BURSTING DISC SIZING

Introduction

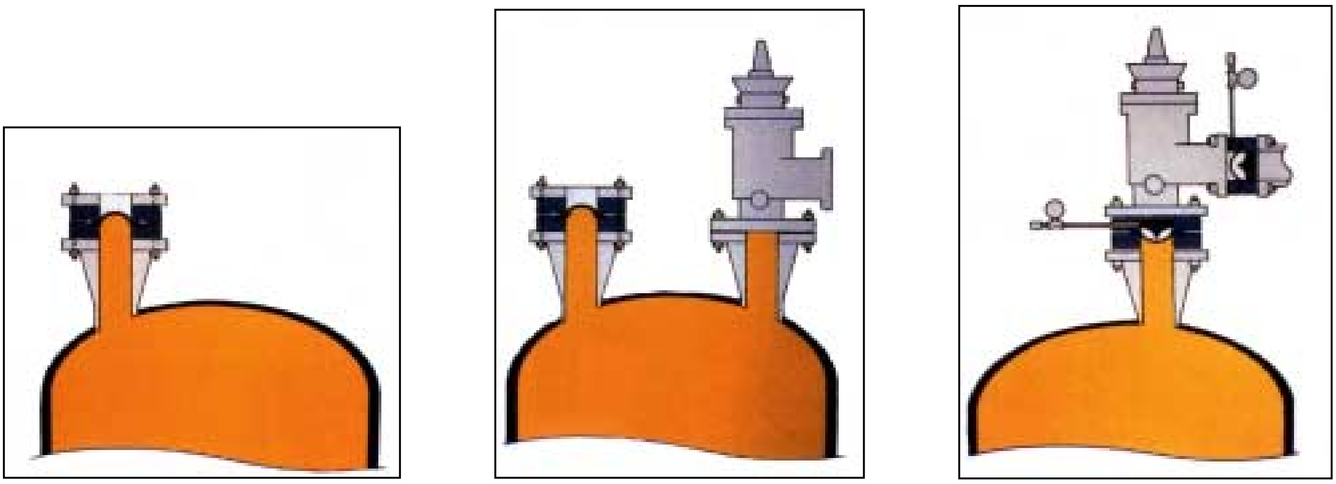
Safety devices for the protection of pressure equipment against excessive pressure include pressure relief devices such as safety valves and bursting disc safety devices which, dependent upon the application, may be used either as the sole pressure relieving devices or in conjunction with each other.
When sizing of bursting disc safety devices in undertaken, it is important to consider not only the pressure relief devices but the whole of the pressure relief system so as not to reduce the relieving capacity below that required or adversely affect the proper operation of the pressure relieving devices.
The objective of this bulletin is to provide detailed guidance for sizing bursting discs using standard methodologies found in EN/ISO 4126-6, ASME Section VIII Div. 1, API RP520, and Crane TP-410.
This brochure is part of a series covering Bursting Disc Sizing. Specific folders, describing the sizing requirements in accordance with ASME and EN/ISO, and the use of bursting discs in combination with safety relief valves, are available. To assist in the sizing process, Fike offers disCalc, a PC-based sizing program. Call Fike or your local representative for your complementary copy.

Overpressure Allowance

When sizing pressure relief devices, generally the Pressure Vessel Codes define the maximum pressure that may build up in the pressure vessel while the device is relieving. This pressure varies depending on the applicable code or standard and on the application of the device. The following table defines the various overpressure allowances as typically allowed for by the ASME Code:

Primary Relief Application	**Multiple Devices (Secondary)**	**External Fire**	**External Fire (Ambient temperature compressed gas storage vessels only)**
10% above the vessel MAWP*	16% above the vessel MAWP*	21% above the vessel MAWP*	20% above the vessel MAWP*

*MAWP = Maximum Allowable Working Pressure, a term used to designate the pressure for which the recipient has been designed



Typical application of bursting disc safety device.

Within the scope of the various pressure vessel codes, the use of bursting disc devices is permitted to achieve protection of such system.

A bursting disc safety device is a non-reclosing pressure relief device used to protect pressure equipment such as pressure vessels, piping, gas cylinders or other enclosures from excessive pressure and/or excessive vacuum.
A bursting disc safety device typically comprises an assembly of components including a bursting disc, a bursting disc holder and, where necessary, other components such as back-pressure supports, stiffening rings etc.

The bursting disc is pressure-containing and pressure-sensitive part of the bursting disc safety device and is designed to open by bursting at a pre-determined pressure. There are many different types of bursting disc safety devices manufactured in corrosion resistant materials, both metallic and non-metallic, to cover a wide range of nominal size, burst pressures and temperatures.

Bursting Disc Sizing Methodologies

All sizing equations for pressure relief devices are derived from the general Bernoulli equations for flow of liquids, steam and vapour. The pressure relief device is considered to behave similar to an orifice device introducing a certain amount of flow resistance. The sizing is specific to single phase flow conditions; in such cases where two-phase flow conditions can occur the given sizing methods are not to be used. Specialists should be consulted for such applications.

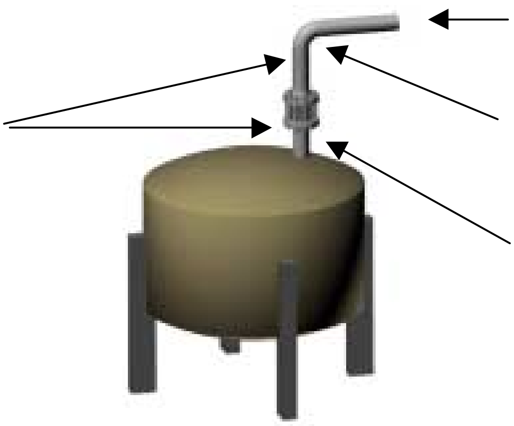
1. The ISO/EN Standards for the use of bursting disc devices offer two different methods; a simplified approach, neglecting pressure drops in the inlet and discharge piping with limited range of application, and a second, more comprehensive method where consideration is given to the changes in pressure throughout the entire pressure relief system. It is important to select the sizing method that is relevant to the particular application and is correctly applied by qualified and experienced persons. Separate sizing rules are being developed to describe sizing of bursting disc devices when used in combination with pressure relief valves.

2.The ASME Code recognises 3 basic methodologies for sizing bursting disc devices:

2.1 Coefficient of Discharge Method (K_D) – The value of K_D is the coefficient of discharge that is applied to the theoretical flow rate to arrive at a rated flow rate for simple systems.

When to use this method?	Use this method for simple systems where the following conditions are true (8 &5 Rule). This method takes into account the vessel entrance effects, 8 pipe diameters of inlet piping, 5 pipe diameters of discharge piping, and effects of discharging to atmosphere. See schematic below.

8 & 5 Rule



2.2 Resistance to Flow Method (K_R) – The value of K_R represents the velocity-head loss due to the pressure relief device. This head loss is included in the overall system loss calculations to determine the size of the relief system.

When to use this method?	Use this method when the 8&5 Rule does not apply. When the bursting disc device is installed in combination with a pressure relief valve this method can be used to calculate the pressure drop between the pressure vessel and the valve. Use this method also where turbulent flow conditions are expected.

Bursting disc devices can be characterized as to their respective resistance to fluid flow. The K_R-value represents the velocity head loss due to the bursting disc device installed in the flow path. This head loss is included in the overall system loss calculations to determine the capacity of the relief system.

Typical K_R –values for most common Fike bursting discs are tabled below:

Disc Type	**SRX**	**SRL**	**SR-H**	**Poly-SD (X-Score)**	**SCRD FSR**	**HO/HOV**	**P, CP, CPC**
K_R	0.99	0.38	1.88	0.99	0.55	2.02	1.35

Disc Type	**PV, CPV, CP-C, CPV-C**	**MRK**	**P FSR**	**GD**	**GDI**	**GDL**	**GDV Bar Type**
K_R	3.50	1.56	0.55	0.26	0.64	0.64	3.4

Consult Fike for K_R-values for bursting disc types not listed.

International and national standards such as EN/ISO 4126-6 & ASME PTC25 provide standardized test methods to measure the K_R of the bursting disc devices. By the quantification of this performance characteristic, bursting disc devices may be accounted for in the piping system sizing calculations in the same way as piping and piping components (such as exit nozzles, elbows, tees, reducers, valves, etc.). Crane Co. Technical Paper N° 410M list generally accepted flow resistance values for typical piping components such as elbows, reducers, etc.).

Note: it is important to understand that the certified K_R is representative of the device (disc and holder), not simply the bursting disc. In cases where there is no holder, the K_R-value is for the disc, which is then defined as the device.

2.3 Combination Capacity Method – When a bursting disc device is installed in combination with a pressure relief valve (PRV), the valve capacity is derated by a default value of 0.9 or a tested value for the specific disc/valve combination. For specific application requirements when using bursting disc devices in combination with PRV's, consult Fike.
The table on next page provides certified combination capacity factors that are published in the National Board of Pressure Vessel Inspectors "Red Book". To use these values, find the listing for the specific rupture disc and valve models. Multiply the rated valve capacity by the combination capacity factor to arrive at the capacity of the combination. Use the value of 0.90 for combinations in smaller sizes or lower pressures than listed.

Certified Combination Capacity Factors

Rupture Disc Model	Valve Model	Min Size	Minimum Burst Pressure Barg	Material	Capacity Factor
Rupture Disc Model: Poly-SD	Dresser 1900, 1900-30, 1900-35	1 in/DN25	4.14	Nickel	0.992
		1 in/DN25	13.80	SST	0.986
	Dresser 1900, 1900-30	2 in/DN50	5.17	Alum/Teflon	0.994
	Dresser 3900-1	2 in/DN50	3.79	Alum/Teflon	0.989
	Dresser 1900E-2, 1900-30E-2, 1900-35E-2 Restricted Lift E Orifice Only	1 in/DN25	4.14	Nickel	0.990
		1 in/DN25	13.79	316 SST	0.987
	Teledyne Farris 2600 (Double Disc Assy Only)	2 in/DN50	5.72	Nickel	0.974
	Teledyne Farris 2600 and 4500	1 in/DN25	4.14	Ni/Teflon	0.991
		1 in/DN25	4.14	Nickel	0.997
		1 in/DN25	7.24	Tantalum	0.994
		1 in/DN25	9.80	Inconel	1.000
		1.5 in/DN40	10.34	SST	0.985
	Teledyne Farris 274 OUL	1 in/DN25	4.38	Ni/Teflon	0.990
	Kunkle 910 to 929, 75	2 in/DN50	3.45	Nickel	0.996
	Kunkle 5000	2 in/DN50	3.45	Nickel	1.000
	Fukui RE	1.5 in/DN40	4.14	Nickel	0.999
Rupture Disc Model: MRK	Anderson Greenwood 323	1 in/DN25	6.07	316 SST	0.9912
		1.5 in/DN40	4.62	316 SST	0.9903
		3 in/DN80	2.69	Tantalum	0.9934
		6 in/DN150	1.01	316 SST	0.9621
	Dresser 1900	1 in/DN25	4.07	SST	0.976
		1 in/DN25	3.65	Nickel	0.979
		1.5 in/DN40	3.31	SST	0.979
		1.5 in/DN40	3.93	SST	0.992
		3 in/DN80	1.45	Nickel	0.983
	Lonergan D, DB	1in/DN25	2.07	316 SST	0.972
		1 in/DN25	3.45	Nickel	0.988
		3 in/DN80	1.45	316 SST	0.946
		3 in/DN80	1.37	Nickel	0.976
	Teledyne Farris 2600, 4500	1 in /DN25	5.10	SST	0.976
		1 in/DN25	5.45	Nickel	0.997
		1.5 in/DN40	4.00	Nickel	0.990
		3 in/DN80	2.34	Nickel	0.983
		3 in/DN80	2.41	316 SST	0.978
	Crosby JOS, JBS	1 in/DN25	4.14	316 SST	0.967
		1 in/DN25	4.14	Nickel	0.977
		3 in/DN80	2.41	316 SST	0.982
		3 in/DN80	2.41	Nickel	0.995
	Fukui RE	1.5 in/DN40	4.00	Nickel	0.994
		1.5 in/DN40	3.93	316 SST	0.985

References

ISO 6718 Bursting Disc Devices (1991 edition)
EN 4126 Safety Devices for protection against excessive pressure, Part 6: Application, selection and installation of bursting disc safety devices (2000 edition)
American Society of Mechanical Engineers, Boiler and Pressure Vessel Code Section VIII, Division 1, 1998 Edition
American Society of Mechanical Engineers, PTC25
American Petroleum Institute, RP520
Crane Valves, Technical Paper 410
Crane Valves, Crane Companion Computer Program
Fike Technical Bulletin TB8104 Certified K_R Factors

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