DRAFT
SECTION XIII RULES FOR OVERPRESSURE PROTECTION
ASME BOILER AND PRESSURE VESSEL CODE

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PROPOSED NEW STANDARD:
ASME BPVC XIII – 20XX

19-1780 - PROPOSAL DATE – 12/8/2020

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

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GENERAL NOTE:

a) If there is a difference between Table 2.1-1 and the listed ASME BPVC Section, the BPVC Section shall apply.

b) Allowable devices 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
- TD = transport tank pressure relief device
- 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

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) 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.
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 restricted 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 so arranged that valve performance meets 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 HLW potable water heaters (HV Designator) 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:
(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.

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

(3) Pressure relief valves marked with the Certification Mark and TV Designator shall be marked with the vessel class, based on the applicable Modal Appendix used to establish the certified flowing capacity.
(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 (Ibm/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) ________ m³/min of air at 20°C and 101 kPa [SCFM (standard cubic feet per minute of air at 60°F and 14.7 psia)] or ________ kg/min (Ibm/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 _____ mm² (in²)
   (2) certified flow resistance (one or more as applicable)
      (a) KRG ________ for rupture disks certified on air or gases
      (b) KRL ________ for rupture disks certified on liquid
      (c) KRGL ________ 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 devices marked with the Certification Mark and UD3 Designator only).

4.7.3 Rupture Disk Holders
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, KR-104(b)(3).
Materials used for pins shall be controlled by the Manufacturer of the pin device by a specification ensuring the control of material properties.

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.

Non-metallic disk inserts and seals shall be compatible with the maximum design temperature established for the pin device.

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, 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 to demonstrate to the satisfaction of the representative of the ASME Designated Organization that
(-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 without chatter or flutter or complete opening cannot be verified, in a stable manner.

If only one pin device of the design will be produced within the 6-yr period within 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(d) shall apply.

(b) For pin devices 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 5.4.2 are followed and the following additional tests are completed satisfactorily:
(-a) Two production pin devices that are representative of the design shall be tested per ASME PTC 25, Part III to 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) seat tightness and a secondary pressure zone leakage 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 within 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(d) 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 (b)(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.
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 Pin Devices
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 or, if neither of these will be visible when the pin device is in service, a tab attached as close as possible to the discharge side of the pin device and visible when installed. For units of measure other than those included below, see 1.5. The marking shall include the following:
(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) ______ m³/min of air at 20°C and 101 kPa [standard cubic feet per minute (SCFM) 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 ________ mm² (in²)
   (2) certified flow resistance (one or more as applicable)
      (-a) KRG ________ for pin devices certified on air or gases
      (-b) KRL ________ for pin devices certified on liquid
      (-c) KRL ________ 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.

5.7.2 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 5.7.1(a), 5.7.1(d), 5.7.1(f), and 5.7.1(j).
(b) For pin devices that are single use and permanently assembled, the pin shall be marked with its lot number.
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 pressure relief valve (TV Designator) (nozzle type) 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, a 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, but 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 is 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

8.5.1 Pressure Relief Valves in Combination With Non-reclosing Pressure Relief Devices
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 device Manufacturer, or pressure relief valve Manufacturer.)

8.5.2 Pressure Relief Valves in Combination with Pin Devices
Pressure relief valves in combination with pin devices shall be marked with the capacity as established in accordance with 8.4(a)(2) (using 0.90 factor) or the combination capacity factor established by test in accordance with 9.5, in addition to the marking of 8.9 and 5.7. The marking may be placed on the pressure relief valve or pin device or on a metal plate or plates securely fastened to the pressure relief valve or pin 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 pin device.
(d) design or type number of the pin 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, pin device Manufacturer, or pressure relief valve Manufacturer.
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:

   \[
   \text{Multiplier} = \frac{1.10p + 0.101}{1.03p + 0.101}
   \]

   \[
   \text{SI Units) } \hspace{1cm} \frac{1.10p + 0.101}{1.03p + 0.101}
   \]

   \[
   \text{(U.S. Customary Units) } \hspace{1cm} \frac{1.10p + 14.7}{1.03p + 14.7}
   \]

   where
   \( p \) = set pressure, MPa gage (psig)

   Such valve capacity shall be marked in accordance with the requirements of 3.9 for pressure relief valves marked with the Certification Mark and UV Designator. 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, 1.10\( p \) + 0.101; for U.S. Customary units, 1.10\( p \) + 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(g).

9.3 REQUIREMENTS FOR NON-RECLOSING PRESSURE RELIEF DEVICES

(a) Non-reclosing pressure relief devices shall be certified for either capacity or flow resistance, except those for Section VIII, Division 3 service marked with the Certification Mark and UD3 Designator.

(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.
9.7 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 or UD3 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 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.
<table>
<thead>
<tr>
<th>Certification Mark Designator [Note (1)]</th>
<th>Service</th>
<th>Maximum Pressure for Capacity Certification Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>V or NV for main steam valves</td>
<td>Steam</td>
<td>103% of set pressure, or set pressure + 15 kPa (2 psi), whichever is greater</td>
</tr>
<tr>
<td></td>
<td>Liquids</td>
<td>110% of set pressure, or set pressure + 20 kPa (3 psi), whichever is greater</td>
</tr>
<tr>
<td>HV</td>
<td>Steam Boilers</td>
<td>Set pressure + 35 kPa (5 psi)</td>
</tr>
<tr>
<td></td>
<td>Hot water heating and water supply boilers</td>
<td>110% set pressure</td>
</tr>
<tr>
<td>UV, UD or NV for pressure relief valves</td>
<td>All except those indicated below</td>
<td>110% of set pressure, or set pressure + 20 kPa (3 psi), whichever is greater [Note (2)]</td>
</tr>
<tr>
<td></td>
<td>Fire or unexpected external heating for vessels with no permanent supply connection [Note (3)]</td>
<td>120% of marked set pressure</td>
</tr>
<tr>
<td>UV3 or UD3</td>
<td>All</td>
<td>110% set pressure</td>
</tr>
<tr>
<td>TV or TD</td>
<td>All except those indicated below</td>
<td>110% of set pressure, or set pressure + 20 kPa (3 psi), whichever is greater [Note (2)]</td>
</tr>
<tr>
<td></td>
<td>As permitted by the appropriate Section XII Modal Appendix [Note(4)]</td>
<td>120% of marked set pressure</td>
</tr>
</tbody>
</table>

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, viii153(a)(3).
(4) See Section XII, Article TR-1.

9.7.3 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:
9.7.7.8 Flow resistance test data reports for each nonreclosing 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 Exceeding the Laboratory Capabilities

(a) If the design exceeds the laboratory pressure capability, 9.7.5 or 9.7.6 shall be followed with the exception that the valves shall be tested with their disks fixed at the minimum design lift to establish the rated capacity. (b) If the design exceeds the laboratory size or capacity capability, 9.7.5 or 9.7.6 shall be followed with the exception that flow models of three different sizes, each tested at three different pressures, shall be used in place of valves 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 pressure relief valves but shall be geometrically similar to the final product. (c) In the case of either (a) or (b), the valve design (i.e., parameters such as spring properties, seat geometry, and mechanical valve lift) shall be evaluated to ensure that production valves will achieve design lift as modeled above.

9.9 Capacity Certification of NV Designated Pressure Relief Valves

(a) The following paragraphs are revisions or additions to the requirements in 9.1 through 9.8 that apply only for NV Designated pressure relief valves.

(b) 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 rules 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.

(c) For each design, a Demonstration of Function test program as required by 9.9.4 shall be performed.

(d) 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) 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); or
   (-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)

(a) 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 by this paragraph.

(b) The capacity shall be determined at no more than 13.8 kPa (2 psi) above the actual set pressure.
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 installing two or more relief devices 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 PRESSURE RELIEF VALVE ORIENTATION
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 WITH SELF-LIMITING PRESSURE CONTROL EQUIPMENT
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 WITHOUT SELF-LIMITING PRESSURE CONTROL EQUIPMENT
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
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 Code Requirements.

Certification Mark stamp: a metallic stamp issued by the Society for use in impressing the Certification Mark.

certified flow resistance, $KR$: 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:
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

(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.
Table C-2-2 Guide for the Preparation of Section IV Manufacturer’s Certificate of Conformance Form HV-1

<table>
<thead>
<tr>
<th>Reference to Circled Numbers in Form HV-1</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name and address of Manufacturer.</td>
</tr>
<tr>
<td>2</td>
<td>Pressure relief valve Manufacturer’s unique identification number, such as serial number, work order number, or lot number.</td>
</tr>
<tr>
<td>3</td>
<td>The date of completion of production of the pressure relief valve.</td>
</tr>
<tr>
<td>4</td>
<td>The NB Certification Number.</td>
</tr>
<tr>
<td>5</td>
<td>The quantity of identical valves for this line item.</td>
</tr>
<tr>
<td>6</td>
<td>The Manufacturer’s Design or Type Number as marked on the nameplate.</td>
</tr>
<tr>
<td>7</td>
<td>The inlet size of the pressure relief valve (NPS).</td>
</tr>
<tr>
<td>8</td>
<td>The nameplate set pressure of the pressure relief valve.</td>
</tr>
<tr>
<td>9</td>
<td>The nameplate capacity of the pressure relief valve.</td>
</tr>
<tr>
<td>10</td>
<td>The fluid used for testing the pressure relief valve.</td>
</tr>
<tr>
<td>11</td>
<td>The year built or the pressure relief valve Manufacturer’s date code.</td>
</tr>
<tr>
<td>12</td>
<td>The name of the Certified Individual.</td>
</tr>
<tr>
<td>13</td>
<td>The signature of the Certified Individual. Required for each line item.</td>
</tr>
<tr>
<td>14</td>
<td>The number of the pressure relief valve Manufacturer’s Certificate of Authorization.</td>
</tr>
<tr>
<td>15</td>
<td>Expiration date of the pressure relief valve Manufacturer’s Certificate of Authorization.</td>
</tr>
<tr>
<td>16</td>
<td>Date signed by the pressure relief valve Manufacturer’s authorized representative.</td>
</tr>
<tr>
<td>17</td>
<td>The Certificate of Shop Compliance block is to show the name of the Manufacturer as shown on his/her ASME Code Certificate of Authorization. This should be signed in accordance with the organizational authority defined in the quality control system (see Mandatory Appendix III).</td>
</tr>
<tr>
<td>18</td>
<td>Include any applicable remarks (referencing the identification number) that may pertain, such as identification of a Code Case that requires marking on the device.</td>
</tr>
</tbody>
</table>

GENERAL NOTE: Any quantity to which units apply shall be entered on the Manufacturer’s Data Report with the chosen units.