



BS&B SAFETY SYSTEMS, L.L.C.  
BS&B SAFETY SYSTEMS LTD.

# SPECIAL APPLICATIONS AND PREVENTIVE MAINTENANCE

CATALOG  
77-1007

SECTION B



**BS&B Safety Heads and  
Rupture Disks**

## OBJECTIVES IN PRESSURE RELIEF SYSTEM LAYOUT

Personnel responsible for the design or safe operation of pressure systems should evaluate these objectives when determining the quantity, type(s) and arrangement of pressure relief devices:

- Provide maximum safety for personnel
- Guard against damage to equipment
- Comply with applicable code(s), rules and regulations
- Minimize loss of product during normal operation
- Cut maintenance by extending the time period between major maintenance of relief systems
- Select metals compatible with process media

BS&B's 40-year leadership and highly competent staff of technical personnel is your assurance of in-depth know-how when BS&B assists you in the selection and arrangement of overpressure relief device(s) for your pressure system.

## BS&B SAFETY HEADS ARE FAST, ACCURATE AND DEPENDABLE

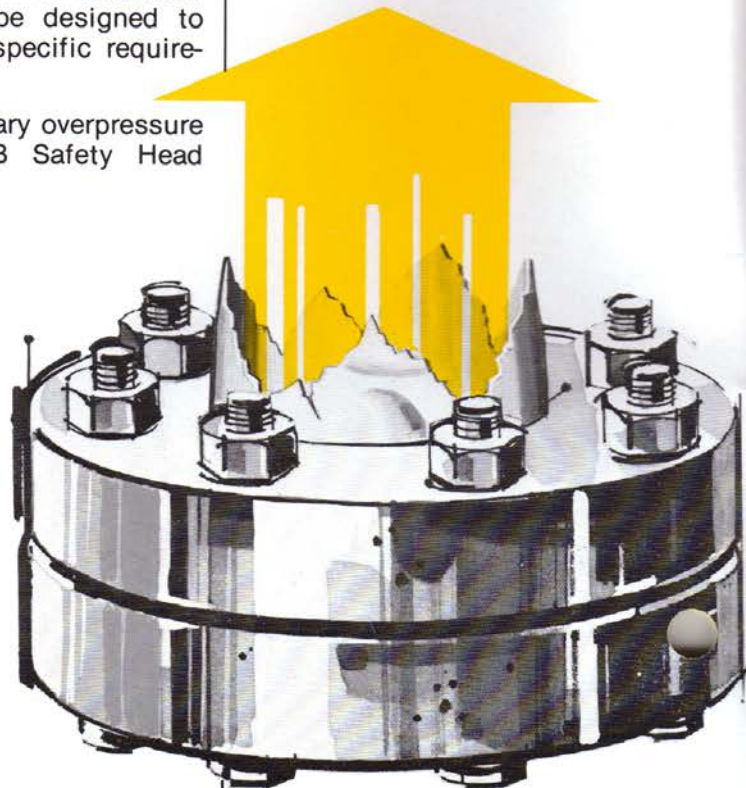
The "heart" of the BS&B Safety Head is the rupture disk, a metal structure designed as the controlled "weak spot" in a pressure system. The BS&B rupture disk as a pressure relief device has these four important features:

- 1 Reacts immediately to release excessive overpressure
- 2 Provides maximum capacity through unrestricted relief area
- 3 Non-mechanical...no parts to gall, freeze, plug or otherwise become inoperative
- 4 Fails with amazing accuracy in tension or compression

BS&B Rupture Disks are available in a wide selection of ductile metals...pressure ratings from 1.5 to 100,000 psi...temperatures from cryogenic to elevated (-420° to + 1000° F.)...sizes from the 1/8" "Peanut" through the 44-inch "Big Daddy" (inside dimensions).

The complete BS&B Safety Head assembly consists of a rupture disk or disk/vacuum support combination and the fitting that holds it. Standard fitting designs are bolted flange, union, screwed and sealed type construction. Special fittings can be designed to meet the customer's specific requirement.

For primary or secondary overpressure protection, the BS&B Safety Head should be considered.





## BS&B SAFETY HEADS FOR PRIMARY RELIEF

Primary relief devices are sized to prohibit pressure in a system from exceeding design pressure by more than 10% unless the system or vessel is subjected to an external source of heat. Should this thermal condition occur, one or more relief devices would be sized to prohibit pressure from exceeding design pressure by more than 20% .

Casualty insurance companies and various inspection agencies at national, state and local levels require pressure systems to be designed, manufactured and tested in accordance with an accepted code(s).

BS&B Safety Heads are acceptable for primary relief under ASME Code Sections I, III, and VIII, ANSI-B9 Refrigeration Code, Compressor System Standards, API Guide RP-520, ICC Regulations, Marine Engineering Regulations and others.

The largest number of applications for primary relief devices come under the provisions of ASME Boiler and Pressure Vessel Code, Section VIII, Divisions I and II. The following extracts and interpretations are provided for your guidance in selecting relief devices.

## PERMISSIBLE OVERPRESSURE

The aggregate capacity of the pressure-relieving device(s)—open flow paths or vents—will be sufficient to prevent overpressure in excess of those specified in the following paragraphs when the pressure-relieving device(s) are discharging:

- 1** *The permissible overpressure for all pressure vessels constructed according to ASME Code shall be limited to 110% of the design pressure when the pressure-relieving device(s) is discharging except:*
- 2** *The permissible overpressure shall be limited to 120% of the design pressure when the pressure-relieving device(s) are discharging if there is exposure to fire or other unexpected sources of external heat...or internal failure of a heat transfer element.*

## SET PRESSURE FOR A SINGLE RELIEF DEVICE

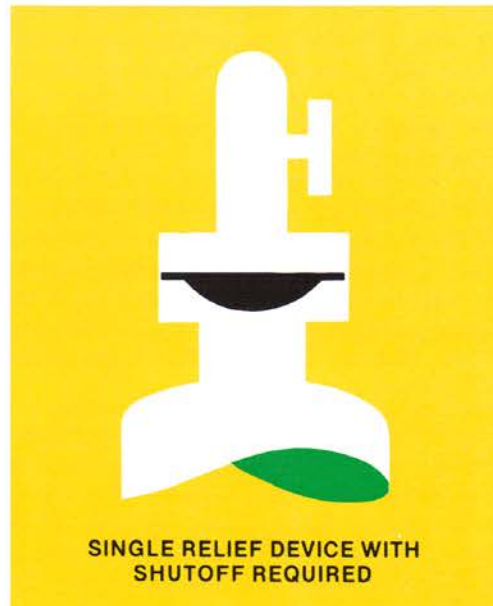
A single pressure-relieving device shall be set to operate at a pressure not exceeding the design pressure of the vessel at operating temperature.

## SET PRESSURE FOR MULTIPLE RELIEF DEVICES

If the required discharging capacity is supplied by more than one relief device, only one need be set to operate at a pressure not exceeding the design pressure of the vessel. Additional devices used to meet the 110% permissible overpressure requirement (see page 2) may be set as high as 105% of design pressure. Additional devices used to meet the 120% requirement (see page 2) may be set as high as 110% of design pressure. If additional device is used to meet both the 110% and 120% requirements, it cannot be set higher than 105% of design pressure.

## SET PRESSURE TOLERANCE

Rupture disks shall have a rupture pressure tolerance of plus or minus 5%. This tolerance shall be considered an acceptable variance from the nominal burst pressure of the disk.



### PRIMARY RELIEF APPLICATIONS

#### SINGLE RELIEF DEVICE WITH SHUTOFF NOT REQUIRED

*Permissible overpressure: 110% of design pressure.*

*Set pressure: At or below design pressure and temperature.*

#### SINGLE RELIEF DEVICE WITH SHUTOFF REQUIRED

*Permissible overpressure: 110% of design pressure.*

*Set pressure: at or below design pressure and temperature.*

#### SINGLE RELIEF DEVICE FOR CONTINUOUS SERVICE

*Permissible overpressure: 110% of design pressure.*

*Set pressure: at or below design pressure and temperature. Switching valve permits continuous operation during maintenance of one of the pressure relief devices.*

#### MULTIPLE RELIEF DEVICES

*Permissible overpressure: 110% of design pressure.*

*Set pressure: one unit at or below design pressure and temperature, additional units at 105% of design pressure.*

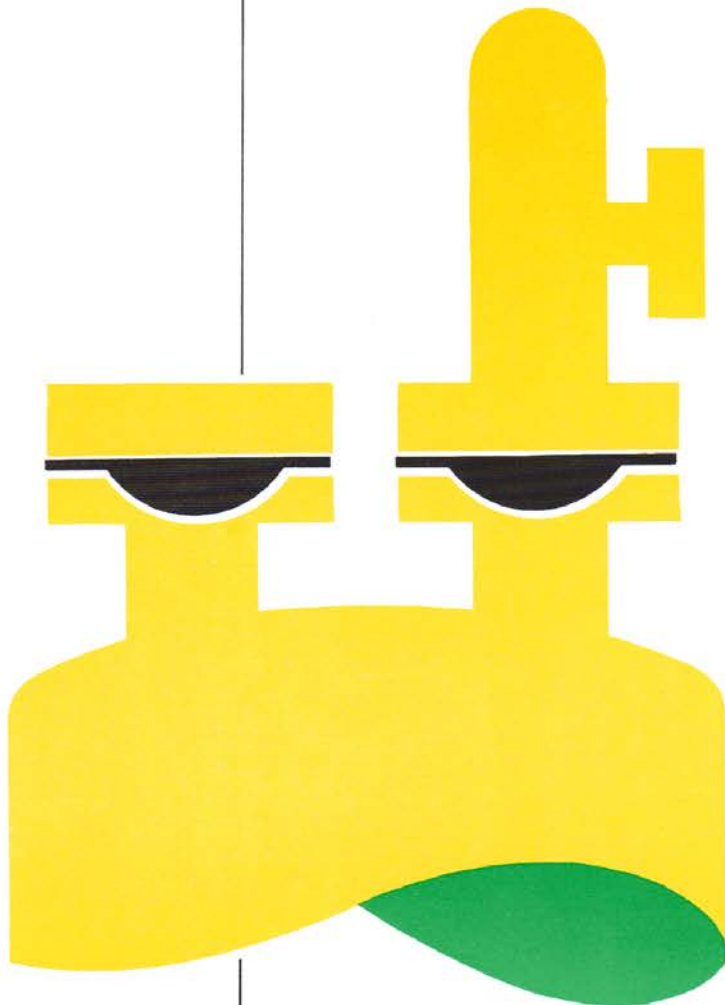
*For fire exposure capacity, additional units at 110% of design pressure with maximum permissible overpressure at 120% of design pressure.*



## DON'T GAMBLE WITH SAFETY!

### PROVIDE SECONDARY CAPACITY FOR THE "UNKNOWN"

Relief devices in a secondary classification are not discussed in any code. Although codes mention capacities for primary relief devices by defining permissible overpressure, the unknown from an exothermic or runaway reaction dictates the need for greater capacity. This extra capacity comes from one or more secondary relief devices.



Non-mechanical fast-acting BS&B Safety Heads will provide the needed relief area should an abnormal overpressure develop.

The major factors to be considered when determining the pressure rating for secondary relief devices are normal system pressure, product in the process, and type of rupture disk.

## SAFETY OR RELIEF VALVES ALONE MAY NOT PROVIDE ADEQUATE CAPACITY FOR PRIMARY RELIEF

Before a valve is selected as the primary relief device for a vessel or system, it is important to determine if exposure of the valve to process media will affect the valve's performance. Even though a valve is properly sized for a predetermined rate of flow, a *dangerous condition* may occur if capacity is restricted or the valve malfunctions.

A BS&B Safety Head at the valve inlet isolates the valve from process media during normal operation of the pressure system. A Safety Head at the valve outlet isolates working parts from external corrosion. With the assurance of clean valve internals when rupture disk actuates, the valve should sense overpressure and operate within acceptable tolerances of set point.

### SECONDARY RELIEF APPLICATION

*One or more of the secondary relief devices may be set at or below system test pressure*

## ISOLATION OF VALVE INTERNALS WITH A SAFETY HEAD

Provides these important benefits:

- A "Bottle-tight" disk-valve package prohibits loss of product during normal operations of the pressure system.
- Less expensive valve trim material can be used.
- Valves last longer, require less maintenance, reduce downtime.
- With RB-90 Safety Head installed at valve inlet, valve can be field-tested while in service with portable pressure source. Pressure is injected between disk and valve inlet.

## IMPORTANT

When Safety Head is installed at valve inlet, a tricock, pressure gauge or some type of tell-tale indicator should be inserted between the disk and valve inlet. BS&B suggests the nipple, tee, pressure gauge and excess flow valve assembly shown at right.

When Safety Head is installed at valve outlet, valve must be balanced type to prohibit back-pressure effect on valve opening should there be any pressure in the closed chamber at valve outlet.

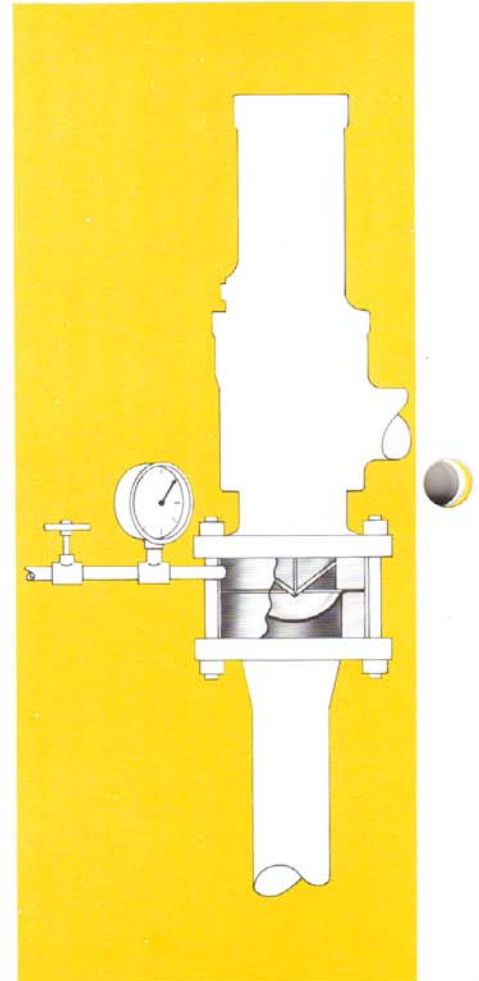
When a Safety Head-Valve combination is used with Safety Head at valve inlet and product to be discharged is corrosive, viscous, or of a formula that could affect performance of the valve, it is recommended the valve and Safety Head flange assembly be cleaned thoroughly before installing a replacement rupture disk.

## SPECIAL SAFETY HEAD APPLICATIONS

It is sometimes necessary or desirable to deviate from standard practice to achieve greater flexibility in the application of Safety Heads. Here are nine "areas of challenge" where BS&B has successfully provided answers for customers.

If a new installation dictates the use of a disk type and metal that falls in the "NOT RECOMMENDED" category (see Sizing and Specifying BS&B Rupture Disks catalog), one of these variations or some other arrangement may convert the disk rating to "ACCEPTABLE."

If you have a problem with an existing installation, one of these proven solutions may be your answer for a trouble-free operation. If not, let us assist you. Outline data that is pertinent to the application.



### IN-PLACE TESTING OF VALVE WITH RB-90 SAFETY HEAD AT VALVE INLET

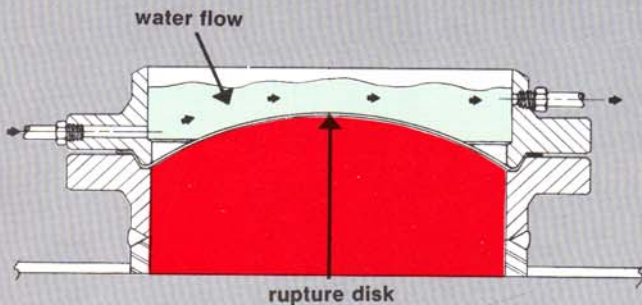
Another BS&B first! This method of testing relief valves is covered by U.S. Patent No. 3 485 082.

Pressure applied to chamber between top or atmospheric side of rupture disk and valve seat cannot be higher than 10% above disk pressure rating. *Important! Check pressure rating on disk tab before injecting pressure for valve testing.* Normally capacity will not be sufficient to provide a clear "pop."

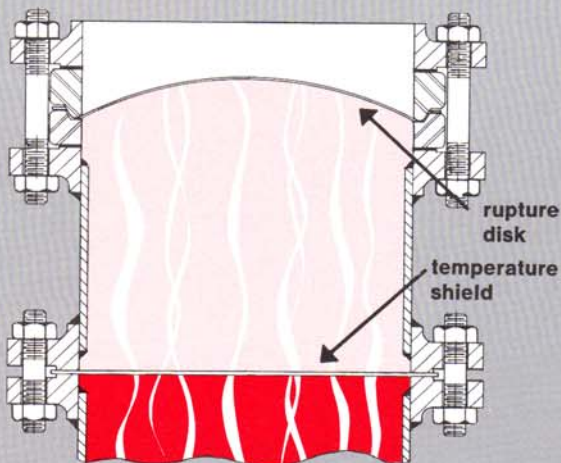
When valve reseats, it may not be tight. This is not important since the RB-90 disk provides a leak-tight assembly.



## REDUCING HIGH TEMPERATURES



**Water flow across disk.** Large diameter Type DV composite rupture disk installed in Safety Head located on waste gas combustor. Process side of disk subject to temperatures of 1200 to 1300° F. TFE plastic was selected as seal material, 316 stainless steel for top section of disk and vacuum support. Water flow across top (atmospheric) side of disk reduced temperature of seal to below 500° F. —maximum for TFE plastic. Temperature of top section remained below 200° F. because water was not allowed to boil. Disk has good service life.



**Temperature shield between disk and process.** Will reduce temperature approximately 50%. This can be used as a damper in a mild pulsating condition up to 8" size. The shield is used between standard companion flanges and should be installed as far below disk as possible.

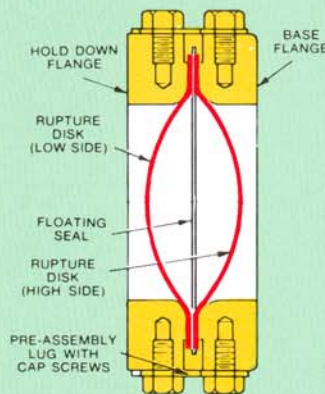
## TWO-WAY RELIEF

### BS&B Double D\* Safety Head

can be used where two-way relief is desired. Rupture pressure on one disk can be twice the rupture pressure of the opposite disk with full relief area in both disks when rupture occurs. Where relief areas are not required to be equal in both directions, it is sometimes possible to design disks with limited opening and low burst in one direction, and with higher burst and full opening in the opposite direction. A good example of this is for combination pressure-vacuum relief.

The Double D\* disk consists of two Type D disk top sections with a plastic seal between them. Plastic seal will float back and forth between disks, depending on pressure differentials. When one D disk ruptures, pressure drop across other disk causes it to reverse and rupture.

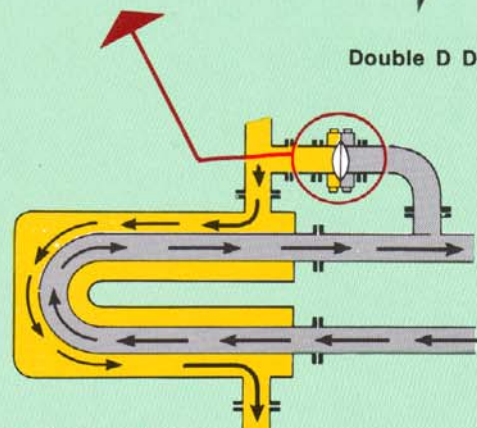
\*Patented. U.S. Patent No. 3,091, 359



Double D Assembly



Double D Disk



Typical application



## VISCOUS FLUIDS TENDING TO SEAL OFF INFLOW LINES

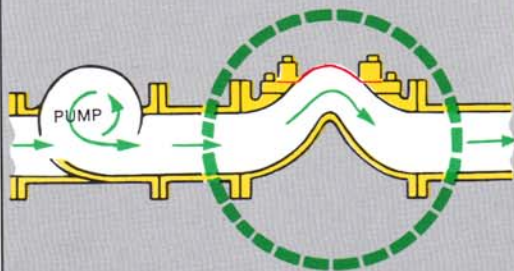
The BS&B LO-TO-FLO Safety Head is specifically designed to protect systems handling liquids of heavy viscosity or which will adhere to pipe walls and solidify to create an unsafe condition.

In the LO-TO-FLO Safety Head, liquid flowing through the line sweeps against the bottom surface of the disk. There is no dead space or voids between the product and the rupture disk to permit accumulation on the disk and its resulting malfunction.

Standard sizes range from 1/2" to 14" and can have flanged, threaded or weld-type connections.

Bodies are available in carbon steel, 316 SS, nickel, monel, hastelloy and other materials. Internal surfaces can be lined with glass, rubber, penton or lithcote.

When selecting the rupture disk, refer to your catalog to determine the type disk best suited for the particular service.

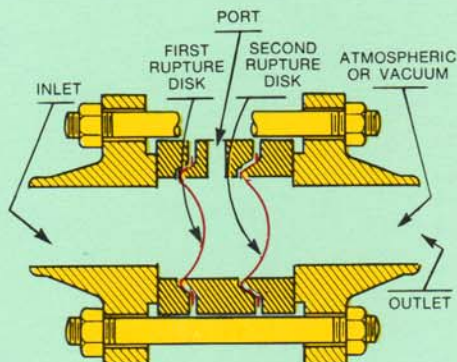


Typical application



LO-TO-FLO Safety Head

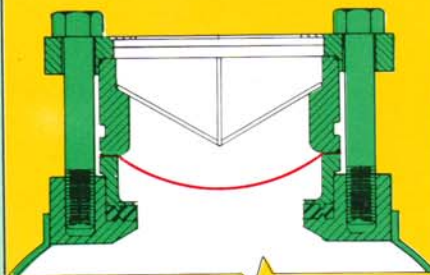
## QUICK OPENING VALVE



Two rupture disks in series can be used as a quick opening valve. Space between the two disks is pressurized. Both disks have rupture rating lower than operating pressure. Pressure between disks is maintained at approximately half the system operating pressure. When pressure between disks is *reduced*, first disk will rupture, followed immediately by the second. Disk rupture can also be initiated by *increasing* pressure between disks until second disk ruptures.

## ULTRA HIGH VACUUM

In most applications for ultra-high vacuum, leakage must be extremely small. A typical unit used for this purpose is a welded RB-90 used on the vacuum jacket of pressure vessels where vacuum must be maintained for extended periods without loss of vacuum. The standard RB-90 with its "bite type" seal or a welded RB-90 as shown can accomplish this requirement.



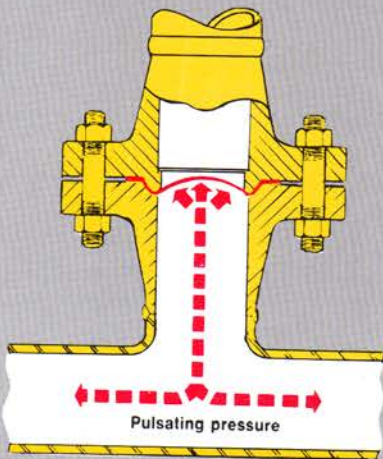
Vacuum vessel



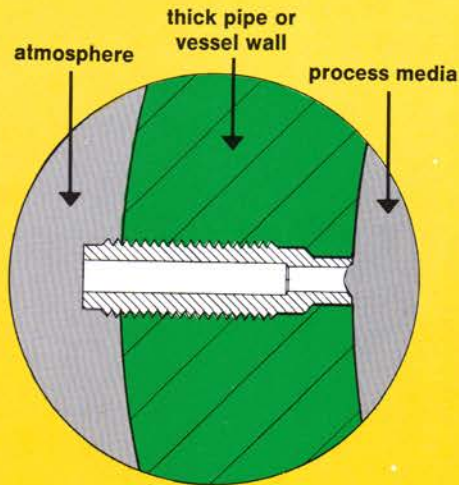
## PULSATING PRESSURES AND WATER HAMMER EFFECT

Standard Safety Head assembly is located so rupture disk is as far away from source of pulsating pressure as convenient. Even a few feet will make considerable difference in the magnitude of pulsations.

For water hammer effect in liquid systems, locate a gas surge chamber under disk or extend a vertical line a few feet to the disk to act as a surge chamber. A rupture disk will react and burst in 1 to 2 milliseconds of overpressure, therefore water hammer effect can rupture a disk without pressure surge showing up on some types of recording equipment.



## FLUSH-MOUNTED SAFETY HEAD PROHIBITS PRODUCT BUILDUP ON RUPTURE DISK



Flush-mounted safety heads prohibits product build-up on rupture disk. These units are designed to fit hole in vessel wall with the rupture disk mount flush with interior wall.

Typical applications polyethylene manufacturing equipment and plastic extruder barrels.



## SEALED TYPE SPECIALS

Special sealed type units are manufactured for hydraulic accumulators, gas cylinders, pressure gauges, portable compressed air systems. ICC regulations prohibits shipping of pre-charged accumulators without a relief device. This is to protect against overpressure should the accumulator be exposed to an external source of heat.



Safety Head especially designed to protect portable liquid oxygen (LOX) bottle should it be exposed to fire or other unexpected source of heat.





# HOW TO GET PROPER PERFORMANCE AND MAXIMUM SERVICE LIFE FROM YOUR BS&B RUPTURE DISKS

Here are three general rules that every Safety Head user should follow:

- 1** Install rupture disks according to recommended practices. Clear and detailed instructions are furnished with each shipment of rupture disks that leaves the factory.
- 2** Do not subject rupture disks to service conditions that exceed those for which they were selected.
- 3** Change out disks on a regular schedule.

## special tip

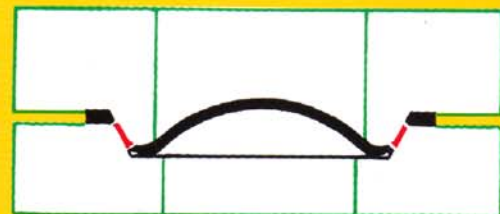
No. **1**

### INSTALL DISKS PROPERLY!

Follow the manufacturer's instructions carefully when installing disks. Cocked flanges and overbolting can crush and separate thin metal disk or plastic seal and cause leakage or premature disk failure. Underbolting can result in disk slippage. This could also cause leakage and premature disk failure.

Each rupture disk type has a specific, detailed instruction sheet. The instructions are included with each shipment of rupture disks. It is important to follow the recommended torque provided in the instruction sheet.

Consult factory if additional installation information or torque data is required.



Metal or plastic crushed and separated in area shown in red indicates excessive torquing or flange cocking.



## special tip

No. **2**

### KEEP FLANGE SEATING SURFACES CLEAN!

Flange surfaces in contact with rupture disk are critical. They must be free of rust, scale, product deposit or other foreign material. Check seating surfaces of all Safety Head flanges for smoothness before installing new or replacement rupture disk. Use emery cloth to bring surface condition to whatever degree of smoothness is required to prevent damage to thin disk when sandwiched between two flanges and bolting is fully torqued. If surfaces are pitted to the extent that leakage could occur, consult factory.

**Do not remachine surfaces without instructions!**

Angular  
Seat  
Safety  
Head



Clean  
and  
polish  
these  
surfaces

RB-90  
Safety  
Head



Clean  
and  
polish  
these  
surfaces

Any indentation in area shown in red indicates rough seating surfaces or foreign material collected on seating surface.



## special tip

No. **3**

### WATCH FOR CORROSION!

Make sure disks you install are compatible from a corrosion standpoint with product and atmospheric environment to which they will be exposed. Frequent inspection of a disk in service can detect early appearance of corrosion. It may be possible to substitute disk metal or lining material that has better corrosion-retarding properties.

Excessive corrosion on downstream side of disk indicates atmospheric environment may be more severe than the process itself. A solid sheet of 3 or 5 mil plastic mounted to facing of outlet flange or cover for exhaust piping may provide the necessary corrosion barrier for bare metal disk.

Consult factory if you have a serious corrosion problem. Send disk for visual inspection. It may be helpful in pinpointing the problem. Include the following pertinent information:

1. Normal system pressure and temperature
2. Pressure, static, gas pulsation or liquid surge
3. Process media
4. Atmospheric environment
5. Alternating pressure-vacuum or continuous vacuum service
6. If valve or discharge piping is located at Safety Head outlet, indicate approximate unsupported weight.

Send disk and information to:

BS&B Safety Systems, Inc.

Product Analysis

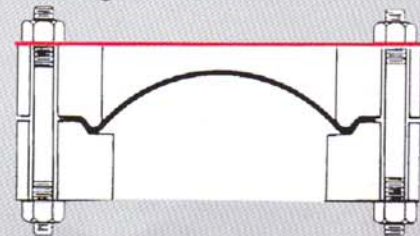
P.O. Box 470590 (7455 E. 46th Street South)

Tulsa, Oklahoma 74147

**Check both sides of disk for corrosion. Atmospheric environment may be more severe than process.**



**Install solid sheet of 3 or 5 mil plastic to protect downstream side of disk against corrosion.**





## special tip

No. **4**

### USE VACUUM SUPPORTS WISELY!

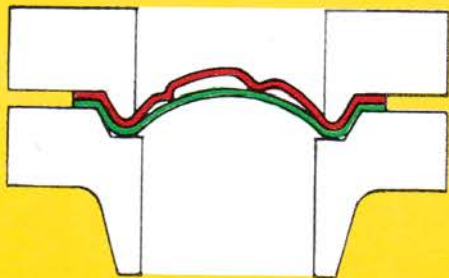
Vacuum supports serve several purposes. If there is a remote chance that vacuum can occur in the system, vacuum supports should be considered. They are also commonly used to protect thin disks in handling before and during installation.

Make sure the support and disk fit properly if they are not permanently attached at factory. All combinations except in the smallest sizes are attached at factory unless otherwise specified.

If disk taken out of service appears to have been reversed by vacuum, the problem can be solved by installing a vacuum support on process side of disk. Standard supports are designed to withstand full vacuum (back pressure differential of 14.7 psi). If back pressure differential can exceed this, consult factory for special design of vacuum support.

Dimpling or "turtle backing" sometimes occurs even when a support is used. This usually indicates movement of the disk away from the support because of higher operating pressure than the disk was built to withstand or an excursion to higher pressures—near the bursting pressure of the disk. Consult factory for assistance. It may be necessary to change operating conditions, use a disk with a higher pressure rating, or form rupture disk-vacuum support combination to a crown contour that will eliminate separation during normal operation.

"Turtle backing" indicates movement of rupture disk away from vacuum support. Application must be reviewed.



## special tip

No. **5**

### HANDLE RB-90 DISKS WITH EXTREME CARE!

RB-90 reverse buckling disks that are damaged in shipment, handling or during installation will fail prematurely.

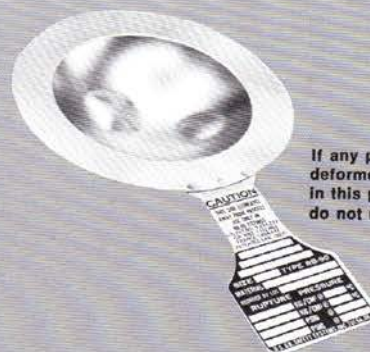
If there is any damage to seating surface or prebulged area of the disk, **do not use it!**

Proper torque is essential for proper operation of RB-90 disks. Underbolting will result in premature failure. Disks taken out of RB-90 flanges should show a definite indentation on the inlet side of disk at "bite" location. Refer to Torque Table for proper torquing procedures.

Examine disk before inserting between RB-90 Safety Head flanges. Overall appearance of disk must look like this.



If any part of disk is deformed, as shown in this photograph, do not use it.



Seating surfaces in both flanges must have a smooth finish.



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ISO 9001 Quality System Certification

