PART PVG
REQUIREMENTS FOR ORGANIC FLUID VAPORIZERS

PVG-12 PRESSURE RELIEF VALVES

PVG-12.1 Pressure relief valves shall be of a totally enclosed type so designed that vapors escaping beyond the valve seat shall not discharge into the atmosphere, except through an escape pipe that will carry such vapors to a safe point of discharge outside of the building. A suitable condenser that will condense all the vapors discharged from the pressure relief valve may be used in lieu of piping the vapors to the atmosphere. The pressure relief valve shall not have a lifting lever. The vaporizer shall be designed in accordance with the rules in this Code for a working pressure of at least 40 psi (280 kPa) above the operating pressure at which it will be used. Valve body drains are not mandatory.

PVG-12.2 Pressure relief valves should be disconnected from the vaporizer at least once yearly (or as recommended by the vaporizer Manufacturer or valve manufacturer). If disconnected, the pressure relief valve should be inspected, repaired if necessary, tested, and then replaced on the vaporizer.

PVG-12.3 In order to minimize the loss by leakage of material through the pressure relief valve, a rupture disk may be installed between the pressure relief valve and the vaporizer, provided the requirements of PVG-12.3.1 through PVG-12.3.4.3 are met.

PVG-12.3.1 The rupture disk shall be installed in accordance with Section XIII, 8.2.

PVG-12.3.2 Every rupture disk shall have a specified bursting pressure at a specified temperature, shall be marked with a lot number, and shall be guaranteed by its manufacturer to burst within 5% (plus or minus) of its specified bursting pressure.

PVG-12.3.3 The specified bursting pressure at the coincident specified temperature shall be determined by bursting two or more specimens from a lot of the same material and of the same size as those to be used. The tests shall be made in a holder of the same form and pressure area dimensions as that with which the disk is to be used.

PVG-12.3.4 A rupture disk may be installed between a pressure relief valve and the vaporizer provided the requirements in PVG-12.3.4.1 through PVG-12.3.4.3 are met.
PVG-12.3.4.1 The maximum pressure of the range for which the disk is designed to rupture does not exceed the opening pressure for which the pressure relief valve is set or the maximum allowable working pressure of the vessel.

PVG-12.3.4.2 The opening provided through the rupture disk, after breakage, is sufficient to permit a flow equal to the capacity of the attached valve, and there is no chance of interference with the proper functioning of the valve, but in no case shall this area be less than the inlet area of the valve.

PVG-12.3.4.3 The space between a rupture disk and the valve should be provided with a pressure gage, try cock, free vent, or a suitable telltale indicator. This arrangement permits the detection of disk rupture or leakage.

PVG-12.4 Pressure relief valve discharge capacity shall be determined from the following equation:

\[ W = CKAP \sqrt{\frac{M}{T}} \]

where
- \( A \) = discharge area of pressure relief valve
- \( C \) = constant for vapor that is a function of the ratio of Specific Heats \( k = \frac{c_p}{c_v} \) (see Figure PVG-12). Note: Where \( k \) is not known, \( k = 1.001 \).
- \( K \) = coefficient of discharge for the design
- \( M \) = molecular weight
- \( P \) = (set pressure \( \times 1.03 \)) + Atmosphere Pressure
- \( T \) = absolute temperature at inlet, °F + 460 (°C + 273)
- \( W \) = flow of vapor

PVG-12.5 Pressure relief valves for organic fluid vaporizers shall be tested and certified under PG-69, and they shall be stamped per PG-110.

PVG-12.6 The required minimum pressure relief valve relieving capacity shall be determined from the following equation:

\[ W = \frac{C \times H \times 0.75}{h} \]

where
- \( C \) = maximum total weight or volume of fuel burned per hour, lb (kg) or ft\(^3\) (m\(^3\))
- \( H \) = heat of combustion of fuel, Btu/lb (J/kg) or Btu/ft\(^3\) (J/m\(^3\)) (see A-17)
- \( h \) = latent heat of heat transfer fluid at relieving pressure, Btu/lb (J/kg)
- \( W \) = weight of organic fluid vapor generated per hour

The sum of the pressure relief valve capacities marked on the valves shall be equal to or greater than \( W \).
Pressure relief valves in hot water service are more susceptible to damage and subsequent leakage, than pressure relief valves relieving steam. It is recommended that the maximum allowable working pressure of the boiler and the pressure relief valve setting for high-temperature water boilers be selected substantially higher than the desired operating pressure so as to minimize the times the pressure relief valve must lift.

The power-actuated pressure-relieving valve is one whose movements to open or close are fully controlled by a source of power (electricity, air, steam, or hydraulic). The valve may discharge to atmosphere or to a container at lower pressure. The discharge capacity may be affected by the downstream conditions, and such effects shall be taken into account. If the power-actuated pressure-relieving valves are also positioned in response to other control signals, the control impulse to prevent overpressure shall be responsive only to pressure and shall override any other control function.

Valve capacities are published in “Pressure Relief Device Certifications.” This publication may be obtained from the National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, OH 43299.

The user may specify a higher test pressure commensurate with the back pressure anticipated in service.

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.

Whenever Authorized Inspection Agency or AIA is used in this Code, it shall mean an Authorized Inspection Agency accredited by ASME in accordance with the requirements in the latest edition of ASME QAI-1, Qualification for Authorized Inspection.

Manufacturer includes contractor, assembler, and installer.

Welder includes welding operator.

Primary furnace gases are those in a zone where the design temperature of those gases exceeds 850°F (455°C).

Manufacturer includes contractor, Assembler, and installer.

Brazer includes brazing operator.

Flux residues can be extremely corrosive as well as interfering with visual examination.

This gross volume is intended to include such gas passages as are integral with the assembled pressure parts and a definition is: the volume of a rectangular or cylindrical enclosure into which all the pressure parts of the boiler in their final assembled positions could be fitted. Projecting nozzles or fittings need not be considered in the volume.

Users are warned that a rupture disk will not burst at its designed pressure if back pressure builds up in the space between the disk and the pressure relief valve, which will occur should leakage develop in the rupture disk due to corrosion or other cause.

The terms gas turbine and combustion turbine shall be considered synonymous and cover turbines burning liquid or gaseous fuels.
PART 4
REQUIREMENTS FOR RUPTURE DISK DEVICES

4.1 GENERAL

4.1.1 Applicability of Part 4 Requirements
This Part contains requirements that are applicable to all rupture disk devices that are to be marked with the Certification Mark and any Designator. Differences in requirements unique to a specific Designator are identified.

4.1.2 Burst Pressure
(a) Every rupture disk shall have a marked burst pressure established by the rules of 4.5.2 within a manufacturing design range at a specified disk temperature and shall be traceable by lot number. The manufacturing design range must be evaluated in conjunction with the specified burst pressure to ensure that the marked burst pressure of the rupture disk will always be within the limits of the agreed-upon requirement. Users are cautioned that certain types of rupture disks have manufacturing ranges that can result in a marked burst pressure greater than the specified burst pressure.
(b) For rupture disk devices with marked burst pressures up to and including 300 kPa (40 psi), the burst pressure tolerance at the specified disk temperature shall not exceed ±15 kPa (±2 psi); for devices with marked burst pressures above 300 kPa (40 psi), the burst pressure tolerance at specified disk temperature shall not exceed ±5%. For Section XII (TD Designator) devices, these tolerances apply unless other requirements are identified by the competent authority or by the Section XII Modal Appendices.

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

4.1.3.2 The rated flow capacity of a pressure relief system that uses a rupture disk device as the sole relieving device shall be determined by the user based on a value calculated in accordance with one of the following methods:
(a) Simple System Method. The simple system method may be used to determine the relieving capacity of a pressure relief system that includes a rupture disk device, provided the following conditions are met:
   (1) The pressure relief system that includes the rupture disk device discharges directly to the atmosphere.
   (2) The rupture disk device is installed within eight pipe diameters of the vessel nozzle entry.
   (3) The discharge piping downstream of the rupture disk device is not greater than five pipe diameters in length.
   (4) The nominal diameters of the inlet and discharge piping are equal to or greater than the marked DN (NPS) designator of the device.

   The calculated relieving capacity of the simple pressure relief system shall not exceed a value based on the applicable theoretical flow equation [see 9.7.6.4 and Mandatory Appendix IV] for the various media multiplied by a coefficient of discharge, K, equal to 0.62. The area, A, in the theoretical flow equation shall be the minimum net flow area as specified by the rupture disk device Manufacturer.
(b) Resistance-to-Flow Method. The calculated capacity of any pressure relief system may be determined by analyzing the total system resistance to flow. This analysis shall take into consideration the flow resistance of the rupture disk device; piping; and piping components, including the exit nozzle on the vessels, and elbows, tees, reducers, and valves. The calculation shall be made using accepted engineering practices for determining fluid flow through piping systems. This calculated relieving capacity shall be multiplied by a factor of 0.90 or less to allow for uncertainties inherent to this method. The certified flow resistance, KR, for the rupture disk device, expressed as the velocity head loss, shall be determined in accordance with Part 9.

4.1.3.3 The relieving capacity of a pressure relief system that uses a capacity-certified rupture disk device as the sole relieving device shall be determined based on the certified capacity marked on the device and the
4.2 DESIGN AND MECHANICAL REQUIREMENTS
(a) The design of the rupture disk device shall incorporate features necessary to ensure consistent operation and tightness.
(b) Rupture disk devices having threaded inlet or outlet connections shall be designed to allow for normal installation without damage to the rupture disk.
(c) Section VIII, Division 3 (UD3 Designator) rupture disk holders shall comply with the applicable requirements of Section VIII, Division 3, Part KD. Alternatively, it is permissible to design rupture disk holders in accordance with the rules in ASME B31.3, Chapter IX, provided that
   (1) the materials for the holder meet the requirements of 4.3.2
   (2) all components of the rupture disk device are outside of the geometric scope of Section VIII, Division 3 and are part of the external piping as defined in Section VIII, Division 3, KG-110

4.3 MATERIAL REQUIREMENTS
4.3.1 Disk Material
(a) The rupture disk material is not required to conform to a material specification listed in Section II.
(b) The rupture disk material shall be controlled by the Manufacturer of the rupture disk device by a specification ensuring the control of material properties.
(c) Rupture disks may be fabricated from either ductile or brittle materials.

4.3.2 Pressure-Retaining Parts
4.3.2.1 Materials used in pressure-containing or pressure-retaining holder components and pressure-retaining bolting shall be as permitted in Section II, Part D by the referencing Code. In addition, the following requirements apply:
   (a) Section VIII, Division 1 (UD Designator) pressure-containing or pressure-retaining holder components and pressure-retaining rupture disk holders and bolting shall meet all applicable requirements of Section VIII, Division 1, Subsection C.
   (b) Section VIII, Division 3 (UD3 Designator) pressure-containing or pressure-retaining holder components and pressure-retaining rupture disk holders and bolting shall meet all applicable requirements of Section VIII, Division 3, Article KM.
   (c) Section XII (TD Designator) pressure-containing or pressure-retaining holder components and pressure-retaining rupture disk holders and bolting shall meet all applicable requirements of Section XII, Part TM.
4.3.2.2 Other than as specified in 4.3.2.1, all parts required for the pressure-relieving or pressure-retaining function shall be of materials that are
   (a) listed in Section II, or
   (b) listed in ASTM specifications, or
   (c) controlled by the Manufacturer of the pressure relief device by a specification ensuring control of chemical and physical properties and quality at least equivalent to that of ASTM Standards

4.4 INSPECTION OF MANUFACTURING
4.4.1 General
(a) A Manufacturer shall demonstrate to the satisfaction of a representative from an ASME Designated Organization that the manufacturing, production, and testing facilities and the quality control procedures will ensure close agreement between the performance of random production samples and the performance of those devices submitted for certification.
(b) At the time of the submission of rupture disk devices for capacity certification or testing in accordance with 4.4.3, the representative of the ASME Designated Organization has the authority to review the device design for conformity with the requirements of 4.2 and 4.3, and to reject or require modification of designs that do not conform.
4.4.2 Verification
Manufacturing, assembly, inspection, and test operations are subject to inspections at any time by an ASME Designee.

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

4.4.3.1 Sample Selection
(a) Two production sample rupture disk devices of a size and capacity within the capability of an ASME accepted laboratory shall be selected by a representative of an ASME Designated Organization.
(b) If a Section VIII, Division 3 (UD3 Designator) rupture disk device incorporates a Manufacturer’s standard rupture disk holder from a different Manufacturer, two new rupture disk holders shall be procured by the rupture disk Manufacturer for use in the tests.

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

4.4.3.3 Test Results
(a) Should any device fail to meet or exceed the applicable performance requirements of this Section, the test(s) shall be repeated at the rate of two replacement devices, selected and tested in accordance with 4.4.3.1 and 4.4.3.2, for each device that failed.
(b) Should any of the replacement devices fail to meet the capacity or performance requirements of this Section, the Manufacturer shall determine the cause of failure and take corrective action to guard against future occurrence. This cause of failure and corrective action shall be documented and submitted to the ASME Designated Organization within 60 days of the failure or be cause for revocation of the authorization to use the Certification Mark on that particular type of device. Upon acceptance of the submitted corrective action by the ASME Designated Organization, the requirements of 4.4.3 shall apply.

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

4.5.1 Pressure Testing
(a) The pressure-containing parts of each rupture disk holder are subject to pressure testing.
(b) Except as specified in (c), a rupture disk holder part requiring pressure testing shall be tested either
   (1) hydrostatically at a pressure no less than 1.5 times the design pressure of the part, or
   (2) pneumatically at a pressure no less than 1.25 times the design pressure of the part
      CAUTION: Pneumatic testing can be hazardous; it is therefore recommended that special precautions be taken when conducting a pneumatic test.
(c) Devices to be marked with the Certification Mark and UD3 Designator shall be tested hydrostatically only, at a pressure no less than 1.25 times the design pressure and no greater than the pressure determined in accordance with Section VIII, Division 3, KT-312.
(d) Pressure testing may be done in the part or assembled condition.
Pressure testing shall be conducted after all machining and welding operations have been completed.

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

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

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

1. The stress that would be applied under hydrostatic test conditions does not exceed 50% of the allowable stress.
2. The holder is not cast or welded.

4.5.2 Burst Tests

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

(b) Test Methods

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

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

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

4.6 WELDING, BRAZING, HEAT TREATMENT, AND NONDESTRUCTIVE EXAMINATION

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

4.7 MARKING

4.7.1 General

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

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

Each rupture disk shall be marked with the following information:

(a) name of the Manufacturer, or an acceptable abbreviation thereof.
(b) Manufacturer’s design or type number.
(c) lot number.
(d) disk material.
(e) DN (NPS) size ______ of rupture disk holder, or nominal diameter, mm (in.), as applicable.
(f) marked burst pressure ______ kPa (psi).
(g) specified disk temperature ______ °C (°F).
(h) for capacity-certified devices, one of the following:
   (1) ______ kg/h (lbm/hr) of saturated steam at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for devices certified on steam.
   (2) ______ L/min (gpm) of water at 20°C (70°F) at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for devices certified on water.
   (3) ______ 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 (lbm/min) of air, at an overpressure of 10% or 20 kPa (3 psi), whichever is greater, for devices certified on air or gas. Devices that are capacity certified in accordance with the Section VIII, Division 1, UG-153(a)(3) shall be marked "at 20% overpressure." In addition to one of the fluids specified in (1) through (3), the Manufacturer may indicate the capacity in other fluids (see Mandatory Appendix IV).

(i) for flow-resistance-certified devices
   (1) minimum net flow area ___ 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).
PART 8

REQUIREMENTS FOR DEVICES IN COMBINATION

8.1 GENERAL
(a) The rules of this Part are applicable only when specified by the referencing Code or Standard.
(b) A non-reclosing pressure relief device in accordance with Part 4 or Part 5 used in combination with a pressure relief valve in accordance with Part 3 may be advisable on pressurized equipment subject to one or more of the following conditions:
   (1) The vessel contains substances that may render a pressure relief valve inoperative by fouling.
   (2) A loss of valuable material by leakage should be avoided.
   (3) Contamination of the atmosphere by leakage of noxious, flammable, or hazardous fluids must be avoided.

8.2 RUPTURE DISK DEVICE INSTALLED BETWEEN A PRESSURE RELIEF VALVE AND THE PRESSURIZED EQUIPMENT
A rupture disk device may be installed between a pressure relief valve and the pressurized equipment, provided the following conditions are met:
(a) The flow capacity of the combined pressure relief valve and the rupture disk device shall meet the maximum permissible overpressure requirements of the referencing Code or Standard.
(b) The combined capacity of the pressure relief valve (nozzle type) and rupture disk device shall be the rated capacity of the valve multiplied by a factor of 0.90. Alternatively, the capacity of such a combination shall be established in accordance with (c).
(c) The capacity of the combination of the rupture disk device and the pressure relief valve may be established in accordance with the appropriate paragraphs of 9.5.
(d) The space between the rupture disk device and the pressure relief valve shall be provided with a pressure gage, a try cock, free vent, or other suitable telltale indicator. This arrangement permits detection of disk rupture or leakage. For Section VIII, Division 3 (UD3 Designator) devices, in lieu of one of the previously mentioned indicators, the series combination can be provided with a second rupture disk device in parallel whose burst pressure is 116% of vessel design pressure. Users are warned that a rupture disk will not burst at its marked bursting pressure if back pressure builds up in the space between the disk and the pressure relief valve, which will occur should leakage develop in the rupture disk due to corrosion or other cause.
(e) The opening provided through the rupture disk after the disk bursts shall be sufficient to permit a flow equal to the capacity of the pressure relief valve [see (b) and (c)], and there shall be no chance of interference with proper functioning of the pressure relief valve; but in no case shall this area be less than the inlet area of the pressure relief valve unless the capacity and functioning of the specific combination of rupture disk device and pressure relief valve have been established by test according to 9.5.
(f) The use of a rupture disk device in combination with a pressure relief valve should be carefully evaluated to ensure that the media being handled and the valve operational characteristics will result in opening action of the valve coincident with the bursting of the rupture disk.
(g) The installation shall ensure that solid material will not collect in the inlet or outlet of the rupture disk; accumulation of such material could impair the relieving capacity of the relief system.
(h) Fragmenting-type rupture disks shall not be used upstream of a pressure relief valve.

8.3 RUPTURE DISK DEVICE INSTALLED ON THE OUTLET SIDE OF A PRESSURE RELIEF VALVE
A rupture disk device may be installed on the outlet side of a pressure relief valve, provided (a) through (i) are met. This use of a rupture disk device in series with the pressure relief valve is permitted to minimize leakage through the valve of valuable material or of noxious or otherwise hazardous materials, to accommodate the use of rupture