

Cylinder pressure-relief devices

Pressure-relief devices are installed on most cylinders to prevent the rupture of a normally pressurized cylinder when it is inadvertently exposed to fire or high temperatures. There are many types of pressure-relief devices; each has a designated use. Types of pressure-relief device designs include fusible plugs, rupture disks, rupture disks with fusible metal backing, and spring-loaded relief valves.

This Safetygram identifies the pressure-relief devices used to provide cylinder protection for various compressed gases. The specific pressure-relief device designated for a compressed gas cylinder depends on many factors, including the type of gas, the Department of Transportation (DOT) rated service, test pressures of the cylinder, and the cylinder size.

The Compressed Gas Association (CGA) lists the pressure-relief devices to be used on specific products in their Pamphlet S-1.1, "Pressure-Relief Device Standards Part 1: Cylinders for Compressed Gases." DOT regulations require compliance with this document for the selection and use of pressure-relief devices to be used on compressed gas cylinders.

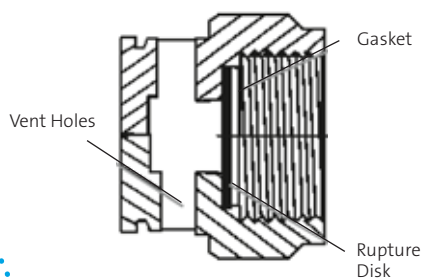
Based on historical influences different regions of the world have established their own standards e.g. European (EN/ISO), Korean (KSB) and Japanese (JIS) Standards. This Safetygram scope is limited to North America and CGA standards.

CAUTION: Pressure-relief devices do not permit the user to exercise any less care in following proper handling, use, and storage procedures for cylinders.

Types of cylinder pressure-relief devices

The CGA has identified several types of pressure-relief devices:

Figure 1: Type CG-1 Pressure-Relief Device



Type CG-1: The rupture disk device

A rupture disk device is a nonreclosing pressure-relief device actuated by static pressure and designed to function by the bursting of a pressure-containing disk. The disk is the operating part of the device. It is a flat disk, typically made of metal, designed to a specification that will allow it to burst at a predetermined pressure to permit the release of gas. Rupture disks relieve overpressure in cylinders that may result from an external fire or from overfilling. The burst pressure of rupture disks may not exceed the minimum DOT required test pressure of the cylinder, which is generally 5/3 of the cylinder service pressure. Some exceptions to this rule are:

- The burst pressure must not exceed 4500 psig for DOT-3E or CTC-3E specification cylinders.
- The burst pressure must not be less than 105% of the cylinder test pressure or greater than 80% of the minimum burst pressure for DOT-39 cylinders.

The pressure rating of the disk is typically stamped onto the face of the device.

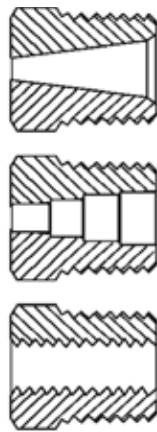
Type CG-2: Fusible plug device rated at 165°F

The fusible plug device is a nonreclosing pressure relief device designed to function by the yielding or melting of a plug of fusible metal. The type CG-2 plugs use an alloy that yields at a temperature not exceeding 170°F, nor less than 157°F (165°F nominal). These devices are not suitable for service pressures exceeding 500 psig. Pressures above 500 psig may cause the fusible alloy to extrude and eventually release the product.

Failures from excess pressure are time- and pressure-dependent. These devices cannot be relied upon to protect from overpressurization at temperatures below their melting point.

They are designed to protect the cylinder from overpressurization caused by exposure to excessive heat only. In the event a cylinder is exposed to fire or other sources of excess heat, the fusible plug is designed to melt and release the cylinder contents. This prevents product within the cylinder from creating excessively high pressures, caused by high external temperatures, and rupturing the cylinder. The plugs may use one of several designs to hold the fusible alloy in place. (See Fig. 2.) The temperature rating of the fusible metal is stamped into the face of the device.

Figure 2: Type CG-2, 3 Pressure-Relief Device



Type CG-3: Fusible plug device rated at 212°F

This device is similar to the CG-2 pressure relief device except that it uses a fusible metal with a higher melting temperature. The CG-3 device uses a fusible alloy with a melting point not exceeding 220°F, nor less than 208°F (212°F nominal). This device is most commonly found on acetylene cylinders.

Type CG-4: Combination rupture disk/fusible alloy rated at 165°F

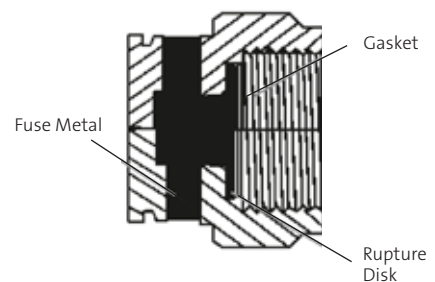
The CG-4 consists of a rupture disk backed by a fusible plug on the atmospheric side of the disk. The burst pressure of the disk must not exceed the minimum DOT required test pressure of the cylinder (except as noted under Type CG-1); the fusible metal must yield between 157–170°F (165°F nominal).

The combination pressure-relief device provides protection against cylinder rupture caused by fire or high temperatures. If a fire occurs, the fusible metal yields or melts, and cylinder overpressure caused by the heated gas is relieved by the bursting of the rupture disk. Both the pressure and temperature requirements of the device must be satisfied before the device can function.

This device will not protect a cylinder from overpressurization if the fusible alloy is not heated to its yield temperature. The fusible alloy will prevent the disk from rupture if it remains in place. The fusible metal prevents premature rupture disk failure from momentary overpressurization and also protects the disk from external corrosion which could cause premature failure of the rupture disk.

The face of these devices is marked with the burst pressure rating of the disk and the yield temperature of the fusible alloy.

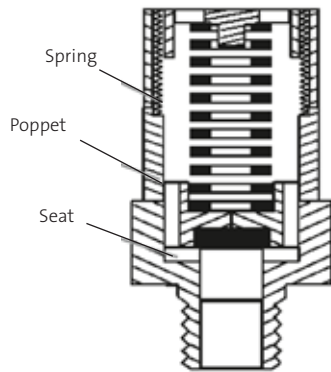
Figure 3: Type CG-4, 5 Pressure-Relief Device



Type CG-5: combination rupture disk/fusible alloy rated at 212°F

This device is the same as the CG-4 pressure-relief device except that it uses a fusible metal with a higher melting temperature. The CG-5 device uses a fusible alloy with a melting point not exceeding 220°F, nor less than 208°F (212°F nominal).

**Figure 4: Type CG-7
Pressure-Relief Device**



Type CG-7: pressure-relief valve

Pressure-relief valves are spring-loaded valves that are normally closed. When the cylinder pressure exceeds the pressure setting of the spring in the relief valve, the valve opens and begins discharging the cylinder contents. Once the cylinder pressure decreases to the relief valve's pressure setting, the valve will normally reseat—without leakage—after venting sufficient gas to control the internal cylinder pressure. The pressure setting of the pressure-relief valve must not be less than 75%, nor more than 100% of the minimum test pressure of the cylinder. The reseating pressure must not be less than the pressure in a normally charged cylinder at 130°F.

An exception is the relief valve on DOT-39 cylinders. With these, the set pressure must not exceed 80% of the minimum burst pressure of the cylinder and must not be less than 105% of the cylinder test pressure.

Cylinder pressure-relief devices for several gases

Cylinder pressure-relief devices for several common industrial gases are described below. For information about relief devices on other gas cylinders, consult your supplier.

Air, argon, helium, nitrogen, oxygen

These gases are nonflammable and stored in cylinders as high-pressure gases. The pressure-relief device used on these gas cylinders is normally Type CG-1.

Carbon dioxide, nitrous oxide

These products are nonflammable and are stored in cylinders as liquefied compressed gases. Cylinders are normally protected by Type CG-1 pressure-relief devices. Small medical cylinders with post-type valves may be protected by Type CG-1 rupture disks or by Type CG-4 combination rupture disk/fusible plug relief devices.

Hydrogen

Hydrogen is flammable and stored in cylinders as a high-pressure gas. Cylinders under 65" long must be equipped with rupture disk/fusible alloy Type CG-4 or Type CG-5 devices in only one end of the cylinder. For tubes (cylinders over 12 ft. long), no pressure relief devices are required. If pressure relief devices are installed on small tubes (< 18" diameter), Type CG-4, Type CG-5, or Type CG-1 devices shall be installed. If pressure relief devices are installed on jumbo tubes (> 18" diameter), Type CG-1 devices shall be installed. For pressure relief devices installed on small and jumbo tubes, the PRDs shall be arranged to

discharge upwards and unobstructed to the open air to prevent any impingement of escaping gas upon the containers or personnel. For Type 3 Composite Overwrapped Pressure Vessels used in Air Products portable hydrogen fueling equipment, no pressure relief devices are required in accordance with DOT Special Permit DOT-SP 21091.

Propane, APACHI™ gas

Propane and Air Products' APACHI gas are flammable. They are stored in cylinders as liquefied compressed gases. Cylinders containing these products are usually protected by Type CG-7 spring-loaded pressure-relief valves. A Type CG-3 212°F fusible metal plug may be used, but only when in combination with the Type CG-7 pressure-relief valve.

Acetylene

Acetylene is a flammable gas stored in cylinders as a dissolved gas. The cylinders are filled with a porous material saturated with a solvent, usually acetone. The acetylene dissolves into the solvent as it is placed into the cylinder. These cylinders are protected by Type CG-3 fusible metal plugs with a nominal yield temperature of 212°F. The devices are usually an integral part of the cylinder rather than being installed in the cylinder valve. Some small acetylene cylinders, Type B or MC size cylinders, are equipped with fusible plugs in the valve body.

Medical gas cylinders with post-type valves

Post-type valves on small medical cylinders are generally equipped with Type CG-4 rupture disks with 165°F fusible metal backing. Carbon dioxide and nitrous oxide cylinders may be equipped with the CG-4 or the CG-1 devices.

Safety considerations

Cylinder pressure-relief devices must be maintained in proper operating condition to function correctly.

- **NEVER** tamper with pressure-relief devices in valves or cylinders.
- Only qualified gas supplier personnel should service pressure-relief devices.
- Care should be taken when handling and storing cylinders to prevent damage to the pressure-relief devices.
- Do not obstruct any pressure-relief device. Dirt, paint, corrosion, or other materials prevent pressure-relief devices from functioning properly.
- If any obstruction, deformation, or extrusion of fusible metal is observed in a pressure relief device, notify the supplier. The cylinder should be removed from service immediately and appropriate action arranged through the supplier.
- Any problem with pressure-relief devices should be immediately reported to your supplier.

Emergency Response System

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For regional ER telephone numbers, please refer to the local SDS 24 hours a day, 7 days a week for assistance involving Air Products and Chemicals, Inc. products

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