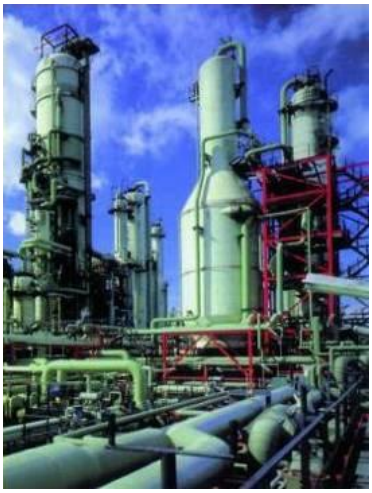
Rupture Discs as Safety Devices



Chemical plants, tanks, reactors, silos and any other equipment working under pressure may be damaged or destroyed by non controlled pressure rises.

Protection of personnel and equipment from this risk is achieved with safety devices that provide an adequate fluid outlet, venting the excess pressure.

In the same way protection from depression is achieved.

Rupture discs and relief valves are the safety devices used more frequently. Their design and performance are widely different but both types protect the equipments from high pressure

Main properties of the two devices are compared in the following table:

EQUIPMENT	RUPTURE DISC	SAFETY VALVE
Type of device	Simple	Mechanical
Mounting position	Any position	Only vertical
Behaviour when overpressure ceases	It does not re-close the disc must be replaced	It closes again
Does it give protection from overpressure	Yes	Yes
Does it give protection from vacuum	Yes	No
Periodical check of calibration	Not required	Required
Is it possible to change calibration	No	Yes
Calibration lower than 0.1 bar	Yes	No
Calibration higher than 500 bar	Yes	No
Availability of diameters	Large selection	Limited
Availability of materials	Large selection	Limited
Maintenance	Minimum	High
Costs	Minimum	High
Leaks during operation	No	Possible

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Rupture discs and safety valves may be used independently as primary safety devices or in conjunction.
Possible combinations are:
Rupture disc and Safety valve in parallel: rupture disc is a second level of protection (usually set at a pressure slightly above that of the valve). Typical application: protection of liquefied gas tanks.
Rupture disc downstream the valve: The disc shields the valve from corrosive fluids eventually present in the discharge duct
Rupture disc upstream the valve solution combines the positive properties of both devices: leak tight seal of the disc and re-closure of the pressure relief valve. In addition the disc protects the valve from corrosive or scaling products and reduces the maintenance requirement of the more expensive and sensitive equipment. Key advantages are:

- Protect the valve from corrosive or scaling products
- Avoid leakage due to corrosion or scaling of valve seat (very important for dangerous fluids)
- Reduce valve maintenance cost (cleaning and calibration)
- Possibility to test the correct performance of the valve without shutting down the plant and dismounting the valve.

The disc is normally set at the same pressure as the valve; pressure build up in the space between the two devices must be monitored and avoided by providing a venting port
The rupture disc (or bursting disc) is a very versatile device and is extremely useful at very low and very high running pressure, in contact with toxic or expensive fluids when leaks are not allowable. It is a very reliable device without maintenance problems notwithstanding its low cost.
Rupture discs belong to 3 families:

- Metal
    - Conventional or forward acting
    - Compression or reverse acting
- Graphite.

Disc selection depends from exercise conditions of the equipment to be protected:

- Conventional discs have a flat or concave surface exposed to the pressure. Bursting happens when the pressure (or depression) overcomes the mechanical resistance of the material, after having gradually increased the camper of the disc.
- Reverse acting discs have a convex surface exposed to the pressure. The shape of the disc does not change until the pressure reaches the bursting point.
- Graphite discs are recommended at low exercise pressure in contact with aggressive fluids. They are normally used at low and medium pressure.

Minimum and maximum bursting pressures are dependent from:

- Disc model
- Dimension
- Material

Minimum and maximum working temperatures are dependent from disc material as in following table

Rupture Discs

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Material	Maximum temperature °C	Minimum temperature °C
Stainless Steel AISI 304	280°C	-196°C
Stainless Steel AISI 304L	280°C	-196°C
Stainless Steel AISI 316	315°C	-196°C
Stainless Steel AISI 316L	315°C	-196°C
Stainless Steel AISI 321	315°C	-196°C
Nickel 200	400°C	-196°C
Monel 400	427°C	-196°C
Inconel 600	427°C	-196°C
Hastelloy C276	480°C	-196°C
Titanium	300°C	-60°C
Copper	200°C	-10°C
Aluminium	260°C	-10°C

Working temperature of discs with a lining is also dependent from lining material

Membranes

Material		USE LIMITS	
Typo	**Code**	**T max.**	**T min.**
Polymer	PTFE	260°C	---
"	FEP	204°C	---
"	MYLAR	110°C	---
Stainless Steel	ASTM A 240 316L	315°C	-196°C
Aluminium	ASTM B 209	260°C	-10°C
Copper	ASTM B 569	200°C	-10°C

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