



SIGMA EXL™

Reverse Buckling Rupture Disk

Designed for the Highest Operating Pressure in Gas or Liquid Service



The SIGMA™ rupture disk is protected by the following US patents: 5,996,605; 6,178,983; 6,446,653.

International patents pending.



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SIGMA EXL™

THE RUPTURE DISK FOR THE HIGHEST OPERATING PRESSURE IN GAS OR LIQUID SERVICE

Sigma EXL™ & Sigma™ Disk Features

- Reverse Buckling Disk in Sizes 1”-8” (25-200 mm)
- High Operating Ratio: 95% of marked burst pressure
- High Operating Ratio: 100% of minimum burst pressure (CEN ISO4126-2)
- Standard 0% Manufacturing Design Range, optional -5%
- Designed for non-fragmentation
- Designed for Gas, Liquid, or two-phase flow conditions
- Fail Safe: Damage Safety Ratio ≤1
- Saf™ technology
- Vacuum resistant
- Smooth process side of disk resists product accumulation
- Long service life in pressure cycling or pulsating conditions
- For installation in BS&B type SRB-7RS™ Pretorqued Safety Head



Sigma EXL™ & Sigma™ DISK SPECIFICATION Min/Max Pressure Rating at 72°F (22°C) PSIG (Bar)

Disk Size		Alloy 200 (Nickel)				316SS				Alloy 600 (Inconel®)				Alloy 400 (Monel®)				Hastelloy® Alloy C-276			
		MIN		MAX		MIN		MAX		MIN		MAX		MIN		MAX		MIN		MAX	
		IN	MM	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg	psig	barg
1	25	35	2.4	500	34.5	35	2.4	500	34.5	50	3.5	500	34.5	58	3.5	500	34.5	55	3.8	500	34.5
1.5	40	30	2.1	400	27.5	30	2.1	400	27.5	45	3.1	400	27.5	45	3.1	400	27.5	45	3.1	400	27.5
2	50	25	1.8	400	27.5	25	1.8	400	27.5	30	2.1	400	27.5	30	2.1	400	27.5	30	2.1	400	27.5
3	80	20	1.4	400	27.5	20	1.4	400	27.5	22	1.5	400	27.5	22	1.5	400	27.5	25	1.5	400	27.5
4	100	16	1.1	400	27.5	16	1.1	400	27.5	18	1.3	400	27.5	18	1.3	400	27.5	20	1.3	400	27.5
6	150	15	1	225	15.5	15	1	225	15.5	15	1	225	15.5	15	1	225	15.5	20	1	225	15.5
8	200	15	1	125	8.6	15	1	125	8.6	15	1	125	8.6	15	1	125	8.6	20	1	125	8.6

Introduction

The Sigma EXL™ Reverse Buckling Rupture Disk has been developed to provide the highest operating pressure capability available from a Rupture Disk pressure relief device. Sigma EXL™ Rupture Disk technology and the SRB-7RS™ Safety Head combine the accuracy and reliability of Reverse Buckling Disk technology with unique disk and safety head design features that enable the Sigma EXL™ disk to operate to 95% of the Marked Burst Pressure (100% of Minimum Burst Pressure according to CEN ISO 4126-2 standards). The Sigma EXL™ Rupture Disk embraces Saf™ technology, Structural Apex Forming, the central feature on the disk dome enhancing burst pressure accuracy.

At its burst pressure, the Sigma EXL™ Rupture Disk dome reverses and opens by shearing around a circular score line located near the perimeter of the dome. The score line engages with one or more points on the integral hinge down stream of the disk.

The disk opens around its circular score line with the central petal supported by the hinge, avoiding fragmentation. The Sigma EXL™ Rupture Disk is offered with a simple burst pressure tolerance.

No Manufacturing Design Range needs to be considered for this high Operating Ratio disk (effectively a ‘zero’ range disk).

The performance of every Sigma EXL™ disk is assured by proof pressure testing each disk to its maximum recommended operating pressure. The Sigma EXL™ Rupture Disk provides the user with the highest Operating Ratio of any Rupture Disk pressure relief device.

For users who wish to obtain the enhanced quality assurance testing of this disk design, and can accept more traditional Reverse Buckling Disk accuracy, the Sigma™ Rupture Disk is offered with a -5% Manufacturing Design Range.

Manufacturing Design Range

Manufacturing Design Range (MDR) is a range of pressure, always applied to the minus side of the user’s requested burst pressure, that simplifies disk fabrication testing and provides an economic benefit to the user where such an added tolerance can be accommodated by the application.

The Sigma EXL™ Rupture Disk has a standard “0%” MDR, and the Sigma™ Rupture Disk less a “-5%” range.

Burst Tolerance

Burst tolerance is the range of pressure over which a rupture disk is expected to burst, expressed as a “+/-”. Both Sigma EXL™ and Sigma™ disks have the same burst tolerance.

Marked Burst Pressure	Burst Tolerance
Less or equal to 40 psig (2.76 barg)	± 2 psig (0.138 barg)
Above 40 psig (2.76 barg)	± 5%

Damage Safety Ratio ≤ 1

If a Sigma EXL™ or Sigma™ Rupture Disk is accidentally damaged, it will relieve pressure by bursting at or typically below its marked burst pressure. This failsafe design feature is called the Damage Safety Ratio, and with a value of 1 or less, will ensure that the Sigma EXL™ or Sigma™ Disk will, if damaged, relieve pressure at a reduced burst pressure. A damaged Sigma EXL™ or Sigma™ Rupture Disk will typically reverse and then open at a reduced pressure.

Operating Ratio

Sigma EXL™ Reverse Buckling Disks can sustain operating pressures to 95% of their marked burst pressure, or to 100% of their minimum burst pressure. (For disks certified under CEN ISO 4126-2 'Performance Tolerance', the Sigma EXL™ disk can sustain operating pressures to 100% of the burst pressure less the negative performance tolerance.)

Sigma™ Reverse Buckling Disks having a -5% Manufacturing Design Range may also sustain operating pressures to 95% of their marked burst pressure, or to 100% of their minimum burst pressure. However, this operating pressure may be lower than for a Sigma EXL™ disk by as much as the -5% MDR.

Materials

The Sigma EXL™ and Sigma™ Rupture Disks are available in a range of corrosion resistant materials (see table). For each material the upper temperature limit has been determined from the recommendations of material manufacturers and user experience. While Hastelloy C-276 is the standard grade used, Hastelloy B and Hastelloy C-22 may be available upon request.

Fluorocarbon film liners are available as an additional corrosion barrier attached to the process side of the Rupture Disk. FEP is the standard liner material. PFA and PTFE may also be available. See table for maximum temperature recommendations. Teflon™ materials are typically used: Teflon™ is a DuPont trademark.

Maximum Recommended Temperature

Material	Temp°F	Temp°C
Nickel Alloy 200	750°	399°
Monel® Alloy 400	800°	427°
Inconel® Alloy 600	1100°	593°
316 Stainless Steel	900°	482°
Hastelloy® Alloy C-276	900°	482°
Fluorocarbon Liner (FEP)	400°	204°
Fluorocarbon Liner (PFA)	400°	204°
Fluorocarbon Liner (PTFE)	500°	260°

Hastelloy® is a trademark of Haynes International Inc., Monel® and Inconel® are trademarks of Inco Alloys International. BS&B may use equivalent materials from other sources

Testing at Temperature

The burst pressure of each lot of Sigma EXL™ or Sigma™ Rupture Disks is tested at the users requested temperature. If the disk is requested above or below ambient temperature, burst testing for product certification will be carried out at this temperature to ensure the best product accuracy. For applications with operating temperatures that may exceed this tested burst temperature, please review with BS&B Safety Systems, LLC or BS&B Safety Systems Ltd.

Flow Performance – Kr Values – Rupture Disk Sizing

Flow resistance factor 'Kr' may be used to determine the relieving capacity of a system using calculations such as those described in Crane Technical Paper No. 410. Individual Kr values have been established for both Gas and Liquid service for the Sigma EXL™ and Sigma™ disks. These are experimentally determined at the BS&B flow laboratory according to ASME procedures and witnessed by ASME representatives. Care must be taken to use the correct value for sizing purposes. When more than one 'Kr' value is marked on the disk tag, 'Krg' is indicated for Gas service, and 'Krl' for liquid service. A single disk tag Kr value is valid for gas service only.

When using Kr value for sizing calculations, the nominal pipe size (assuming schedule 40 pipe) of the vent system is used.

When using 'coefficient of discharge' sizing techniques, the Minimum Net Flow Area or Net Relief Area of the Rupture Disk device is used.

Minimum Net Flow Area (MNFA) /Net Relief Area (NRA)

unit	Disk Size													
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm		
size	1	25	1.5	40	2	50	3	80	4	100	6	150	8	200
in ² *	0.86		1.93		3.36		7.39		12.74		28.89		50	
cm ² **	4.8		11.3		19.7		40.8		69.7		158.6		275.6	


* Use MNFA in in² when sizing according to ASME code, simple system case.
** Use Net Relief Area cm² when sizing according to European codes

Certification

The certification procedure for Sigma EXL™ and Sigma™ Rupture Disks exceeds those required by standard industry Codes and Standards that require limited destructive testing to validate burst pressure and permit acceptance of the lot with any burst test distribution and uncentered test data. The Sigma EXL™ and Sigma™ disk's test data is graphically presented on their Burst Test Certificate (see picture). The curve includes 'in process' and final certification burst test data to build a clear picture of the burst pressure distribution. Only when the data is appropriately centered and distributed is the lot accepted for shipment. The Certificate indicates also the burst test results of rupture disks tested from the "lot" for Quality Department final acceptance – the quantity of test results will typically be determined by the certification Code or Standard chosen by the user.

Sigma EXL™ and Sigma™ Rupture Disks are also validated for liquid service for each lot using a fully hydraulic burst test system and the Burst Test Certificate endorsed accordingly.

The combination of statistical control techniques for burst pressure, and proof pressure testing of all ordered Sigma EXL™ and Sigma™ Rupture Disks enables their application to the highest operating pressures available from the Rupture Disk Industry.



BS&B
HAYNES SAFETY SYSTEMS, LLC
CORPORATE HEADQUARTERS

BURST TEST CERTIFICATE

A CERTIFICATE OF CONFORMANCE

SUPPLIED TO

HS&B LOT NO **A0675825-1**

SIZT **3 INCH**

TYPE **SIGMA-EXL**

MATERIAL **316SS** | IFAT No.

QUANTITY SUPPLIED **25**

WE CERTIFY THAT THE Rupture Disks covered by this data have been manufactured, inspected, tested and packaged in accordance with the purchase order requirements.

DATE **01 AUG 2000** | PO NO. **492609**

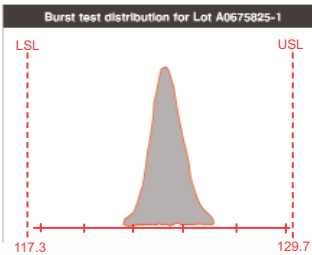
S&P LY HEAD (HOLDING) REFERENCE **SRB-7RS/SRB-7FS**

TAG NO(S) **PSE5725/6/7/8/9**

BURST PRESSURE			
MARKED	UNITS	TOL.	TEMP
123.5	PSIG	-5%	72°F

Burst Test Results			
TEST	PRESSURE	UNITS	TEMP
1	122.5	PSIG	72°F
2	125.0	PSIG	72°F
3	123.0	PSIG	72°F
4	122.5	PSIG	72°F

Burst test distribution for Lot A0675825-1




Performance Testing		Results
BURST PRESSURE TESTS	100% MIN	PASS
PROOF PRESSURE TEST	100% MIN	PASS
LIQUID OPENING TEST		PASS

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Manufactured and tested according to
ASME Section VIII UD (stamp).



Manager Quality Assurance

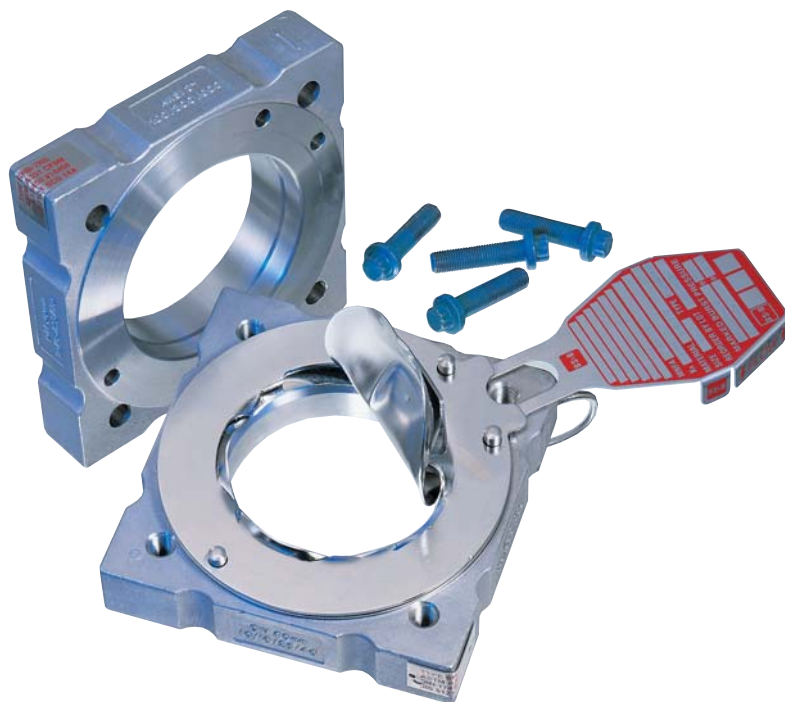
Installation in SRB-7RS™ Safety Head

The Sigma EXL™ and Sigma™ disks are installed in an SRB-7RS™ Safety Head permitting the correct torque to be applied in the workshop before installation into the process. The asymmetric locating pins ensure centering and orientation of the disk within the Safety Head. The performance-proven metal-to-metal 'bite type' seal in the Safety Head (2"/50mm size and above) assures a leak tight assembly.

When installed properly into the SRB-7RS Safety Head, the assembly can be removed, inspected, cleaned carefully then reinstalled without replacing the disk as the pretorque cap-screws maintain the clamp load on the disk.

The SRB-7RS Safety Head is used with the other rupture disks (Types SKR™, S90™, JRS™, RLS™, FRST™) of the STA-SAF® System.

US patent No 5,005,722 and other international patents pending.



Nominal Size		Safety Head Flange Rating			Safety Head Flange Thickness		Dimensions			
							X		Y	
in	mm	ANSI	DIN	JIS	in	mm	in	mm	in	mm
1	25	150	-	-	1 1/2	38.0	2 5/8	66.7	2 5/8	66.7
1	25	300/600	10/16/25/40	10/16/20/30/40	1 1/2	38.0	2 7/8	73.0	2 7/8	73.0
1.5	40	150	-	10/16/20	1 5/8	43.0	3 3/8	85.7	3 3/8	85.7
1.5	40	300/600	10/16/25/40	30/40	1 5/8	43.0	3 3/4	95.2	3 3/4	95.2
2	50	150/300/600	10/16/25/40	10/16/20/30/40	1 3/4	47.5	4 1/8	104.8	4 1/8	104.8
3	80	150/300/600	10/16/25/40	16/20/30/40	2 1/8	55.0	5 1/4	133.3	5 1/4	133.3
3	80	-	-	10	2 5/8	66.7	4 3/4	120.6	4 3/4	120.6
4	100	150/300	10/16/25/40	16/20/30/40	2 7/8	73.0	6 1/4	158.7	6 1/4	158.7
4	100	-	-	10	2 3/4	69.9	Flower Petal			
4	100	600	-	-	2 5/8	66.7	7 5/8" OD/193.7 mm OD			
6	150	150/300	10/16/25/40	10/30/40	3 11/16	93.7	Flower Petal			
6	150	-	-	16/20	4 1/5	106.7	Flower Petal			
6	150	600	-	-	3 1/8	79.4	10 3/8" OD/263.5 mm			
8	200	150/300	-	-	3 13/16	96.8	Flower Petal			

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