Gaseous Systems

Fire Protection Solutions

Carbon Dioxide & Inert Gas Extinguishing Systems

Foreword

Carbon Dioxide (CO_2) is widely used in the fire industry as an extinguishing agent for total flooding and local application fire suppression systems. Physically the CO_2 is an electrically non-conductive, odourless and colourless gas. It is heavier than air and does not leave residuals upon discharge. These properties make it a perfect choice for the fire protection of highly valuable equipment. Carbon Dioxide is then preferred to protect hazards in normally unoccupied areas, where the presence of personnel in the protected spaces is regulated by safety devices and procedures.

Inert Gases are widely used in the fire industry as extinguishing agents for total flooding fire suppression systems within normally occupied areas. Physically inert gases are electrically non-conductive, non-toxic and environmentally friendly making them a perfect choice for the fire protection of normally occupied areas and highly valuable equipment.

SAFire is a manufacturer of Hardware & Systems approved

to EN 12094 for CO_2 and inert gases such as IG-01, IG-100, IG-55 and IG-541.

These gases are very effective and suppress fires by oxygen depletion, thus creating a surrounding atmosphere where the combustion processes cannot be sustained. These gases are stored in high pressure containers connected to a piping distribution network that runs from the cylinder bank to the protected area. Upon system activation, the agent is released from the container and travels in the pipe-work till it reaches the discharge nozzles. When discharged, the gas fills the area creating a low-in-oxygen atmosphere that causes a rapid fire extinguishment. The

cylinders may be stored inside dedicated rooms or outside in designated areas. Depending on the installation, they may be located in specifically designed open racks or inside closed cabinets.

Overview

The SAFire HP Carbon Dioxide and Inert Gas fire extinguishing systems provide protection for a variety of industrial hazards. Every system is manufactured according to client specifications and may assume various configurations depending on the features that are selected. Standard systems are made of cylinder assemblies, valves, actuators, a manifold and discharge nozzles.

For each system, one or more cylinders are configured as pilot cylinders and therefore they are equipped with an actuator that provides local and remote valve opening. The rest of the cylinders are configured as slave cylinders, hence they receive a pneumatic command from the pilots to open their own valve. All cylinders are secured to a cylinder rack that may be a wall type, self-standing open type, or a self-standing closed cabinet. The latter may include also complementary systems and controls such as lights, heaters and HVAC. Each cylinder bank, independently from its configuration, may be provided with components suitable for hazardous areas and/or with SIL2 actuators.

Container Assembly

The cylinders used for SAFire HP Carbon Dioxide fire extinguishing systems are T-PED compliant, manufactured according to EN 1964-2 and ISO 9809-2. They are available in different capacities (7.7, 14, 27,40, 60, 67,5 and 100 litres) and are normally filled with carbon dioxide with a filling density of 0,67 kg/L.

The cylinders used for the SAFire Inert Gas fire extinguishing systems are T-PED compliant and available in two different capacities (80 & 140 litres).

Standard cylinder assembly for CO_2 is equipped with a cylinder, a siphon tube and a valve. They are available in two configurations: pilot and slave. The pilot configuration comes with a solenoid valve and is used to initiate a system discharge, meanwhile the slave cylinder is actuated pneumatically upon activation of the pilot cylinder. The Carbon Dioxide cylinders are designed for vertical installation. Both CO_2 and Inert cylinders are shipped with a metallic protection cap that provides physical protection during handling.

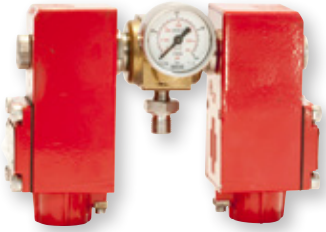
Gaseous Valves

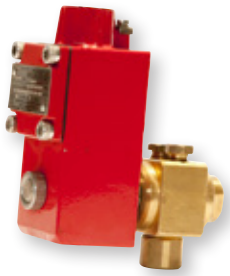
The container valve consists of a forged Brass or Stainless Steel body held in a normally closed position. The valve is pressure operated and includes also a manual lever for emergency actuation. The valve is designed for multiple threaded connections which accommodate the actuator and the cylinder connection. The valve is also equipped with provisions for a safety disc holder and a double port connection to host single or redundant actuators.

Gaseous Actuators

Single and redundant actuators are used to activate the pilot cylinders and initiate the gas system discharge. They are available with a Brass or Stainless Steel body and can be coupled with one or two solenoids. In Inert Gas systems, each actuator may be coupled to a pressure gauge indicating the cylinder pressure, with the SPDT contacts for remote indication of the cylinder charge.

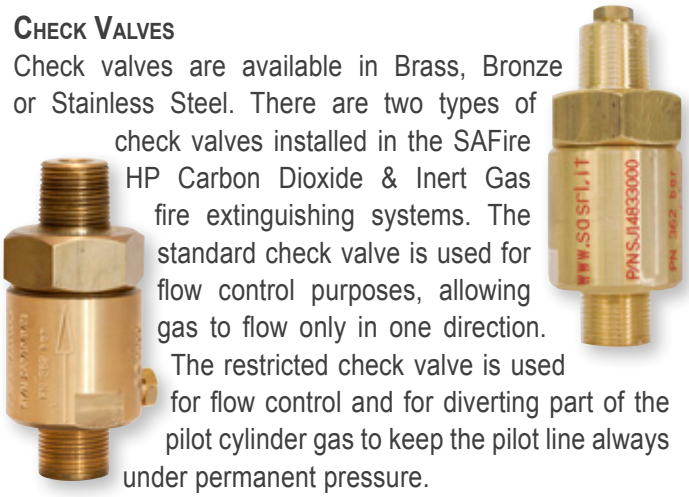
Actuators with double solenoids are designed for use within SIL2 compliant installations and are therefore





specifically addressed to protect valuable industrial process applications such as gas turbines, generators, turbo compressors, server farms, data centres, highly valuable systems or equipment etc. The actuators can be installed directly onto the gaseous valve or connected to a separate nitrogen pilot cylinder when a separate source of actuation is preferred.

Check Valves

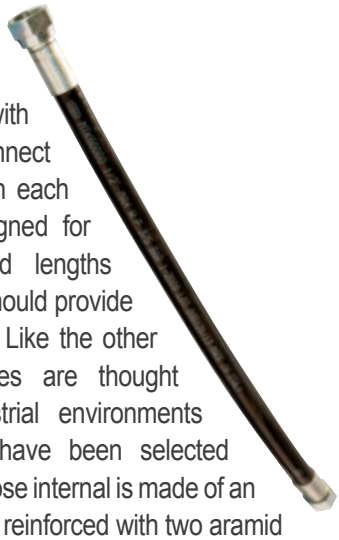


Check valves are available in Brass, Bronze or Stainless Steel. There are two types of check valves installed in the SAFire HP Carbon Dioxide & Inert Gas fire extinguishing systems. The standard check valve is used for flow control purposes, allowing gas to flow only in one direction. The restricted check valve is used for flow control and for diverting part of the pilot cylinder gas to keep the pilot line always under permanent pressure.

Weighing System

Minor gas losses within valve and valve components may happen in a gaseous based fire extinguishing system. The weighting device is a system that monitors the cylinder weight overtime and gives visual and remote indication in the case of cylinder weight losses. The weighing device is a concentric Brass and Stainless Steel mechanism that connects a counterweight with a cylinder. The counterweight is then calibrated to be in perfect equilibrium with the charged gas cylinder in a way to detect very precisely any loss of weight from the container. In the case of gas loss, the counterweight moves downwards, indicating that the cylinder has lost its charge. Each weighing system may be equipped with a micro switch that provides signalling to remote fire panels. These micro switches are available for harsh industrial environments as well as for hazardous areas. The weighing device application is used for CO_2 instead of electric monitored pressure gauges when the Carbon Dioxide system is to be located in hazardous areas.

Flexible Hoses



The flexible hoses are used to connect discharge valves with a manifold and to interconnect pneumatic actuation circuits with each valve. Flexible hoses are designed for multiple connection types and lengths depending on the service they should provide within the extinguishing system. Like the other components, the flexible hoses are thought to withstand all difficult industrial environments and therefore their materials have been selected accordingly. In this respect, the hose internal is made of an oil resistant polyamide substrate, reinforced with two aramid fibre braids and one steel braid covered by a micro-perforated polyurethane resistant to abrasion, oil and atmospheric agents.

CO_2 Pneumatic Discharge Time Delayer

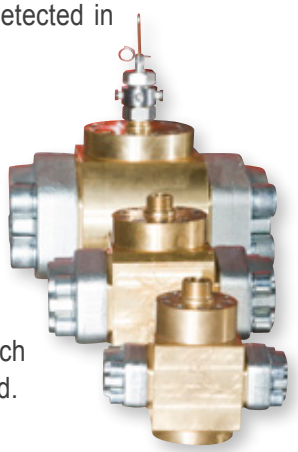
The pneumatic delay unit is used to delay the Carbon Dioxide into the protected zone. The installation of a delay unit allows enough time for a safe exit from the protected zone before system discharge. Normally it is set at a 30 second delay even though it can be adjusted to meet different requirements or specific emergency exit plans.

CO_2 Odourisers

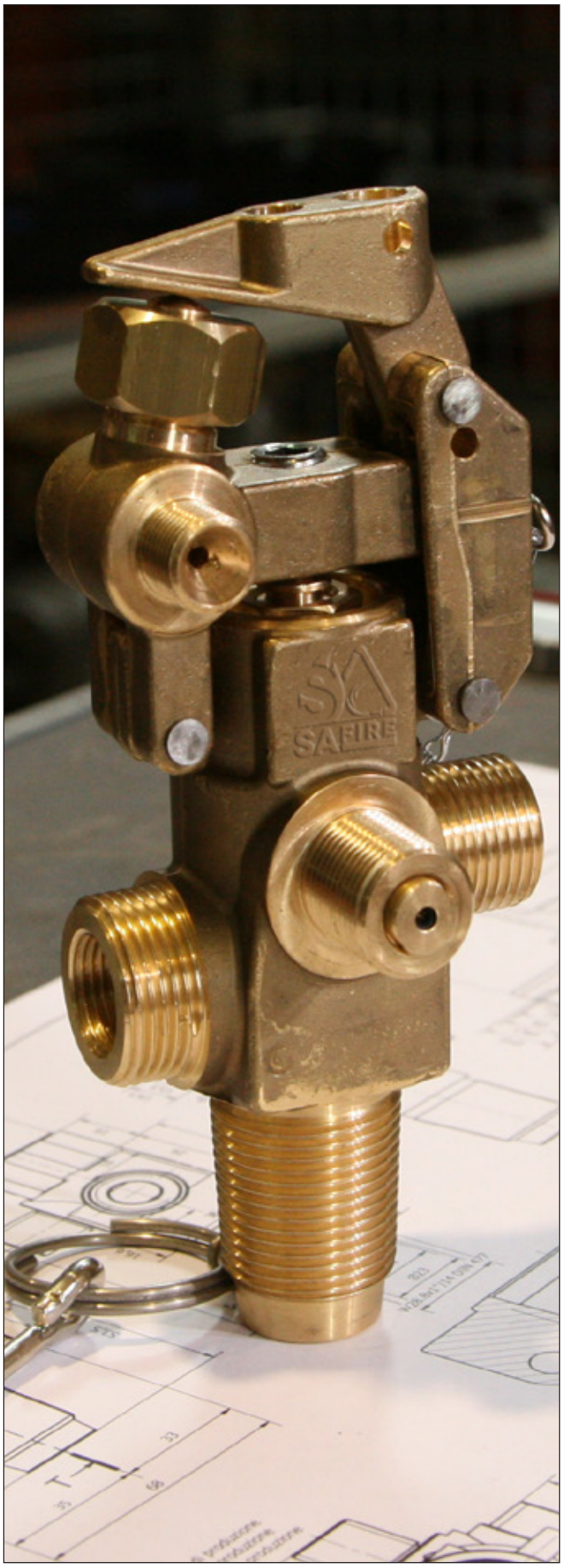
When Carbon Dioxide is discharged in local application systems or even in total flooding, the possibility that the Carbon Dioxide cloud expands in the surrounding areas cannot be ruled out. Because CO_2 is odourless, this phenomenon may be a threat to human life.

To avoid such a risk, SAFire has developed a safety odouriser that injects a specific odour into the flowing Carbon Dioxide during the system discharge. This makes the Carbon Dioxide detectable to human sense and therefore warns personnel about the dangerous presence of Carbon Dioxide even when detected in small concentrations.

Directional Valves



Selector or directional valves are used to protect multiple areas using a common cylinder bank. The valves act as blocking devices directing the gas flow only in the compartment which requires the gas to be discharged.



Nozzles

SAFire HP Carbon Dioxide and Inert Gas nozzles are designed for total flooding.

The CO_2 nozzles are for local application systems and these nozzles are designed for multiple threaded connection (½" and ¾") M. NPT ensuring perfect gas distribution thanks to the several geometric options available. Whereas the Inert Gas nozzles are available in a variety of directional flow configurations. The gas flow can be distributed at 45°, 90°, 180° and 360° for perfect gas distribution within the protected space

All nozzles are manufactured in brass or stainless steel and may be provided with protection caps to avoid nozzle clogging in dirty environments.

Cylinder Rack & Cabinet

Cylinders used in the Carbon Dioxide and Inert Gas fire extinguishing systems shall be secured together to form an assembly. There are various cylinder installation options available: wall type, open rack, closed cabinet.

The wall type rack assembly is the simplest solution, which is mainly used when cylinders are kept stored in dedicated rooms. In this case, the rack consists of two rows of galvanised steel channels & brackets with bolts. The open rack type assembly is a self-standing structure made of galvanised steel. It hosts the system manifold in the middle of the rack, using a reinforced channel to hang cylinders by means of their weighing system. The structure can be delivered with a further base frame allowing fork lifting on site. For large systems, the structure is divided into modules that can be easily coupled on site.

The closed cabinet is a fully covered, self-standing structure with one or more doors allowing for system inspections. The cabinet is manufactured using a galvanised steel

frame with carbon steel sheets covering the structure. The cabinet may be provided with insulation material on all sides and with additional systems such as heaters and air conditioning. Such accessories make it suitable for installation where the environmental temperature may bring the cylinders under or above the suggested working temperature. If required, cabinets may be manufactured in modules and fully assembled with a structure suitable for site lifting when fully assembled. Racks and cabinets are manufactured in compliance with specifications issued by the world's largest manufacturers of gas turbines.
Accessory systems may be provided for hazardous area installation.

Actuation Methods

The SAFire HP Carbon Dioxide and Inert Gas extinguishing systems may be selected with two actuation methods. The first method uses an auxiliary cabinet with one or two nitrogen pilot cylinders. In this case, the nitrogen cylinders may be actuated electrically using a solenoid valve (single or redundant) or manually by means of a manual pull lever. In any case, when actuated the nitrogen is released towards the CO_2 / Inert Gas valves resulting in their sequential opening. In this installation, all the CO_2 / Inert Gas cylinders are configured as slaves meanwhile the pilots consist of an external source of nitrogen cylinder(s).
The second possible actuation method is that of connecting the solenoid actuators directly on top of the CO_2 / Inert Gas valves. In this case, the pilot cylinder(s) are represented by the same CO_2 / Inert Gas cylinders present in the system. Upon actuation, the CO_2 /Inert Gas is released from the pilot(s) and then diverted to the slave cylinders resulting in a quick and sequential actuation of the whole system.

Special Configurations & Accessories

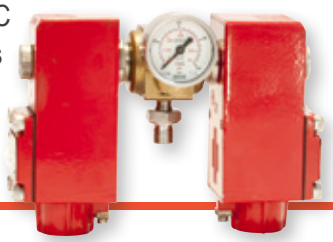
The SAFire HP Carbon Dioxide and Inert Gas fire extinguishing systems are mainly used for the protection of industrial fire risks involving valuable equipment. In this respect, the SAFire Gaseous Systems are featured with several accessories and configurations developed in order to fulfil all safety and process requirements for securing a highly reliable fire suppression unit.

Redundant Cylinder Banks

Redundant cylinder banks are a common practice for all those protections where it is paramount that the fire extinguishing system shall be kept in service at all times. To cope with such requirements, the SAFire Gaseous Systems can be arranged in a redundant cylinder bank configuration where the first bank is used as the main one, while the second is used as a stand-by unit. If the first system experiences a discharge or simply is undergoing a regular inspection, the second bank is activated as the main protection allowing for the first bank to be disabled. In this configuration protection is always granted, the machines are always protected and back in commercial operation in no time. The redundant cylinder bank is made up of two twin systems connected to the same manifold where the wiring for actuators and signalling devices is collected in one or two JBs and uses a main switch to select from first to second bank and vice versa.

SIL Actuators

Due to the increase of safety requirements for systems in the Oil & Gas, Chemical and Power Generation industries, SAFire has developed a special series of actuators which comply with IEC 61508 & IEC 61511 meeting the requirements of Safety Integrity Level (SIL2). These actuators are used



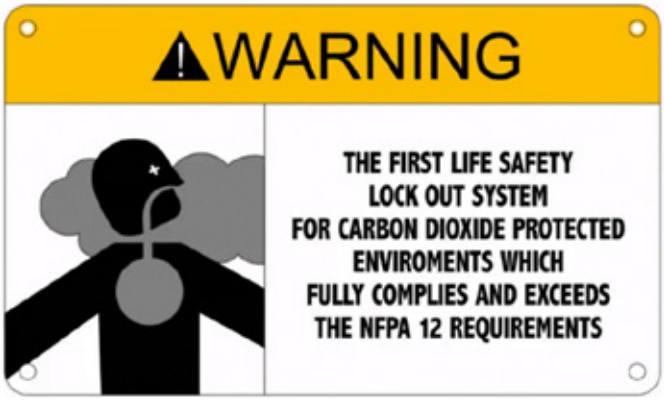
within fire systems that protect industrial processes where the probability of failure on demand (PFD) is reduced to a minimum. The redundant actuators are installed on a single CO_2 valve and allow the pilot cylinder to be actuated by one or two separate signals ensuring operation even if one of the two should fail.

Personnel Safety Systems

Safety Interlock

Carbon Dioxide fire extinguishing systems are very effective solutions for fire protection. However, due to the physical properties of Carbon Dioxide, these systems may be dangerous for human life and therefore are designed by professional fire protection engineers and managed by trained personnel.

One of the most dangerous hazards related to gaseous based extinguishing systems is the accidental release of the extinguishing agent while personnel are present within the protected zone.

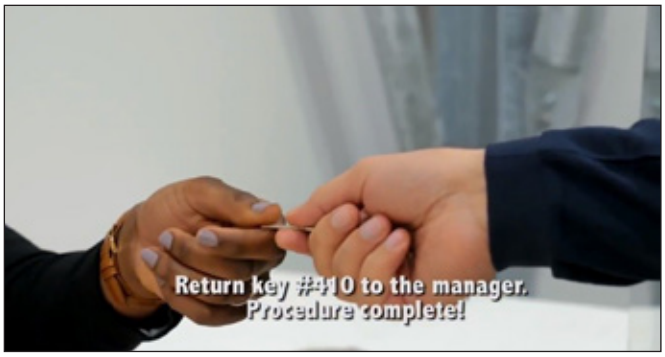


To avoid such situations in CO_2 systems, NFPA 12 has included in its 2008 edition the introduction of lock off units to prevent accidental Carbon Dioxide discharge into the protected space. To avoid such situations in Inert Gas systems, the introduction of a shut off unit in the actuating circuit prevents accidental discharge into the protected space. Lock off and shut off units are devices used to isolate the SAFire HP Carbon Dioxide fire extinguishing system when personnel are required within the protected spaces. The lock off unit is installed upon the main entrance of the protected space while the shut off is installed on the pilot cylinder actuating circuit.

The shut off is installed on the pilot cylinder actuating the circuit providing a mechanical block to system actuation. Both provide increased personnel safety and allow for the establishment of an entering procedure that avoids accidents. Both units are equipped with locks and micro switches providing indications on the system's status to the remote fire panels.

SAFire manufactures a series of NFPA 12 compliant lock off devices with interlocks and a series of shut off valves that allow the implementation of a "safe to enter" procedure controlled by position switches and remote signalling of the system's status.

The lock off devices can be installed just outside the main door of the protected space or located on the Carbon Dioxide skid providing isolation of either the pneumatic actuation line or the gas discharge manifold in CO_2 systems. For inert gas systems, the lock off devices can be installed in the system skid providing isolation of the pneumatic actuation line. These solutions provide for the safe entry of personnel by means of a set safety procedure as well as the possibility to report the system status to remote control panels or DCS.



Application

The SAFire Gaseous fire extinguishing systems are used mainly to protect industrial fire risks involving valuable machinery or processes such as: Electronic Rooms; Gas Turbines; Generators; Compressors; Engine Rooms; Control Rooms; Server Farms; Financial Centres; Telecom Centres Flammable/ Archive Storage Areas; Process Equipment; Pharmaceutical Processes; Switchgear Rooms; Polling Mills; Printing & Packaging; etc

Approvals

CPD/CPR EN 12094 Approved