

## Carbon Dioxide Fire Suppression Systems Extinguishing Agent

### Application

Carbon dioxide extinguishing agent is particularly useful for hazards where an electrical, nonconductive medium is essential or desirable; where clean-up of other agents presents a problem; or where the hazard obstructions require the use of a gaseous agent.

The following are typical hazards protected by carbon dioxide systems:

- Printing presses
- Vaults
- Open pits
- Dip tanks
- Spray booths
- Ovens
- Engine rooms
- Coating machines
- Process equipment
- Hoods and ducts
- Coal grinding and storage
- Turbine generators
- Rolling mills
- Flammable gas or liquid storage areas

### Description

Carbon dioxide is a plentiful, non-corrosive gas that does not support combustion nor react with most substances. It has a low toxicity classification by Underwriters Laboratories (Group 5a). It is commonly compressed to the liquid state for storage and transportation in DOT cylinders. Upon release, it discharges under its own pressure giving the appearance of steam as its low temperature crystallizes water in the air. For fire suppression purposes the discharge is designed to raise the carbon dioxide concentration in the hazard. This removes the free oxygen which supports combustion\*, and results in fire extinguishment. The resultant lack of free oxygen dictates that total flooding hazards be evacuated immediately, and carbon dioxide from local application be avoided by personnel.

Because the carbon dioxide used in the system is reclaimed from the atmosphere and is not created for the system, this fire suppression system has a zero net effect on the environment.

### Performance

Carbon dioxide is an effective fire extinguishing agent that can be used on many types of fires. It is effective for surface fires, such as flammable liquids and many solid combustible materials. It expands at a ratio of 450 to 1 by volume. Other desirable attributes are its high degree of effectiveness, its excellent thermal stability, and freedom from deterioration. In addition, carbon dioxide has so many additional commercial uses that refills are available in practically every large city or seaport throughout the world. Criteria for quantity and concentration of carbon dioxide is developed in NFPA-12 for both local and total flooding applications.

\*Certain materials do exist which contain their own oxygen supply (such as cellulose nitrate). The exclusion of oxygen by carbon dioxide is not effective in the extinguishment of fires involving these materials.

### Properties of Carbon Dioxide

The following are the properties of the agent:

Chemical formula	CO <sub>2</sub>
Molecular weight	44.011
Normal sublimation temperature at atmospheric pressure	-109.21 °F (-78.45 °C)
Triple point temperature at 75.35 psi (5.2 bar)	-69.88 °F (-56.6 °C)
Critical temperature	87.87 °F (31 °C)
Critical pressure	1069.96 psi (73.77 bar)
Critical density	29.21 lb/ft <sup>3</sup> (467.9 kg/m <sup>3</sup> )
Density of liquid at 86 °F (30 °C)	37.3 lb/ft <sup>3</sup> (597.5 kg/m <sup>3</sup> )
Specific volume of saturated vapor at 5 °F (-15 °C)	0.266 ft <sup>3</sup> /lb (0.017 m <sup>3</sup> /kg)
Specific heat of liquid at 86 °F (30 °C)	2.5 btu/lb °F (10.5 kJ/kg °K)
Specific heat of gas at 77 °F (25 °C) and one atmosphere	C <sub>p</sub> 0.203 btu/lb °F (0.850 kJ/kg °C) C <sub>v</sub> 0.157 btu/lb °F (0.657 kJ/kg °C)
Specific heat ratio (C <sub>p</sub> /C <sub>v</sub> ) of vapor at 59 °F (15 °C) at one atmosphere	1.304
Vapor Pressure	838 psi (57.8 bar) @ 70 °F (21.1 °C) 300 psi (20.7 bar) @ 0 °F (17.8 °C)
Specific Gravity	~1.5
Vapor Density	0.114 lb/ft <sup>3</sup> (1.83 kg/m <sup>3</sup> ) @ 70 °F (21.1 °C)
Specific Volume (Vapor)	8.74 ft <sup>3</sup> /lb (0.55 m <sup>3</sup> /kg) @ 70 °F (21.1 °C)
Relative dielectric strength of vapor at ambient temperature and one atmosphere pressure (Nitrogen = 1)	0.88
Color	Clear and water white
Flammability	Non-flammable
Toxicity, Underwriters Laboratories classification	Group 5a
Quality criteria for initial and recharge are as follows:	
	<ul style="list-style-type: none"> <li>• The vapor phase shall not be less than 99.5% carbon dioxide with no detectable odor.</li> <li>• The water content of the liquid phase shall not be more than 0.01% by weight (-30 °F dew point).</li> <li>• Oil content shall not be more than ten parts per million by weight.</li> </ul>
Refer to MSDS for information concerning toxicity.	

## Ordering Information

Carbon dioxide cylinders for use in engineered systems may be ordered in 50 lb (22.7 kg), 75 lb (34 kg), and 100 lb (45.4 kg) sizes.

## Approval

PYRO-CHEM carbon dioxide system components comply with NFPA Standard 12 and are included in Underwriters Laboratories listed File Numbers EX-2968, EX-2969 and EX-2970 for PYRO-CHEM carbon dioxide fire suppression systems. Containers meet the applicable Department of Transportation and U. S. Bureau of Explosives specifications.

Safety Data Sheets (SDS) are available at [www.pyrochem.com](http://www.pyrochem.com)

**Note:** The converted values in this document are provided for dimensional reference only and do not reflect an actual measurement.

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