BS&B®

Catalog # 77-1006

Rupture Disks Combined with Safety Relief Valves

BSBsystems.com | BSB.ie

Visit our website for the most complete, up-to-date information

Instructions

The ASME Pressure Vessel Code permits the use of a rupture disk device at both a safety relief valve inlet and outlet. This combination, once considered a luxury, has proven itself to save money through:

- Zero process leakage to the atmosphere
- Longer periods between major valve overhauls
- Valves can be tested in place
- Less expensive trim material can be used
- Valve life is extended by isolating internal valve parts from corrosive environments

This bulletin has been published to give you the facts, the advantages, applications, and the ASME Code that governs rupture disks and safety relief valves.

Advantages of Rupture Disks Used in Combination with Safety Relief Valves

Zero Process Leakage to the Atmosphere - An important reason for isolating safety relief valves with rupture disks is to prevent the process from leaking into the atmosphere. On conventional safety relief valves, API Standard 526 states that for an orifice size of F and smaller, the maximum allowable leakage rate is 40 bubbles / minute (approximately 6 cubic feet per 24 hours). The rupture disk used at the inlet of the relief valve acts as a solid metal barrier between the process and the valve to eliminate leakage.

Allows Safety Relief Valves to be Tested in Place - When a rupture disk is used to isolate a safety relief valve, the set pressure of the valve can be tested in place. With a reverse buckling rupture disk installed at the valve inlet, the safety relief valve can be tested on the spot by one man with a portable pressure source. To accomplish this without shutting down the process, air or other suitable gas, is injected into the chamber between the rupture disk and the safety relief valve inlet. Pressure is increased until the operator hears the valve pop or simmer. Test pressure should not exceed 110% of the marked burst pressure of the disk.

Valve Life is Extended - Safety relief valve life extension is the third major advantage for using a disk / valve combination. The rupture disk acts as a solid metal barrier between the valve and the process. The disk prevents product buildup from adhering to mechanical components of the valve that otherwise would affect valve performance and safety of the system. Since the process media will not come in contact with internal surfaces and parts of the valve, it will remain in new condition until activated by an overpressure event.

Longer Periods Between Major Valve Overhauls - Because the valve internals are not normally exposed to process contamination, they remain in "like new" condition, allowing longer periods between major overhauls.

Less Expensive Valve Material Can Be Used - The large initial cost of the safety relief valve can be reduced by ordering the valves from less expensive metal and isolating it with a rupture disk. As an example, if a Hastelloy® valve is normally required, use a carbon steel valve with Hastelloy® rupture disk, with 65% savings (average). The savings will buy the rupture disk.

When to Use a Rupture Disk, Relief Valve Combination

Pressure relief systems protect life and property from dangerous overpressure events within process pressure systems, serving as an important safeguard in establishing a safe, Code compliant, industrial working environment.

Pressure relief valves, rupture disks, or combination of both, function as the pressure relief system, discharging excessive pressure. Individually, a rupture disk is an excellent choice for overpressure protection. However, a rupture disk / relief valve combination will sometimes be the unrivaled choice when:

1) A leak tight seal of the system is needed because the system contains a corrosive or hazardous substance and there is a concern that a relief valve may leak.

2) The system contains highly viscous substances that may clog the relief valve over time causing it to become inoperable. The installation of a rupture disk upstream serves as a barrier between the process and the relief valve.

3) Cost savings - BS&B rupture disks are 100% leak proof serving as a solid metal barrier between the valve and the process. The disk prevents product buildup from adhering to mechanical components of the valve. Since the process media will not come in contact with internal surfaces and parts of the valve, the valve will remain in new condition until called upon to activate.

Safety Relief Valve Isolation

BS&B recommends the Sta-Saf® lineup of reverse buckling rupture disks when isolating safety relief valves. Sta-Saf products cover most ranges of safety relief valve pressures ranging from 5 psig (0.34barg) to 2000 psig (138barg).

Sta-Saf disks offer the user a vacuum resistant, solid metal rupture disk designed for non-fragmentation and ultimate leak-tightness. Each Sta-Saf rupture disks is installed in a pre-torqued SRB-7RS safety head that allows the rupture disk to be removed from service, inspected, cleaned, and reinstalled without resetting the torque.

The following is a guide to selecting rupture disks for each application:

1. New Construction Valve Inlet Isolation

Sta-Saf system recommended: The Sta-Saf lineup of rupture disks are available in models: Sigma EXL, Sigma, SKR, SRD, RLS, JRS, FRS, S-90, and LPS depending on burst pressure required and service conditions. The disk and safety head fits between flanges, assuring correct installation by means of a J-bolt and disk centering pins.

Application Summary Chart		
Application	**Inlet**	**Outlet**
New construction	Sta-Saf	AV Disk or Sta-Saf
Retro free vent	Sta-Saf	AV Disk or Sta-Saf
Retrofit fixed	SVI	AV Disk or Sta-Saf
Outlet piping	SVI	AV Disk or Sta-Saf
Liquid service	Sigma, RLS, SK_R, LPS	AV Disk or Sta-Saf

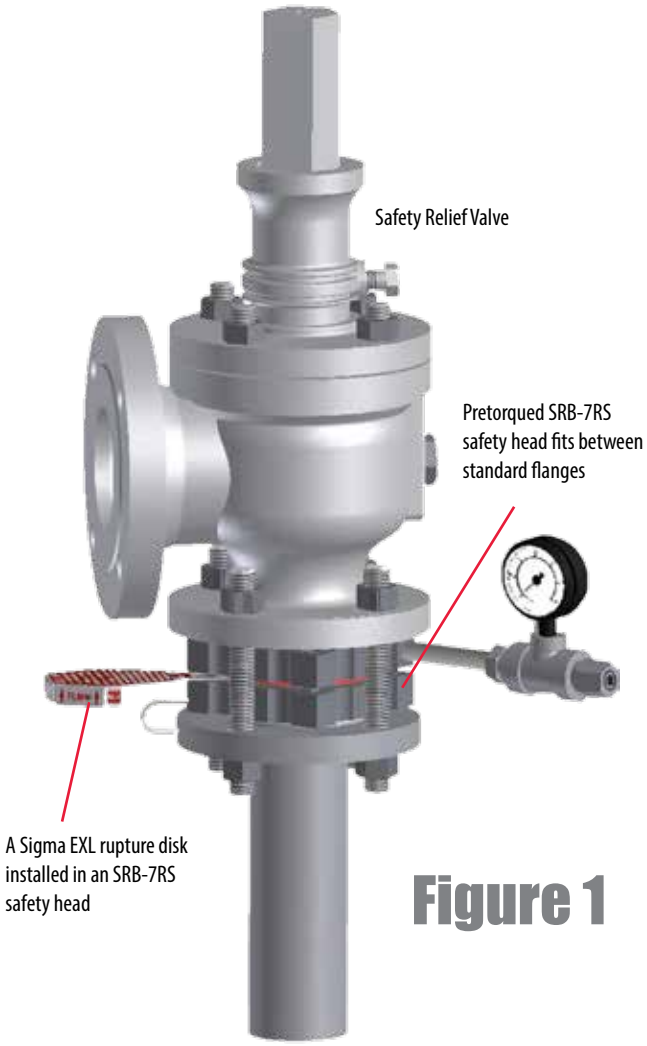


Figure 1

Figure 2

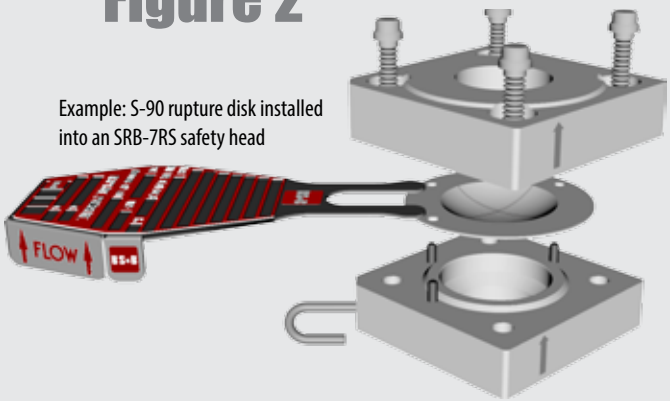
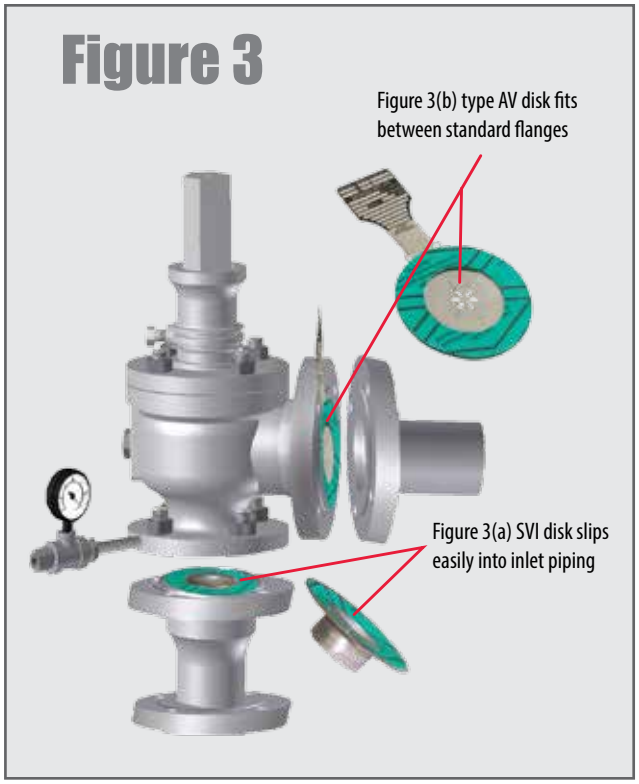


Figure 2: The S-90 rupture disk is one of eight rupture disk models within the Sta-Saf family including three safety heads that provide the user a multitude of options for isolating safety relief valves. Standard features of the Sta-Saf family include:

- Sizes from 1 to 40 inches (25 to 1000mm)
- Up to 95% operating ratio
- Pressures from 5 to 2,000 psig (0.7 to 138 barg)
- Vacuum resistant
- Solid metal, leak-tight construction
- Designed for non-fragmentation
- Models for all process environments
- Saf (structural apex forming) technology



2. Retrofit - Inlet to Valve (gas / vapor service)

For isolating safety relief valves already in service with rigid discharge piping, the SVI rupture disk assembly is recommended (figure 3a). The SVI is a reverse buckling S-90 rupture disk welded into a one piece metal assembly. Supplied with affixed gasket for immediate assembly, the SVI easily slips into the inlet piping. Advantages include:

- No safety head required
- Fits into inlet piping
- Non-fragmentation
- Available in sizes 1.5 to 8 inches (40 to 200mm)

3. New Constructions or Retrofit Valve Outlet Isolation

With tighter EPA regulations causing safety relief valves to be manifolded rather than discharged to the atmosphere, it is important to isolate the safety relief valve outlet (as well as the inlet) with a rupture disk to prevent "backflow" corrosion.

The type AV low pressure rupture disk is the perfect fit for the job (figure 3b). The AV disk requires no safety head, comes with affixed gasket and fits between standard flanges (figure 3b). Advantages for valve outlet isolation:

- Low burst pressures available
- Bursts at equal pressure in both directions (1:1 ratio)
- Cannot be installed wrong, both sides are identical
- Available in sizes 2 to 72 inches (50 to 1800mm)

Application Considerations

To better understand the use of rupture disks to isolate safety relief valves, compare the advantages and disadvantages of each relief device.

Safety Relief Valve

- Metal seated valves leak – loss of products as well as pollution of the atmosphere
- High cost
- High maintenance required – since the process goes through the valve, it must be checked periodically for correct operation. The system must be shut down
- Adjustable
- Recloses after pressure relief

Rupture Disk

- Leak tight
- Low cost
- Low maintenance required
- Fixed setting
- Non-reclosing
- Disposable – must be replaced after each operation

Rupture Disk / Safety Relief Valve Combination

- Leak-tight
- Moderate cost
- Medium maintenance required
- Adjustable
- Recloses after pressure relief
- Valve is reusable, disk is disposable

The BS&B rupture disk metal tab (pictured to the right) shows stamped lot number, disk size, and rated rupture pressure at temperature.

BS&B rupture disks are manufactured in accordance with the requirements of international codes and standards when specified including: ASME Section VIII (UD stamped) and Section III and EU Pressure Equipment Directive (CE marking EN 4126-2: Bursting disk safety devices).

ASME Pressure Vessel Code Section VIII, Division 1, 2015 Edition:

Rupture Disks and Safety Relief Valves Defined

UG-126: Pressure Relief Valves[45]

(Meeting the Requirements of ASME CODE, 2015 Section VIII - Division 1)

(a) Safety, safety relief, and relief valves shall be of the direct spring loaded type.

(b) Pilot operated pressure relief valves may be used, provided that the pilot is self-actuated and the main valve will open automatically at not over the set pressure and will discharge its full rated capacity if some essential part of the pilot should fail.

(c) The set pressure of a pressure relief device shall not be adjusted outside the range of set pressure specified by the device manufacturer. The initial adjustment shall be performed by the Manufacturer, his authorized representative, or an Assembler, and a valve data tag shall be provided that identifies the set pressure capacity and date. The valve shall be sealed with a seal identifying the Manufacturer, his authorized representative, or the Assembler performing the adjustment.

(d) The set pressure tolerances, plus or minus, of pressure relief valves shall not exceed 2psi (15kPa) for pressures up to and including 70 psi (500kPa) and 3% for pressures above 70 psi (500kPa).

UG-127: Nonreclosing Pressure Relief Devices
(a) Rupture Disk Devices[46]

General. Every rupture disk shall have a marked burst pressure established by rules of UG-137 (d)(3) within a manufacturing design range[47] at a specified disk temperature[48] and shall be marked with a lot[49] number. The burst pressure tolerance at the specified disk temperature shall not exceed +2 psi (+ 15kPa) for marked burst pressure up to and including 40 psi (300 kPa) and + 5% for marked burst pressure above 40 psi (300kPa).

Footnotes to ASME Code

[45] A safety valve is a pressure relief valve actuated by inlet static pressure and characterized by rapid opening or pop action. A relief valve is a pressure relief valve actuated by inlet static pressure which opens in proportion to the increase in pressure over the opening pressure. A safety relief valve is a pressure relief valve characterized by rapid opening or pop action, or by opening in proportion to the increase in pressure over the opening pressure, depending on application. A pilot operated pressure relief valve is a pressure relief valve in which the major relieving device is combined with and is controlled by a self-actuated auxiliary pressure relief valve.

[46] A rupture disk device is a nonreclosing pressure relief device actuated by inlet static pressure and designed to function by the bursting of a pressure containing disk. A rupture disk is the pressure containing and pressure sensitive activation component of a rupture disk device. Rupture disks may be designed in several configurations, such as plain flat, prebulged, or reverse buckling. A rupture disk holder is the structure that encloses and clamps the rupture disk in position.

[47] The manufacturing design range is a range of pressure within which the marked burst pressure must fall to be acceptable for a particular requirement as agreed upon between the rupture disk manufacturer and the user or his designated agent. 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 applicable limits of UG-13 4. 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.

[48] The specified disk temperature supplied to the rupture disk manufacturer shall be the temperature of the disk when the disk is expected to burst.

[49] A lot of rupture disks is those disks manufactured of a material at the same time, of the same size, thickness, type, heat, and manufacturing process including heat treatment.

Meeting ASME Code Capacity of Combination

In order to meet the ASME code, the capacity of the combination of the safety relief valve and rupture disk must be determined one of two ways:

A) Flow test the combination to arrive at a "certified combination capacity factor". Testing must be done in accordance with Paragraph UG-132 and approved by the National Board of Boiler and Pressure Vessel Inspectors.

Rupture disk / relief valve combinations with flow tests will be allowed a relieving capacity of the valve multiplied by a correction factor obtained from actual flow tests of the rupture disk/relief valve combination.

The combination capacity factor shall be used as a multiplier to derate the ASME rated relieving capacity of the safety relief valve in all sizes of the design.

Refer to BS&B Catalog 77-1006A for "Combination Capacity Factors"

B) UG-127(a)(3)(b)(2), In lieu of testing, a factor of 0.90 must be applied to the capacity of the relief valve.

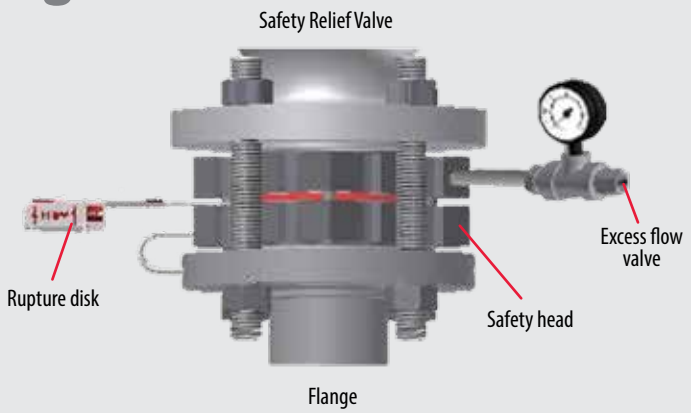
Rupture disk / relief valve combinations, which have not been flow tested as a combination, must be rated in allowable relieving capacity to 90% of the rated relieving capacity stamped of the valve.

Note: *If a rupture disk device is to be used with a relief valve, then an additional nameplate must be installed on the relief valve or safety head. The nameplate must show the valve type, the disk holder type, the type of disk and the flow capacity of the combination, UG-129 (c).*

Meeting ASME Code: Arrangement of Piping

ASME Code requires that the space between a rupture disk device and a safety relief valve be provided with a pressure gauge, tricock, free vent or suitable telltale indicator, UG-127(a)(3)(b)(4).

Figure 4



A typical piping arrangement is shown in figure 4. The telltale indicator consists of a pipe nipple, tee, an excess flow (flow check valve), and pressure gauge. The outlet side of the excess flow valve has a threaded connection. If free venting is not desirable, a discharge line can be installed to permit dispersion of product to a safe location.

After the relief system has been operated by pressure and the safety relief valve reseats, the prevailing line pressure will force the ball in the excess flow valve to its seat. This permits the line pressure to be indicated on the gauge. After a replacement disk is installed, the chamber between the disk and relief valve is again voided of pressure and gauge reading is at zero.

Another common method is to use a pressure switch instead of a pressure gauge. If pressure builds above the disk cavity, it sets off an alarm device at the site or at a remote location. This pressure increase could be leakage allowing pressure buildup above the disk and thus increasing the pressure required to burst the rupture disk. It could also be caused by the rupture disk bursting.

If a closed system is used with pressure gauge, tricock or other types of telltale indicators, the relief system is then dependent upon a visual or manual check to determine if pressure is present in the cavity between the two relief devices elevating the burst pressure of the disk.

Meeting ASME Code: Rupture Disks Installed on the Outlet (Discharge) Side of the Valve

UG-127

A rupture disk device may be installed on the outlet side[54] of a pressure relief valve which is opened by direct action of the pressure in the vessel provided:

(1) the pressure relief valve will 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. [55]

(2) the pressure relief valve is ample in capacity to meet the requirements of UG-125(c);

(3) the marked burst pressure of the rupture disk at the specified disk temperature plus any pressure in the outlet piping shall not exceed the design pressure of the outlet portion of the pressure relief valve and any pipe or fitting between the valve and the rupture disk device. However, in no case shall the marked burst pressure of the rupture disk at the specified disk temperature plus any pressure in the outlet piping exceed the maximum allowable working pressure of the vessel or the set pressure of the pressure relief valve.

(4) the opening provided through the rupture disk device after breakage is sufficient to permit a flow equal to the rated capacity of the attached pressure relief valve without exceeding the allowable overpressure;

(5) any piping beyond the rupture disk cannot be obstructed by the rupture disk or fragment

(6) the system is designed to consider the adverse effects of any leakage through the pressure relief valve or through the outlet side rupture disk device, to ensure system performance and reliability. [56]

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

Footnotes to ASME Code

[54] This use of a rupture disk device in series with the pressure relief valve is permitted to minimize the loss by leakage through the valve of valuable or of noxious or otherwise hazardous materials, and where 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.

[55] 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.

[56] Some adverse effects resulting from leakage may include obstructing the flow path, corrosion of pressure relief valve components, and undesirable bursts of the outlet side rupture disk.

Edmonton, AB Canada
T: +1 780 955 2888
F: +1 780 955 3975
E: contacts@bsbprocess.com

Tulsa, OK USA
T: +1 918 622 5950
F: +1 918 665 3904
E: sales@bsbsystems.com

Minneapolis, MN USA
T: +1 952 941 0146
F: +1 952 941 0646
E: sales@bsbipd.com

Houston, TX USA
T: +1 713 682 4515
F: +1 713 682 5992
E: sales@bsbsystems.com

Monterrey, Mexico
T: +011 52 81 1958 0560
F: +011 52 81 1958 0560 138
E: sales@bsbsystems.com

Sao Paulo, Brasil
T: +55 11 2084 4800
F: +55 11 2021 3801
E: sales@bsbbrasil.com

BS&B®

AN ISO 9001 CERTIFIED COMPANY

ASME UD

CE

BSBSystems.com

Visit our website for the most complete, up-to-date information

Manchester, UK
T: +44 0 161 955 4202
F: +44 0 161 870 1086
E: sales@bsb-systems.co.uk

Limerick, Ireland
T: +353 61 484700
F: +353 61 304774
E: sales@bsb.ie

Moscow, Russia
T: +7 495 747 5916
F: +7 499 133 4394
E: sales@bsbsystems.ru

Seoul, Korea
T: +82 (2) 3782 4500
F: +82 (2) 3782 4555
E: sales@bsbsystems.kr

Shanghai, China
T: +86 21 6391 2299
F: +86 21 6391 2117
E: sales@bsbsystems.com

Düsseldorf, Germany
T: +49 211 930550
F: +49 211 3982171
E: info@bormann-neupertbsb.de

The Netherlands
T: +31 70 362 2136
F: +31 70 360 4724
E: info@bsbsystems.nl

Yokohama, Japan
T: +81 45 450 1271
F: +81 45 451 3061
E: information@bsb-systems.co.jp

United Arab Emirates
T: +971 (0) 55 518 0314
T: +971 (0) 55 518 0916
F: +971 (0) 2 558 9961
E: sales@bsbsystems.ae

Singapore
T: +65 6513 9780
F: +65 6484 3711
E: sales@bsb.com.sg

Chennai, India
T: +91 44 2450 4200
F: +91 44 2450 1056
E: sales@bsbsystems.com

BSB.ie