relief path is not allowed except as permitted by 9-A.2.2.5, 9-A.2.2.6, 9-A.2.2.7 and 9-A.2.2.8 below, and only when specified by the user. The responsibilities of the user are summarized in 9-A.2.2.3. The specific requirements of 9-A.2.2.5, 9-A.2.2.6, 9-A.2.2.7 and 9-A.2.2.8 are not intended to allow for operation above the maximum allowable working pressure.

(b) The pressure relief path shall be designed such that the pressure in the equipment being protected does not exceed the maximum allowable working pressure before the pressure at the pressure relief device reaches its set pressure and the pressure does not exceed the allowable overpressure limits of Section VIII, Division 1.

9-A.2.2.2 Definitions

(a) Administrative Controls are 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:

(1) Documented Operation and Maintenance Procedures,

(2) Operator and Maintenance Personnel Training in the above procedures.

(b) The Pressure Relief Path consists of all equipment, pipe, fittings and valves in the flow path between any protected equipment item and its pressure-relieving device and 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 that may be provided exclusively for pressure relief device maintenance.

(c) Valve Operation Controls are devices used to ensure that stop valves within the pressure relief path are in their proper (open/closed) position. They include the following:

(1) Mechanical Interlocks which are designed to prevent valve operations which could result in the blocking of a pressure relief path before an alternative pressure relief path is put into service.
(2) Instrumented Interlocks which function similar to mechanical interlocks, except that instrument permissives and/or overrides are used instead of mechanical linkages/devices to prevent valve positions that block the pressure relief path.

(3) Three-way valves designed to prevent a flow path from being blocked without another flow path being simultaneously opened.

(d) Valve Failure Controls are measures taken in valve design, configuration, and/or orientation of the stop valve with 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 stem oriented at or below the horizontal position.

(e) A Full Area Stop Valve is a valve in which the flow area of the valve is equal to or larger than the inlet flow area of the pressure relief device.

(f) Mechanical Locking Elements are 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.

(g) A Management System is the collective application of administrative controls, valve operation controls, and valve failure controls, in accordance with the applicable requirements of this Division.

9-A.2.2.3 Responsibilities

The user has the responsibility to establish and maintain a management system that ensures that a vessel is not operated without overpressure protection. These responsibilities include, but are not limited to, the following:

(a) Deciding and specifying if 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.

(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 the 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 valve(s) is 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 reviewed and accepted in writing by the individual responsible for the 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.

9-A.2.2.4 Requirements of Procedures/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.

9-A.2.2.5 Stop Valves Provided in Systems for Which the Pressure Originates Exclusively 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 such an arrangement, there may be stop valve(s) between any vessel and the pressure-relieving devices, and these stop valve(s) 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.
9-A.2.2.6 Stop Valves Provided Upstream or Downstream of the Pressure Relief Device Exclusively for Maintenance of That Device

Full area stop valve(s) may be provided upstream and/or downstream of the pressure-relieving device for the purpose of inspection, testing and repair of the pressure relief device or discharge header isolation, provided that, as a minimum, the following requirements are complied with:

(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, pre-defined 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 for only the time required to test, repair, and/or replace the pressure relief device.

9-A.2.2.7 Stop Valves Provided in the Pressure Relief Path Where There Is Normally Process Flow

Stop valve(s), excluding remotely operated valves, may be provided in the relief path where there is normally process flow, provided the requirements in (a) and (b), as a minimum, are complied with. These requirements are based on the overpressure scenarios involving accidental closure of a single stop valve within the relief path [see 9-A.2.2.3(g)]. The accidental closure of these stop valve(s) in the pressure relief system need not be considered in the determination of the specified design pressure in Part 2 of this Division.

(a) The flow resistance of the valve in the full open position does not reduce the relieving capacity below that required by 9.1.3.
(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 and:
   (1) If the pressure due to closure of the valve cannot exceed 116% of the maximum allowable working pressure, then no administrative controls, or valve failure controls are required, or
   (2) If the pressure due to closure of the valve cannot exceed the following:
      (a) the documented test pressure, multiplied by the ratio of stress value at the design temperature to the stress value at the test temperature, or
      (b) if the test pressure is calculated per 8.2.1(e), in addition to the stress ratio specified in (a), the test pressure shall also be multiplied by the ratio of the nominal thickness minus the corrosion allowance to the nominal thickness then, as a minimum, administrative controls and mechanical locking elements are required, or
   (3) If the pressure due to closure of the valve could exceed the pressure in (2), then the user shall either:
      (a) eliminate the stop valve, or
      (b) apply administrative controls, mechanical locking elements, valve failure controls, and valve operation controls, or
      (c) provide a pressure relief device to protect the equipment that could be overpressured due to closure of the stop valve.

9-A.2.2.8 Stop Valves Provided in the Relief Path of Equipment Where Fire Is the Only Potential Source of Overpressure

Full area stop valves located in the relief path of equipment where fire is the only potential source of overpressure do not require mechanical locking elements, valve operation controls, or valve failure controls, provided the user has documented operating procedures requiring the equipment isolated from its pressure relief path is depressured and free of all-liquids.

9-A.3 INLET PIPING PRESSURE DROP FOR PRESSURE RELIEF VALVES

For pressure relief valves, the flow characteristics of the upstream system shall be such that the cumulative total of all non-recoverable inlet losses shall not exceed 3% of the valve set pressure. The inlet pressure losses shall be determined accounting for all fittings in the upstream system, including rupture disks installed in the pressure relief valve inlet piping, and shall be based on the valve nameplate capacity corrected for the characteristics of the flowing fluid.
9-B.1 GENERAL

(a) The 2021 Edition of this Division adopts the new Boiler and Pressure Vessel Code Section XIII, Rules for Overpressure Protection. All Division 2 pressure relief device requirements have been transferred from Part 9 to Section XIII, and the remaining Division 2 overpressure protection requirements have been restructured within Part 9. Table 9-B-1 lists the new locations for all requirements.

(b) Part 9 has been revised to reference this Annex. The reference and this Annex will be deleted from the next Edition of this Division.

(c) Table 9-B-1 may also be obtained in a spreadsheet format from:

https://cstools.asme.org/

Note - Link address is example only and to be specified by ASME Staff.

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