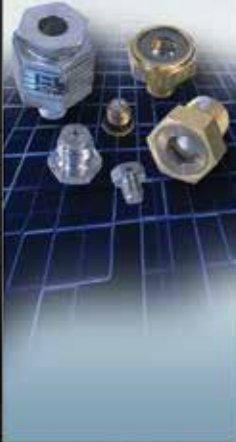




**RUPTURE DISK DEVICES**



**CUSTOM ENGINEERED PRODUCTS**



**SPECIALTY VALVES**



**INDUSTRIAL EXPLOSION PROTECTION**



**PROCESS SYSTEMS**



**FLAME ARRESTERS**



# CORPORATE PROFILE



## **A History Defined by Innovation**

The BS&B® story began over 120 years ago at the dawn of the modern energy industry in the United States. A.H. Black observed the costly and unsafe storage of oil in open earthen pits and developed the industry's first fabricated oil storage tanks. These tanks were in such demand that Black partnered with Jim Sivalls and W.G. Bryson. That successful Black, Sivalls & Bryson partnership gave rise to the "BS&B" name.

The BS&B commitment to innovative engineering continued over the ensuing decades to make possible the growth of the oil and gas processing industry. The BS&B name is well known for the innovative design of separators, dehydrators, heaters, treaters and other process equipment integral to the industry's safe and efficient operations.

Research and development efforts resulted in innovations that extended well beyond the oil and gas equipment industry. The invention of the world's first rupture disk (bursting disc) in 1931 provided a safe and reliable pressure relief mechanism to not only protect such equipment, but also a means to provide for personal protection against dangerous over pressurizations and damaging vacuum conditions.

The year 1966 brought the invention of the reverse buckling rupture disk, which offers superior resistance to operating conditions, greater accuracy and reliability. With our development of the scored reverse buckling disk in 1972, the combination of rupture disk devices with pressure relief valves was born. Changing from a perfect seal to a full open flow area in milliseconds, the rupture disk compliments the reclosing characteristics of relief valves, enhancing pressure relief system reliability, particularly for owners and operators of hazardous and toxic materials processing and storage facilities.

With the growth in processing and handling of dry plastic materials in pellet and powder form, together with the large scale processing of dry agricultural products, BS&B rupture disk technology was further developed to achieve the large relief areas and low set pressures required for explosion venting of combustible dust hazards. With the development of explosion suppression technology in 1993, BS&B protects the dry materials industries, from chemicals to foods, and from pharmaceuticals to power generation.

Continuing the rich history of BS&B innovation, the Buckling Pin Relief Valve (BPRV™) was invented in 1995 and further developed to achieve ASME and CE certification in 2005. Designed to protect large piping systems from overpressure, the BPRV™ is the safety solution for the API compliant flare systems used by the oil and gas industries, marking a return to our technology roots.

BS&B technology is all around you, in transportation systems, power generation, transmission and distribution systems, medical equipment, chemical and pharmaceutical process plants, as well as the food and beverage industries. Where innovation is present, you will find BS&B technology.

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The goal of the BS&B companies is to exceed industry standards in quality, design, safety and performance through innovation.

## Rupture Disk Devices

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BS&B provides application choices with the industry leading range of reverse buckling, forward acting, and graphite rupture disk devices. Within each of these three technology groups are further choices to attend to each of the users specific application needs. Additional specialty designs provide protection for sanitary / aseptic systems and transportation equipment.

## Custom Engineered Products

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BS&B serves original equipment manufacturers (OEM) as well as the defense and aerospace industries with both standard and custom overpressure relief solutions configured to perform accurately and efficiently. An unrivaled range of rupture disk technology satisfies applications from low pressure to over 50,000 psig (3,500barg). The technology trinity of FRB, QRB, and MRB reverse buckling disks provides superior performance where compact dimensions are required. From a single custom designed component to high volume applications, our design experience and manufacturing support capabilities are ready to meet your challenge. Over 200 million installations and growing.

## Specialty Valves

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The BS&B specialty valve technology is focused on providing the highest flow capacity available from both in line and angle valve devices. BS&B Buckling Pin valves are fast acting / quick opening pressure relief devices that offer rapid and easy field reset, dramatically reducing plant downtime after activation. The 60 inch (1,500mm) BPRV™ (page 125) is the world's largest ASME certified pressure relief device. Custom designed spring loaded pressure relief valves compliment the BS&B specialty valve range.

## Industrial Explosion Protection

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At BS&B, we have the most practical safety solutions for combustible dust processes. Designing client application solutions, BS&B enables users to achieve compliance with NFPA, OSHA and ATEX standards while maintaining process throughput and economy. With the widest range of explosion protection, flameless venting, isolation and suppression, BS&B provides the most complete options to the end user.

## Process Systems

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BS&B Process Systems and Black, Sivalls & Bryson provide leading technology and innovation in the oil and gas processing equipment market. We are a leading global supplier of equipment and systems to the international oil, gas, refining and chemical processing markets. Our engineers combine a technology legacy and current know-how to provide a comprehensive portfolio of products and services that exceed customer and industry standards for quality and reliability. Our customized, integrated solutions are time and field tested to efficiently deliver maximum value, safety and control.

## Flame Arresters and Breather Vents

16-17

BS&B FlameSaf is dedicated to protecting industrial plants and personnel from the dangers of explosion and fire propagation typically in hydrocarbon service. FlameSaf™ arresters protect from both deflagration and detonation conditions with product certified to EN / ISO 16852: 2010 and are complimented by a range of pressure and vacuum breather vents.



# Our Core Values



## Innovation

We grow by being first with innovative products, solutions and services that are valued by our customers. Our employees pursue ingenious solutions in their roles and responsibilities.

## Reliance

Our customers rely on us to deliver the best solutions and services. Our employees do the right thing and act with integrity, depending on each other working towards the success of the team and the company.

## Excellence

We are committed to delivering high quality solutions and services that exceed expectations. We strive to be the best in everything we do through continuous improvement.

## Respect

We inspire trust in our employees and gain trust from our customers by saying what we mean, matching our actions to our words.

## High Quality Manufacturing

The BS&B companies have facilities throughout the world, offering more than a million square feet (100,000 square meters) of manufacturing, research and development facilities, and office space dedicated to the production and support of quality over-pressure protection devices and process equipment.

BS&B manufacturing facilities have achieved the prestigious ISO 9001 certification by passing a series of independent audits, proving the companies have modern, quality control systems to help ensure that consistent, quality products are provided to the marketplace. The ISO 9001 audits assess all of our companies' systems that affect quality; from the ordering of raw materials to the manufacturing, testing and final distribution of our products. What this means to you is that BS&B companies conform to established international standards of quality. You can rest assured that any product that bears the BS&B name has passed a rigorous set of tests and meets the highest industry standards.



## Codes and Standards

The BS&B companies are the world leaders in the design and manufacture of non-reclosing pressure relief devices. The BS&B companies set the standards in the pressure relief industry. BS&B has been responsible for originating patents on all rupture disk designs and continues its commitment to innovation.

BS&B pressure relief devices are manufactured in conformance with the requirements of the following international codes and standards:

- ASME Sections VIII and III (UD stamped) - USA
- EC Pressure Equipment Directive (CE marked) - European Union
- Canadian Registration (CRN marked) - Canada
- EN / ISO 4126-2 - Europe / International
- EN / ISO 16852:2010 (flame arresters) - Europe / International
- EN / AS 9100 (aerospace)
- TUV AD Merkblatt A1 - Germany
- SVTI - Switzerland
- Stoomwezen - The Netherlands
- ISO 9001 - International
- MLSE / GB567-2012 - China
- GOST - Russia
- KOSHA - Korea
- ISO / TS1694 - International
- ISO 14001 - Europe
- KGSC - Korea





## Meeting Your Needs

BS&B products are present in every industry that produces the material items used daily by billions of people. From its many global manufacturing locations, BS&B's diversity of business ranges from directional drilling system suppliers to outer space, and everywhere in between. BS&B leads in design, quality and manufacturing capability, and above all, innovation.



## Environmental, Health and Safety

BS&B companies are certified under the international environmental standard ISO 14001. To achieve certification, BS&B processes underwent rigorous performance reviews in regards to environment standards. ISO 14001 requires that an organization monitor and continually improve its performance. The standard encompasses all of the environmental effects of a manufacturing site, including energy use, water treatment, waste disposal, noise and air quality.



## Training and Technical Service

BS&B provides a network of technical service and educational opportunities to enhance customer product knowledge, technical competencies, and diagnostic capabilities with respect to overpressure relief and pressure protection technology.



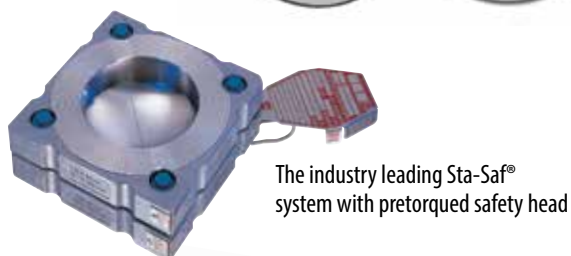
# Rupture Disk Devices

Rupture disks (bursting disks) are non-reclosing, pressure relief devices that activate at a specified pressure and temperature. They may be used as stand-alone pressure relief devices, or in parallel or in series with safety / pressure relief valves. Rupture disks are available in a variety of materials including nickel based alloys (stainless steel, nickel 200, alloy 400 and alloy 600) as well as exotic elemental metals such as tantalum, niobium, silver, platinum and gold.

The rupture disk device typically consists of a pressure sensitive disk element and a safety head (holder) that clamps the disk into place in the piping system, although some disk designs may be installed directly between pipe flanges or fittings without a holder. In addition to the vast material options, rupture disks are available for flanged piping applications in sizes 1/2 through 72 inches (15 through 1800mm) and at pressures from 4 inches water column (10mBar) to over 100,000 psig (6,900barg). The BS&B companies have disk designs for industrial process, sanitary / aseptic pharmaceutical and biotech and highly viscous process media applications. The broad range of rupture disk products offered by BS&B for gas, vapor, liquid and multi-phase flow is unrivaled in the industry.



Reverse buckling disks



Forward acting rupture disks



## Applications Engineering

The BS&B companies' global network of sales offices, distributors and representatives partner with customers to assist in the selection of the best overpressure protection solutions to their unique application requirements. In addition to the basic specification details related to burst pressure and coincident temperature, size and material, other application parameters are evaluated to ensure the most appropriate safety systems are provided.



Application parameters include service phase, frequency and magnitude of pressure cycles, vacuum / back pressure, vibration and operating margin. To satisfy the diverse array of application requirements, the BS&B companies have developed the most comprehensive product line in the industry. This breadth of products includes forward acting / tension-loaded and reverse buckling / compression-loaded, metal bursting disks as well as graphite bursting disks for highly corrosive service media applications.

The list of "industry firsts" is dominated by BS&B technology since the invention of the rupture disk. When no existing technology can fully satisfy a customer or industry requirement, BS&B sets the global standard for innovation, developing tailored solutions to meet those requirements.



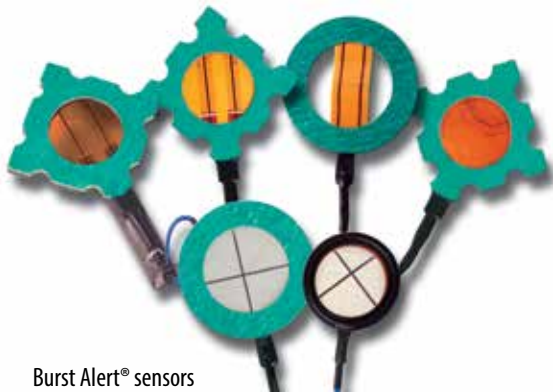
## Service

The BS&B companies offer training services to assist process and maintenance engineers in the proper selection, specification and use of rupture disk devices according to applicable international codes and standards. BS&B offers a variety of other services to assist with the compliance and safety of customer partners. These services include Advanced Maintenance Workshops for pipefitters and mechanics responsible for the installation and servicing of rupture disk devices as well as installation supervision, pressure relief device audits / surveys and PRD (pressure relief device) code compliance audits. BS&B's engineers and field service technicians stand ready to support you.

BS&B®



## Additional Products



Burst Alert® sensors

Supporting the rupture disk devices, BS&B companies offer a complete range of wired and wireless sensor and monitor options as well as exclusive technologies that are designed to predict when a rupture disk should be replaced. These instrumentation accessories are used with rupture disks to provide immediate notification of pressure relief events and may be interfaced with other control systems to activate alarms and process response activities. Our predictive maintenance technology is designed to assist our customers in replacing rupture disks on a preventive maintenance basis before activation, avoiding costly and possibly hazardous unscheduled outages. The integrity of the pressure relief system can be monitored using these exclusive tools to maximize the productivity and reliability of plant processes.

## Inventory Management

The BS&B companies have perfected inventory management (vendor managed inventory) with the long established BS&B Inventory Management Systems (BIMS) program. Over 350 facilities around the world have subscribed to the BIMS program, which is designed to help plants control costs and manage critical spares inventory, and to ensure continuity of supply and the most efficient, cost effective means of procuring rupture disks and related products. What started in 1988 as a simple inventory management program has developed into a sophisticated, tailored approach, customized to the unique requirements of every subscriber account. Productivity, safety, service and reliability are the primary objectives of the BIMS team, and the delivery of innovative cost reduction strategies is the commitment to every customer who partners with BIMS.



# Custom Engineered Products

Solutions for Original Equipment Manufacturers (OEM), Aerospace and Energy Industries

BS&B fast tracks customer projects by the efficient use of standard building blocks of rupture disk technology. Many custom engineered product solutions are in the form of an assembly that permanently combines the rupture disk and holder device, ready for use. Whether created by welding, screw thread connection or custom fitting, a rupture disk assembly provides the highest performance at the best cost. BS&B will help you define your rupture disk assembly needs whether for a single custom designed component or for thousands of competitively priced units. Our design and manufacturing experience is put to work to meet your challenge.



Image reprint with permission from Chart®

## Capabilities

At the heart of our custom engineered products are a proven family of rupture disk designs, developed to achieve the wide range of sizes and burst pressures and to support the operating conditions demanded by the OEM, aerospace and energy industries.

## Rupture Disk Application Solutions

Rupture Disk Type	FRB™	QRB™	MRB™	XT™
<b>Standard sizes</b>	1/8, 1/4, 3/8, 1/2 and 3/4 inch (3, 6, 9, 12 and 19mm)	1/4, 3/8, 1/2 and 3/4 inch (6, 9, 12 and 19mm)	1/4, 3/8, 1/2, 3/4, 1 through 8 inches (6, 9, 12, 19, 25 through 200mm)	1/4, 3/8, 1/2, 3/4, 1 through 8 inch (6, 9, 12, 19, 25 through 200mm)
<b>Burst pressure</b>	15 to 1,000 psig (1 to 67bar)	350 to 16,000 psig (24 to 1,100bar)	1,500 to 70,000 psig (100 to 4,660bar)	50 to 30,000 psig (3.3 to 2,000bar)
<b>Operating ratio</b>	85%	90%	90%	80%
<b>Vacuum resistant</b>	Yes	Yes	Yes	Yes
<b>Back pressure resistance</b>	To 15 psi (to 1bar)	Variable, up to 1.25 times burst pressure	Up to 1.5 times burst pressure	To 15 psi (to 1bar)
<b>Fragmentation</b>	No	No	Yes - 1 large piece	No

Rupture Disk Type	B, BV	D, DV	OTR™
<b>Standard sizes</b>	1/4, 3/8, 1/2, 3/4, 1 through 8 inch (6, 9, 12, 19, 25 through 200mm)	1/4, 3/8, 1/2, 3/4, 1 through 8 inch (6, 9, 12, 19, 25 through 200mm)	11/16 inch (17mm) 24UNEF-21 male thread rupture disk welded to body
<b>Burst pressure</b>	55 to 50,000 psig (1,000 for BV) (4 to 3,516 barg (70 for BV)	150 to 1,000 psig (10 to 70 barg)	1,000 to 14,500 psig (70 to 1,000 barg)
<b>Operating ratio</b>	70%	80%	95%
<b>Vacuum resistant</b>	Yes	Yes	Yes
<b>Back pressure resistance</b>	To 15 psi (to 1bar)	Variable, up to 1.25 times burst pressure	Up to 1.5 times burst pressure
<b>Fragmentation</b>	Yes	Yes	No



The above tables are intended to provide snapshots of our capabilities. Detailed design and performance information is provided in the following pages, on our corporate website and by consultation with BS&B with respect to your specific application. Where larger sizes are called upon, all of BS&B's rupture disk technology in nominal sizes 1 through 72 inches (25 through 1,800mm) can be deployed as a custom assembly.



## Special Requirements

BS&B companies support many industries often requiring special performance testing. Whether for design type approval or ongoing supply, special testing is a part of BS&B's customer support program. Examples include:

- Leak testing; bubble, liquid penetrant, helium mass spectrometer
- Pressure decay
- Proof pressure testing; gas or liquid
- Pressure cycle testing
- Temperature testing; cryogenic through high temperature
- Serialized identification, AQA™ (Advanced Quality Assurance) - international patents pending
- Dimensional inspection; traditional metrology or CMM
- PMI (positive material identification)
- Flow resistance testing (ASME PTC 25 method)

This area of BS&B's expertise is constantly evolving. For requirements not listed, just ask!



## Specification

The starting point for all custom engineered pressure relief products is to define the following parameters:

- Burst pressure
- Operating pressure and fluctuations
- Operating temperature and fluctuations
- Required relief area / opening area
- Preferred materials
- Mounting dimensions or design footprint

With BS&B's wide range of rupture disk technology, there are typically several design and performance options available. Our experts are on hand to assist with the best fit among performance, timing and budget considerations.

Inconel®, stainless steel and nickel are the most widely employed materials for custom engineered rupture disk products, and Inconel® is often favored for the stability of burst pressure over a wide range of temperature that it can uniquely

## Materials

- Stainless steel
- Nickel
- Monel® alloy 400
- Inconel® alloy 600 and alloy 625
- Hastelloy® alloy C276
- Titanium
- Tantalum
- Aluminium

*Hastelloy is a trademark of Haynes International Inc. Monel and Inconel are trademarks of Huntington Alloys Corporation*

provide. Holder components made from brass or stainless steel are most typically selected by customers. A considerable percentage of BS&B's product output is manufactured from custom materials. Please ask us if the material you wish to use is not listed above.

## Quality Assurance

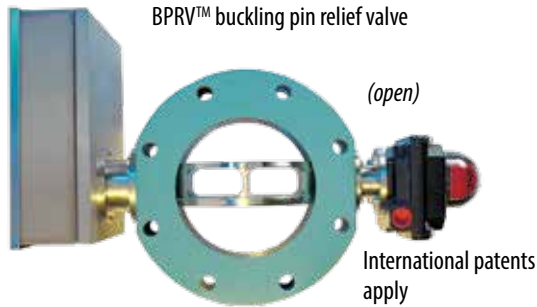
All BS&B custom engineered products are manufactured and tested within ISO 9001 certified facilities. Depending upon the industry that we are supporting, additional standards are met, including:

- Aerospace, AS9100
- Automotive TS16949
- Nuclear ASME section III
- Pressure vessels ASME code stamp and European Pressure Equipment Directive
- CE marked

## Commitment to Excellence

While BS&B's products are often small in size, their contribution to safety and science ranges from space programs past and present, to vehicle protection systems, and the safety of the energy industry from exploration of fossil fuels to renewable power systems. Whether providing a single custom engineered product, building a few hundred simple threaded assemblies or embarking upon a journey to supply millions of items, the commitment to innovation and excellence is reflected in our people and our products.

# Specialty Valves



## Buckling Pin Pressure Relief Devices

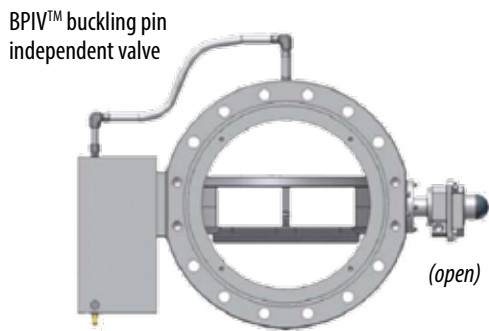
The BS&B companies produce fast acting / quick opening buckling pin activated pressure relief devices (inline and angle discharge) designed to protect personnel, equipment and the environment from the dangers of overpressure. Buckling pin pressure relief devices combine the accuracy of rupture disks with the ability to be 'field-reset' while remaining installed after an overpressure event.

## BPRV™ Buckling Pin Relief Valve

The BPRV offers the highest flow capacity and convenient inline installation. After activation, the valve is manually reclosed and the pin replaced while the valve remains bolted between pipe flanges. This dramatically reduces plant downtime and personnel exposure. The pin is accessible in a lockable enclosure containing the BPRV mechanism. Valve sizes range from 2 inches (50mm) to 60 inches (1525mm).

## Innovation

BS&B's 60 inch (1500mm) BPRV, first released in 2007, is the world's largest ASME certified pressure relief device. Where variable back pressure is a concern, BS&B provides the BPIV™ (Buckling Pin Independent Valve) which is also available ASME certified. Both the BPRV and BPIV are available CE marked.



*Buckling Pin Relief Valve installed as inline bypass to control valve on a gas flare system*

## Features and Benefits

Buckling pin pressure relief devices provide practical technology for the protection of applications containing one or more of the following conditions:

- Continuous processing (fast reset in the line)
- Hazardous service (limits operator exposure)
- Large line size (convenient reset in the line)
- High flow capacity
- Inaccessible location (external reset in the line)
- High operating pressure to set pressure ratio
- Sizes from 1 inches (25mm) to 60 inches (1500mm)
- Cryogenic design available
- ASME "UD" stamped, section VIII, division 1
- European Pressure Equipment Directive "CE" marked
- Back pressure independent options available (BPIV model)

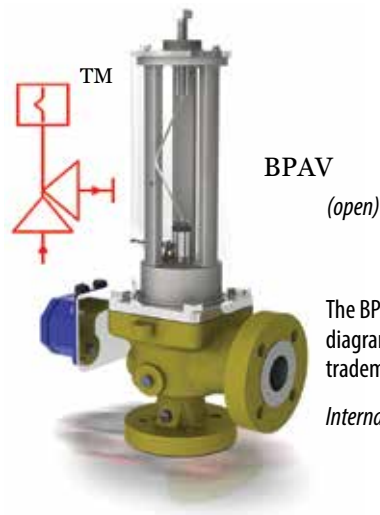
## BPAV™ Buckling Pin API-Series Valve

The BS&B BPAV valve set pressure is controlled by a precision buckling pin that is calibrated to respond to the forces generated by inlet pressure acting on the valve plug. When the pin activates, the valve plug lifts to achieve a full diameter flow area. The BPAV valve has a soft seat. Standard valve materials are carbon steel and stainless steel for process contact components. Special materials are available upon request.

- The first API-526 piping configuration buckling pin valve
- 1 x 1.5 inches (25 x 40mm) to 8 x 10 inches (200 x 250mm) size range
- Full bore relief for maximum flow capacity; 0.8 coefficient of discharge /  $K_d = 0.8$  for gas,  $K_d = 0.686$  for liquid
- Fast acting
- Set pressure independent of back pressure, suitable for variable back pressure applications
- Operable to 90% of set pressure - no simmering
- Suitable for gas, liquid and two-phase flow
- Higher flow capacity than equivalent sized relief valve
- ANSI / ASME - EN / DIN - JIS flange compatibility
- ASME "UD" stamped, section VII, division I
- Pressure Equipment Directive "CE" marked

### Benefits

- Direct replacement of API series relief valves - no piping modifications
- Capacity of the BPAV exceeds the largest API size orifice per line size -  $K_d = 0.8$  - ideal solution for brown-field projects ; 0.686 for liquid
- More flow per cost than a relief valve
- Increased production capacity for same piping configuration
- Smaller size BPAV may be adequate for application
- Reducing valve cost, piping cost and weight - critical for offshore applications



BPAV  
(open)

The BPAV™ and the piping diagram icon are BS&B trademarks

*International patents apply*

### BPAV-R™

Sharing the same configuration as the BPAV but with a replaceable seat - applied to corrosive and erosive application which may result in frequent seat replacements. Also applied to high H2S processes where the replaceable seat material needs to be of a higher alloy (eg. Inconel 625).

### BPAV-LP™

Low set pressure buckling pin API series valve for set pressures below 25 psig (1.72bar).

#### Sizes:

- 2 x 3 inches (50 x 80mm)
- 3 x 4 inches (80 x 100mm)
- 4 x 6 inches (100 x 150mm)
- 6 x 8 inches (150 x 200mm)
- 8 x 10 inches (200 x 250mm)

### BPCV™

Buckling pin valve with common inlet and outlet connection size.

### BPPV™

The BPPV is a buckling pin pilot valve ranging from 6 x 6 inches through 30 x 30 inches (150 x 150mm through 1,220 x 1,220mm) with a set pressure from 10 to 275 psig (0.69 to 18.96barg). Larger sizes to 48 x 48 inches are also available.



# Industrial Explosion Protection

Risk Management / System Solutions Provider

The BS&B companies have proven to be the fastest growing manufacturers of industrial explosion protection technology with products designed to meet the requirements of the United States OSHA Combustible Dust National Emphasis program, NFPA standards and European ATEX Directive.

With a broad range of dust explosion prevention and protection technology, BS&B is in a unique position to provide support to owners, operators and equipment manufacturers in their quest for compliance to OSHA, NFPA and ATEX requirements. BS&B offers more than 80 years of pressure safety management and a team of research and development specialists and application experts who support our clients' existing and new applications.

## Capabilities

- Equipment protection by
  - explosion venting direct to atmosphere
  - ducted explosion venting
  - flameless explosion venting
  - suppression
  - chemical isolation
  - mechanical isolation
  - spark detection and extinguishing
- Dust testing for combustion characteristics
- Combustible dust facility audits
- Inspection of prevention and protection systems

## Explosion Protection and Prevention Solutions Applied to Typical Milling Process



### Prevention

- Explosion isolation systems applied to ducting to stop propagation of a dust explosion
- Spark detection and extinguishing systems applied to ducting to arrest ignition sources in air flow

### Trusted Service

- BS&B provides service 24/7 to support new and established installations

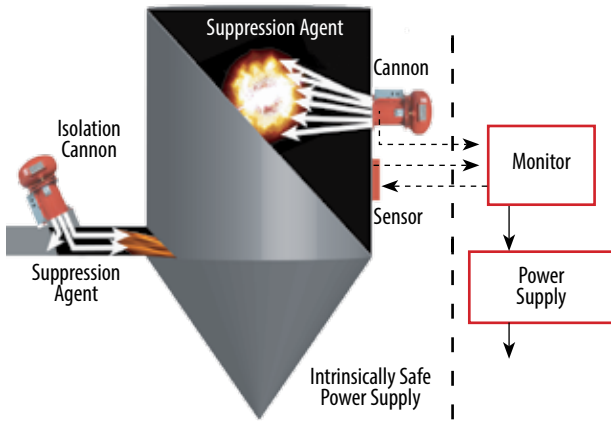
### Protection

- Explosion vents for process equipment protection
- Explosion vents for building protection
- Flameless vents for indoor applications or wherever fireball release is unacceptable
- Fast acting valves for mechanical isolation of connecting ductwork
- Chemical isolation systems to provide a barrier to flame transmission through connecting ductwork

## Combustible Dust Risk Management Technology Platforms

Combustible dust explosions are fast and dangerous, producing flame and pressure risks which must be managed according to the user application conditions. The technology platforms employed for protection and prevention all seek to maintain the pressure developed by a dust explosion within safe limits for the typically light metal construction process and storage equipment used in bulk materials handling. Suppression and chemical isolation systems extinguish flame early in the dust explosion event. Explosion venting to atmosphere requires careful management of the flameball generated, which can be 100 feet (30 meters) or more in length.

### Explosion Suppression / Isolation



Sensing of the pressure waves ahead of the fireball developed by early stages of a dust explosion allows a suppression cannon module to extinguish the flame inside this dust collector before it engulfs the process equipment and develops a dangerous pressure. The isolation cannon blocks the flame from entering the dirty air inlet, avoiding propagation of the dust explosion. System relays are used to shut down the process and generate appropriate user alarms.



### Venting

Explosion venting offers the most economic approach to dust explosion protection when the flameball generated during venting can be accepted in the surrounding environment. Sizing and placement of explosion vents must be correctly engineered to ensure their effectiveness. Where ducted venting is deployed, enlarged vent areas must be implemented to offset the delay in the fast combustion event reaching the open atmosphere. BS&B provides more than ten models of explosion vent, each developed for specific application conditions and to be in compliance with industry standards. Whether protecting a storage silo, a dust collector or an oven, BS&B has proven vent technology for your application.



VSP™ vent

### Isolation



Pinch valve

While chemical isolation is the most flexible approach to providing a barrier to flame propagation, some applications cannot accept the presence of the extinguishing agents commonly used (most typical is sodium bicarbonate). Mechanical isolation barriers such as the BS&B IVE 'pinch valve' or IFV 'flap valve' can be inserted into a process line. Under normal operating conditions the process flow passes through the mechanical barrier. Under dust explosion conditions, the mechanical barrier either self closes due to the pressure wave that precedes the flameball of a dust explosion or is actuated shut. Isolation devices must be located at a distance from the dust explosion hazard verified by BS&B.

### Spark Detection and Extinguishing

Under normal air flow conditions, hot spots and sparks passing through ducting can be optically detected and extinguished with water or other compatible medium further along the piping. Successful extinguishing is typically achieved without stopping the process. Spark detection systems are often deployed to detect a hot spot in a process flow and provide a trigger to an abort gate or diverter valve, directing the unwanted hot material to a safe location.

# Process Systems

BS&B Process Systems and Black, Sivalls & Bryson design and build world class process equipment systems and plants for the oil and gas, chemical and refining industries. BS&B's well respected technology and reliability are evident in tens-of-thousands of oil and gas and other processing systems and plants operating throughout the major energy producing areas of the world. This technology is the foundation for much of the oil and gas processing technology in common use today.

BS&B's wide range of expertise includes separation, gas and liquid treating systems, gas and liquid dehydration systems, gas and liquid recovery topping and stabilization systems, direct and indirect firetube heating units and other processes, developed initially for the oil and gas industry.



BS&B supplies reliable process systems and equipment to meet clients' specifications at competitive prices. Installation may be undertaken in almost any country in the world. If local project requirements so dictate, BS&B can provide for local fabrication and supply to the maximum extent possible, consistent with clients' specifications and BS&B's quality standards.

## Oil and Gas Primary Separation

BS&B custom-engineered separators have exclusive design and operational efficiency throughout a long service life. The strength and preeminence of BS&B's experience with high volume crude oil streams is proven and includes separation of foamy and / or waxy crude oils using single vessel capacities to 600,000 barrels per day.

## Glycol Dehydration

The BS&B companies are particularly proud of its leadership in glycol dehydration. BS&B technology provided the first experimental unit for service in the natural gas industry in 1964. Today, there are thousands of glycol dehydration units in operation utilizing that technology and providing the most economical way to remove water vapor from natural gas streams.

BS&B's standard glycol units are designed to produce  $-65^{\circ}\text{F}$  ( $-53^{\circ}\text{C}$ ) dewpoint depressions. They feature an efficient tray type absorber design to assure maximum gas-to-glycol contact and minimum glycol loss, and are available in a wide range of capacities.

BS&B's Hi-Con™ units provide all the features of the standard unit, plus a dewpoint depression as great as  $-140^{\circ}\text{F}$  ( $-95^{\circ}\text{C}$ ). These units are equipped with a "super concentrator" that uses a small quantity of stripping gas to achieve glycol purities as high as 99.95%.

## Engineering Services

BS&B draws upon a wealth of experience in specifying the optimum configuration of the many components available for processing oil and gas. The combination of modern computer design and simulation programs with detailed knowledge of the individual pieces of equipment involved enables realistic forecasting of plant performance. BS&B also offers engineering studies to diagnose and solve operating problems, evaluate existing equipment for new process operating conditions and debottlenecking for increased capacity.







## Process Equipment

### Heaters

BS&B supplies direct and indirect firetube heaters, low pressure steam generators and the unique Flue Gas Reticulating Process Heater, which provides thermal efficiencies as high as 90% for a broad range of applications. The heater is suitable for both high and low pressure process streams in thermal capacities from 5 to 100 mmbtu per hour.

### Services

Black, Sivalls & Bryson offers a wide range of services that draws from a tradition of expertise and experience. Our service division has the qualified personnel in place to support our customers with their service, maintenance and repair requirements. We provide worldwide startup and commissioning services for all process equipment. We can also offer engineering design services, process design verification and de-bottlenecking services that use our extensive history to solve complex process problems. With countless years of knowledge, we can provide you with a solution to any of your production and operations problems.

### Parts

Our Spare Parts division carries a large inventory of BS&B original parts as well as many other common replacement parts. We specialize in sourcing the “tough to find” parts. With our many years of technical expertise, we have extended this service to all companies requiring spares or replacement parts for their product lines. Our specialty is providing customer support and getting the parts you need to get your business online quickly.

#### Heating

- Indirect heaters
  - Salt bath
  - Water bath
  - Glycol / water bath
  - LPG vaporizers
  - Steam generators
- Direct heaters
- Convective heaters

#### Separation

- Standard two-phase and three-phase separators
- High-surface defoaming separators
- Free-water knockouts
- Liquid knockouts
- Blowcases
- Microscrubbers, liquids and solids
- Oil coalescers
- Water coalescers
- Slug interceptors
- Gas scrubbers

#### TEG Gas Dehydration

- Glycol dehydrators for natural gas, CO<sub>2</sub> or ethylene
- Super Hi-Con regeneration system produces lean TEG as high as 99.95 + percent concentration. Dewpoint depressions as low as -140°F (-95°C)
- LPG driers
- Dry desiccant units

#### Propane Vaporizers

- Sizes available from 50,000 BTU per hour to 16,000,000 BTU per hour

#### Oil Treaters

- Standard heater treaters
- Electric treaters
- Desalters
- Oil sweetening units
- Flow spitters

#### Amine Units

- CO<sub>2</sub> removal

# BS&B FlameSaf™

BS&B FlameSaf™ is a safety company dedicated to protecting industrial plants and personnel from the dangers of explosion and fire propagation. The company's rich history spans more than 80 years with the BS&B name being well known for its innovative solutions for personal protection against dangerous over pressurizations and explosions within industrial settings.

BS&B offers a comprehensive portfolio of products and services that meet and exceed rigorous industry standards for quality and reliability. Our integrated solutions have been time-tested and fine-tuned to deliver maximum value and greater efficiencies to individual engineering processes.

BS&B is a certified manufacturer of flame arresters, detonation arresters and pressure / vacuum vents both with and without flame arrestor function. Our flame arresters and pressure / vacuum vents (P/V vents) incorporate impressive design and performance features that include compact and light weight construction, with low pressure loss in flowing conditions. The easy-to-assemble design enables quick installation of replacement parts when required.

## Certification

All products have been certified through a certification body (DNV, BAM, IBExU, PTB) as per the EC Directive 94/9/EC and awarded the CE mark of conformity.

Our state of the art flow and dimensional measurement techniques ensure the user receives high quality safety devices compliant with industry standards. Product performance features are controlled according to EN 10204 and in line with customer special requirements.

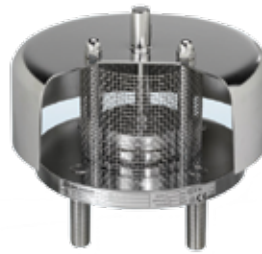
The BS&B FlameSaf quality assurance system is monitored by Det Norske Veritas (DNV), who issue certification according to ISO 9001 to BS&B.



Model 935E  
Over Pressure Valve



Metal Foil Element



Model 942-EV



Model 937E  
over and under-pressure valve

## Flame Arresters

Flame arresters are used as secondary protection against explosions by preventing the transmission of flame and explosion transfer in machines, equipment and plants, containing inflammable gas or steam-air mixtures of inflammable liquids. These autonomous safety systems limit the effects of the explosions, rendering them harmless, they are intended to allow flow but prevent flame transmission.

BS&B FlameSaf arrester products use the technical principle of a 'quenching gap'. Precision coiled arrester elements are manufactured to allow normal flow to occur and to present a barrier to flame propagation. The quenching gap selected for the combustion condition of each application is too small for flame to pass and burning is 'arrested'. Precision coiled arrester elements offer superior safety as compared to mesh type arresters which offer less stability of quenching gap.

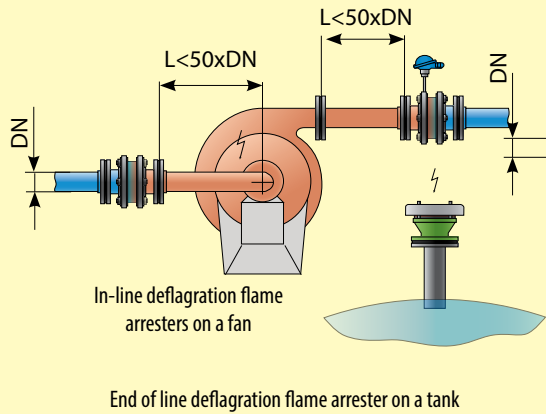
The BS&B FlameSaf product line includes arrester technology suited to safe management of deflagration and detonation risks in piping systems and equipment. End-of-line and in-line devices are available along with P/V vents that offer integral arresters.

## Functions of Flame Arrester

Protects systems for generating, storing, and transporting gases and liquids of every hazard category against dangers such as deflagration, detonation and stabilized burning.

### Deflagration

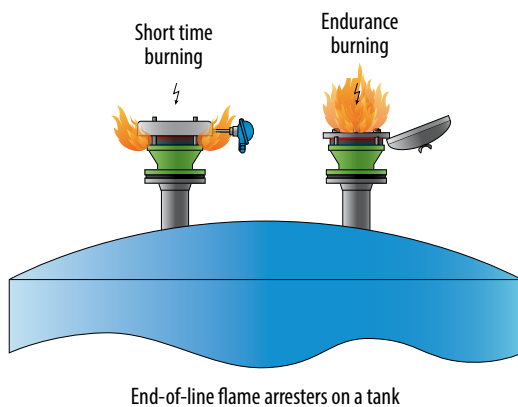
A deflagration is an explosive combustion process in which the flames propagate at subsonic velocity. There are end-of-line and in-line deflagration flame arresters. It is imperative to adhere to the maximum distance (L) from the ignition source when installing in-line flame arresters.



## Stabilized Burning

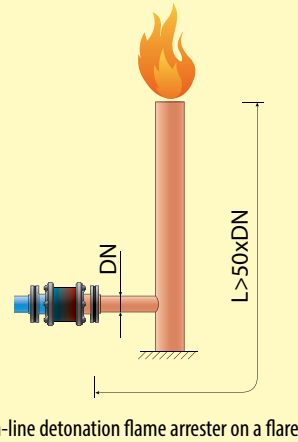
Stabilized burning is the steady burning of a flame at or on a flame arrester element. Survival of such conditions requires the selection of an arrester model designed for endurance conditions.

BS&B FlameSaf short time burning flame arresters have an integral temperature sensor for the user to monitor temperature. If a pre-determined limit is exceeded, the user must initiate a process shut down to end the combustion event within a defined time period specific to the application.



### Detonation

A detonation is an explosion propagating at supersonic velocity characterized by a shock wave. Detonations occur in pipelines with long distances to the ignition source ( $L > 50 \times DN$ ) being an example for explosion group IIA).



The flame arresting capability and mechanical strength of an in-line detonation flame arrester is much greater than an in-line deflagration flame arrester. Devices designed for detonation conditions will provide deflagration protection as well.

## Flame Arrester Product Range

Flame arresters are suitable for a variety of explosive atmospheres within industrial applications. Please refer to the BS&B FlameSaf brochure for solutions to protect your application. For detailed information, please visit our website at [www.BSBflamearrester.ie](http://www.BSBflamearrester.ie).





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