

Safety of installations Rupture discs



*A high quality protection
for your installations*

RUPTURE DISCS

CARBONE LORRAINE



Applications

Industry	For the protection of:
Pharmacy	Chemical reaction vats
Chemicals	Fermentation vats
Petrochemicals	Tankers for the transport of fermentable products
Aviation	Compartments in tanker ships
Plastics	Storage tanks on oil tank farms
Electrical materials	Steam turbine exhaust circuits
Food products	Electrical circuit breakers

The advantages of a CARBONE LORRAINE rupture disc

- GRAPHILOR® 3 (see documentation GCA 15) does not deform and does not age.
- The range of diameters varies from 25 mm to 600 mm.
- The effective burst pressure is between 0.07 bar and 100 bars.
- They are reliable and safe, and can be adapted when corrosion occurs.
- They guarantee bursting immediately when the defined pressure has been reached.
- The bursting pressure does not vary with time.
- CARBONE LORRAINE rupture discs are standard and comply with national and international standards.
- There is a permanent stock of the most frequently used diameters.
- Finally, prices are competitive.

The choice of a rupture disc

The following parameters must be known when selecting a rupture disc:

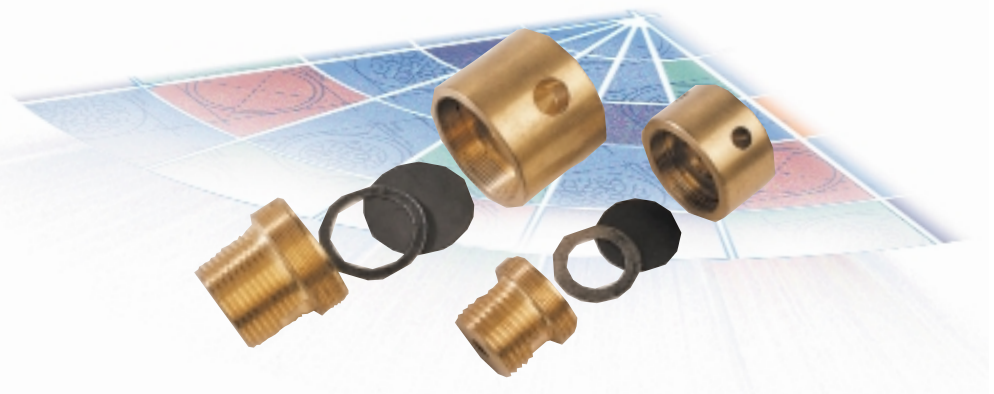
- the effective burst pressure (EBP), the difference between the upstream pressure and downstream pressure
- the operating temperature
- the minimum active diameter defined by the exhaust flow
- pressure and vacuum conditions
- the nature of the material in contact with the rupture disc



Rupture disc series A



Rupture disc support series 1

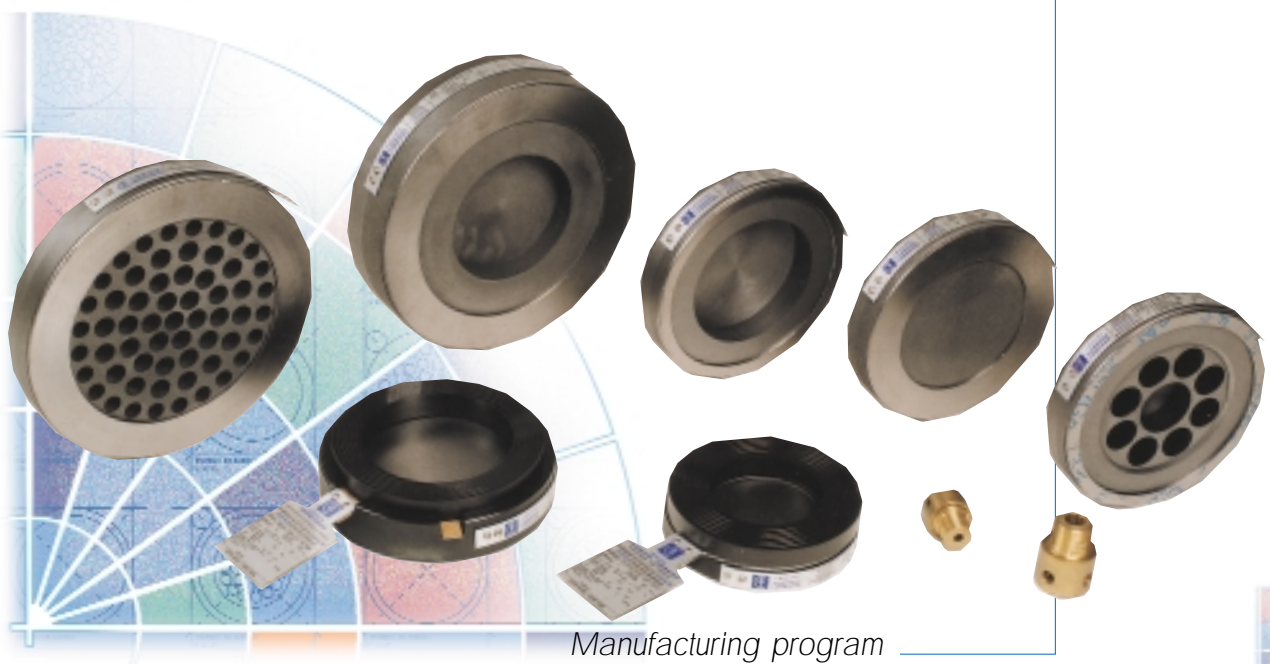


The manufacturing program

The manufacturing program includes three product groups:

- replaceable membrane discs
- monobloc discs
- capsulated discs

Product type	Series	Active diameter		Usage range	EBP in bars at 20°C	Tolerance on EBP	T°C limits	Options
		mm	inch					
Replaceable membrane discs	1	50 to 600	2 to 24	Low pressure	0.07 to 0.34	±25 %	-50 to +165	<ul style="list-style-type: none"> • Stainless steel support • Rupture detector
	2	25 to 600	1 to 24	Medium pressure	0.35 to 30	±10 %	-50 to +165	<ul style="list-style-type: none"> • Thermal insulation device • Vacuum netting
Monobloc discs	3	25 to 600	1 to 24	Medium pressure	0.8 to 40	±10 %	-50 to +165	
	4	25 to 600	1 to 24	Medium pressure	0.35 to 40	±10 %	-50 to +165	<ul style="list-style-type: none"> • Thermal insulation device • Vacuum netting for series 4
	5	25 to 600	1 to 24	High pressure	1.2 to 100	±10 %	-50 to +165	<ul style="list-style-type: none"> • Rupture detector
	6	25 to 600	1 to 24	High pressure	0.1 to 35	±15 %	-50 to +200	<ul style="list-style-type: none"> • Spark guard basket
	8	25 to 600	1 to 24	Medium pressure	0.08 to 40	±15 %	-50 to +165	
Capsulated discs	7	12.7 and 19	1/3 and 3/4	Low flow	1.4 to 80	±15 %	-50 to +165	<ul style="list-style-type: none"> • Brass or stainless steel support

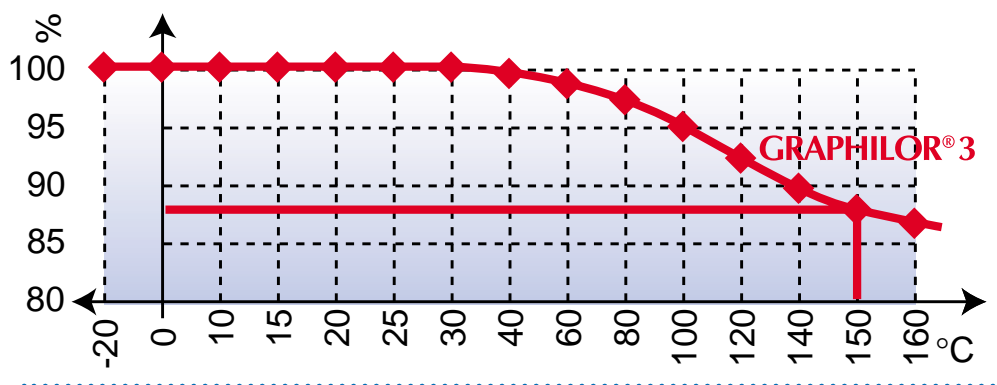


Manufacturing program



The influence of temperature on the effective burst pressure:

Discs are calibrated at 20°C (the temperature 20°C is marked on the label of each disc). When the operating temperature is greater than 20°C, the EBP decreases slightly in the proportions given in the following curve:



Example :

For a GRAPHILOR rupture disc (or membrane), the EBP at 150°C will be equal to 88% of the EBP indicated at 20°C.

Therefore for a EBP of 6 bars relative at 150°C, the disc will burst at:

$$\frac{6}{0.88} = 6.82 \text{ bars relative at } 20^{\circ}\text{C}.$$

A disc with a EBP equal to 7 bars relative at 20°C will be chosen.

NOTE :

When the operating temperature is greater than 165°C, a thermal insulation device will have to be adapted on the inlet side of the disc.

A series 6 rupture disc could also be chosen if the maximum operating temperature is less than 200°C. In this case, there is no need to make a EBP correction as a function of the operating temperature.

The active diameter:

The following formulas are used to calculate the minimum active diameter, in other words the size of the rupture disc, based on British standard BS 2915, 1990.

Symbols:

W: mass flow per hour in kg/h

De : hourly volumetric discharge rate

A : active cross-sectional area of the disc in mm²

d : active disc diameter in mm

T : temperature in Kelvin (K)

P : absolute pressure

M : molar mass of the gas in kg/kmole

V₀ : molar volume in m³/kmole under normal temperature and pressure conditions (T₀ = 273 K and P₀ = 1 bar).

C : constant depending on the ratio $\gamma = \frac{C_p}{C_v}$ of the specific heats of the gas at constant pressure

K : evacuation coefficient dependent on the shape of the orifice



Calculation starting from the required exhaust flow

The mass flow : $W = CKAP \left(\frac{M}{T}\right)^{1/2}$

volume flow: $De = CKA \frac{Po Vo}{To} \left(\frac{T}{M}\right)^{1/2}$

Assume that all gases are perfect and that $Vo=22.4$ m³/k mole.

- K = 0.6

NOTE: C varies between : ⇨ 2.39 for $\gamma = 1$

- C = 2.4 for all gases

⇨ 2.84 for $\gamma = 1.62$

This assumption can result in slightly oversizing the diameter of the rupture disc.

Therefore: $W = 1.13 d^2 P \left(\frac{M}{T}\right)^{1/2}$

$De = 0.1 d^2 \left(\frac{T}{M}\right)^{1/2}$

The disc diameter is determined as follows (in mm):

$d = 0.94 \left(\frac{W^2 T}{P^2 M}\right)^{1/4}$

$d = 3.3 \left(De^2 \frac{M}{T}\right)^{1/4}$

We then obtain: M = 29kg/k mole

T = 298 K

Special case: air at 20°C

The air mass flow at 20°C

The air volume flow at 20°C:

$W(\text{air}, 20) = 0.35 d^2 P$

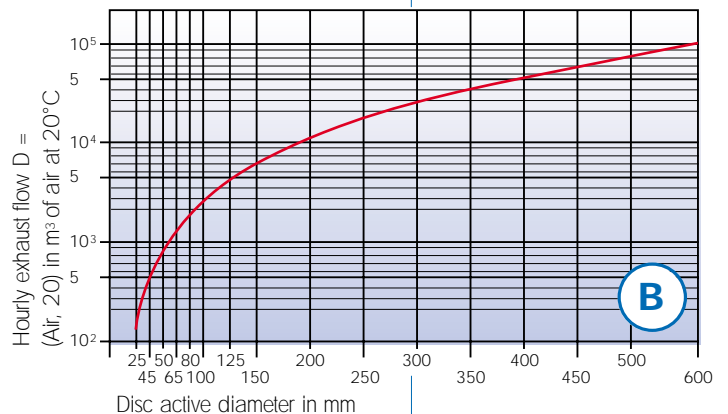
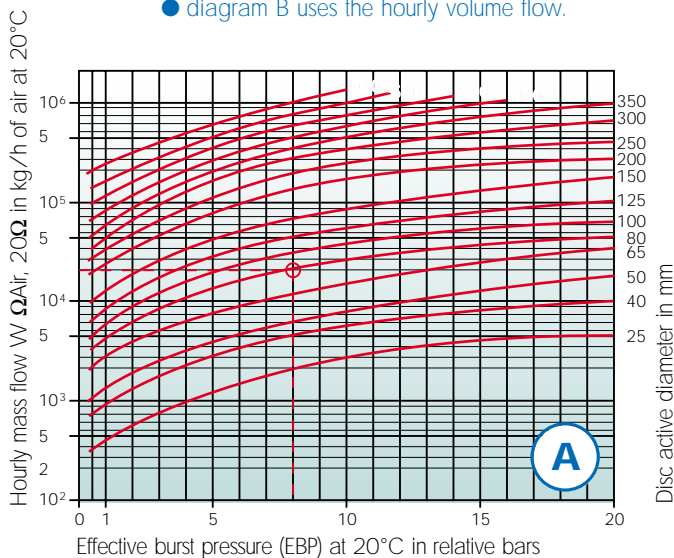
$De(\text{air}, 20) = 0.3 d^2$

$d = 1.7 \left(\frac{W(\text{air}, 20)}{P}\right)^{1/2}$

$d = 1.83 (De(\text{air}, 20))^{1/2}$

Dependent on the EBP at 20°C and the required air exhaust flow

- diagram A uses the required hourly mass flow and the EBP at 20°C.
- diagram B uses the hourly volume flow.





Graphic method of selecting the active diameter for a gas other than air at temperature T:

The previous diagrams can be used to determine the active diameter necessary in the case of a gas with molar mass M and at temperature T.

The first step is to calculate the air equivalent to 20°C, of the gas exhaust flow at temperature T, using the following correction formulas:

$$W(\text{air}, 20) = 0.32 \left(\frac{T}{M}\right)^{1/2} W \qquad De(\text{air}, 20) = 3 \left(\frac{M}{T}\right)^{1/2} De$$

For example :

Assume that it is required to be able to dissipate 5000 kg/h of hydrogen at 20°C using a rupture disc calibrated at 8 bars relative at 20°C.

With a temperature correction, the disc would actually burst at 6.9 bars relative at 120°C. Since the molar mass M of hydrogen = 2 and the temperature is T = 273 + 120 = 393, we will determine the air equivalent at 20°C of 5000 kg/h hydrogen at 120°C

$$W(\text{air}, 20) = 0.32 \left(\frac{393}{2}\right)^{1/2} \times 5\,000 \approx 22\,400 \text{ kg/h of air at } 20^\circ\text{C}.$$

Using diagram A for this example gives a disc with active diameter = **80 mm**.

Graphic determination of the exhaust flow for a gas other than air at temperature T:

The previous diagrams can be used to determine the exhaust flow for a gas with molar mass M at a temperature T through a disc with active diameter d.

These diagrams show the mass exhaust flow of air at 20°C, and then it is just necessary to apply the following correction formulas:

$$W = 3.1 \left(\frac{M}{T}\right)^{1/2} W(\text{air}, 20) \qquad De = 0.33 \left(\frac{T}{M}\right)^{1/2} De(\text{air}, 20)$$

Case of a disc equipped with a vacuum netting or a thermal insulation device:

The cross-sectional area of the passage is visibly reduced by 40 to 50% (see the specifications for series 1, 2, 4 and the thermal insulation device) and this reduction in the cross-sectional area of the passage must be taken into account once the disc diameter has been calculated, by correcting the diameter of the active disc calculated as follows:

$$d_{\text{actual}} = d_{\text{calculated}} \left(\frac{\text{active cross section of disc alone}}{\text{active cross section of equipped disc}} \right)^{1/2}$$

Example:

If the cross-sectional area of the passage indicated in the characteristics is equal to 60% for a calculated active diameter of 80 mm, then the active diameter of the disc (if it is equipped with a netting or a thermal insulation device) must be:

$$80 \times \left(\frac{1}{0.6}\right)^{1/2} = 100 \text{ mm}.$$



Thermal insulation device



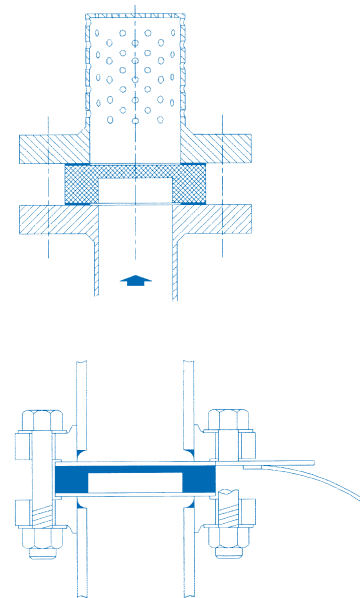
Installing a rupture disc:

The first step is to insert the disc or the supports and membrane assembly, with their rings and gaskets, between two pipe flanges. The following precautions will prevent problems:

- Use flanges with plane faces and standard dimensions.
- Check that flanges are perfectly clean and flat (planeness, concave or convex defects, must not exceed 2/100 mm per 100 mm diameter).
- Respect pipe flange bores on the inlet and outlet sides, indicated for each series.
- Center the gaskets on the discs in order to distribute the tightening force uniformly.
- Do not replace the gaskets supplied with the discs without asking us.
- Check that the disc is assembled in the right direction for the pressure to be exerted in the appropriate direction on the inlet and outlet sides, indicated for each series.
- Installation in the reverse direction will completely false the bursting characteristics.
- Labels must remain visible after the disc has been installed.
- Apply the values of the tightening torques given in the table for the different series: fasteners must be in perfect condition and must be greased.
- Torques are applicable to our standard gaskets (expanded graphite).
- Tighten the bolts crosswise, gradually and progressively.
- It is useful to provide an appropriate device on the output side to prevent sparks caused by rupture of the disc (perforated plate, metal netting, spark guard basket).
- If the gases are inflammable, noxious or toxic, provide a device to eliminate them after the disc has burst, to a location at which they are no longer dangerous.
- Make sure that their working pressure does not exceed 80% of the EBP.
- Check the disc installation once every month by checking the tightness of the disc, then tighten according to our installation instructions.
- Replace the disc if it is clogged.
- Replace the disc after three years in cases of severe use and every ten years in other cases.
- Respect appropriate safety measures when working on rupture discs.

Finally, a disc must be easily accessible for inspection or replacement.

An installation brochure (GCA 120) is supplied with rupture discs.



Storage recommendations

Leave the discs in their original packaging and store them flat.

Quality control

The TÜV has authorized our Quality Control department to issue product inspection certificates. For some series, we can supply certificates according to British standard BS 2915 (1990). All our products are accepted by our Quality Control department, any other reception will be invoiced for an extra after it has been precisely defined.

Example inspection: Stomwezen, Vinçolte, Ipsesl.

Information required with the order

- the active diameter
- the effective burst pressure at 20°C,
- the chosen serial number
- the EBP and the operating temperature
- any options (vacuum netting, thermal insulation device, rupture detector)
- the nature of the fluid used.

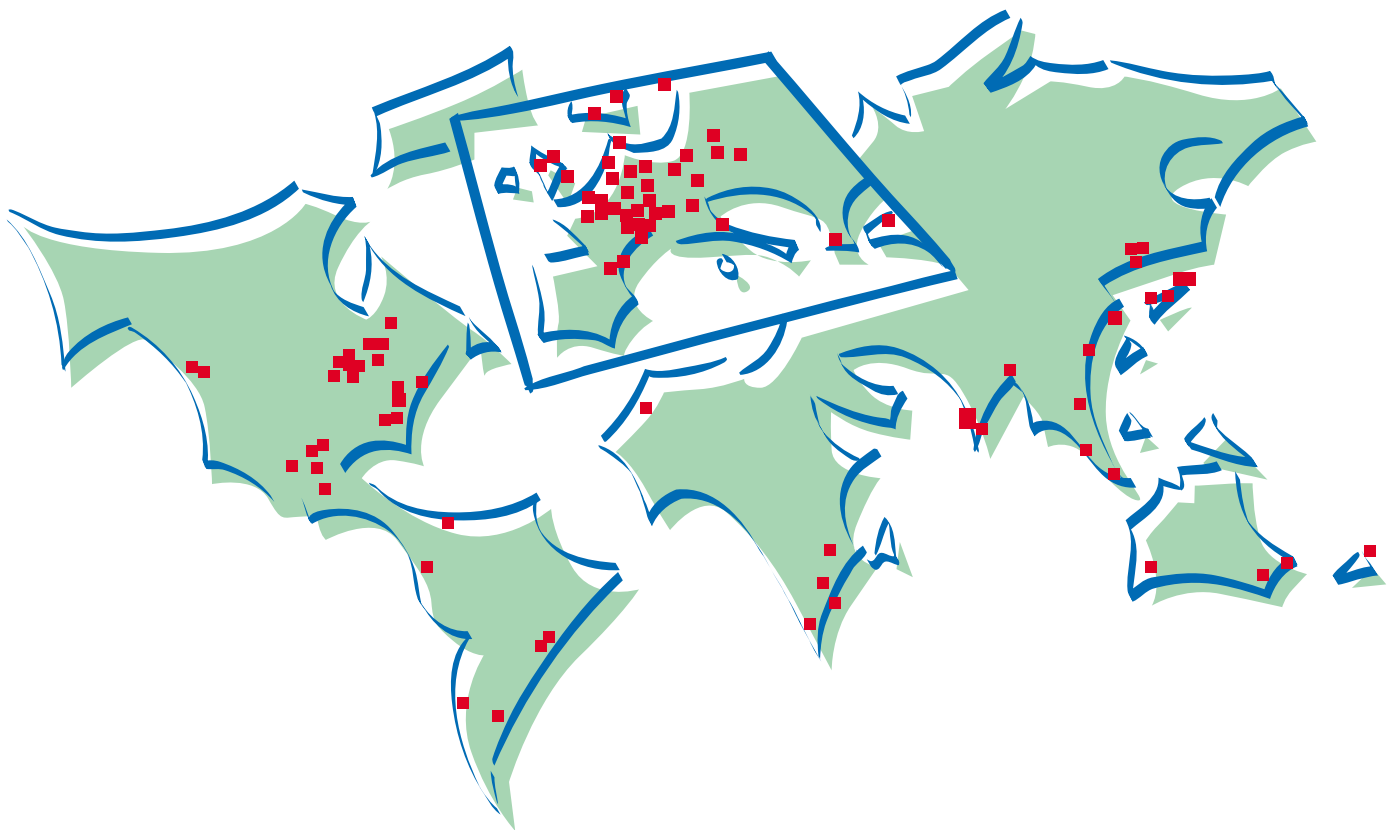
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WORLDWIDE SPECIALIST in industrial components

Since its founding in 1892, CARBONE LORRAINE has built an international reputation by creating subsidiaries on all continents. Today with industrial and commercial plants located in more than 30 countries, agencies and representatives in more

than 70 countries and 250 commercial contacts throughout the world, CARBONE LORRAINE offers its customers worldwide reliable, high technology products and the service of its experienced technicians.

A global player



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