Carbon Dioxide Fire Extinguishing Systems

Fire Protection Solutions

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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. It is extremely effective and suppresses the fire by oxygen depletion, thus creating a surrounding atmosphere where combustion processes cannot be sustained. 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 non occupied areas, where the presence of personnel in the protected spaces is regulated by safety devices and procedures. Carbon Dioxide is 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 carbon dioxide fills the area creating a low-in-oxygen atmosphere that causes 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 SA HP Carbon Dioxide fire extinguishing system provides 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 wall type, self standing open type or 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 SIL 2 compliant actuators.

Container Assembly

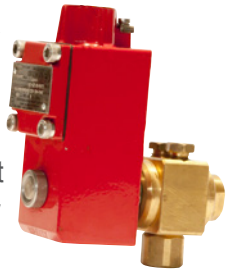
The cylinders used for SA HP Carbon Dioxide fire extinguishing systems are T-PED compliant, manufactured according to EN 1964-2 and ISO 9809-2. They are available in different capacities (7.7, 14, 27,40, 60, 67,5 and 100 litres) and are normally filled with carbon dioxide with a filling density of 0,67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

Standard cylinder assembly 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 and are shipped with a metallic protection cap that provides physical protection during handling.

Valve

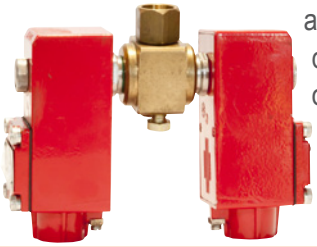
The container valve consists of a forged brass or stainless steel body held in a normally closed position. The valve is pressure operated and includes also a manual lever for emergency actuation. The valve is designed for multiple threaded connections which accommodate the actuator and the cylinder connection.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

Actuators



Single and redundant actuators are used to activate the pilot cylinders and initiate the CO_2 system discharge. They are available with a brass or stainless steel body and coupled to one or two solenoids.

Actuators with double solenoids are designed for use within SIL 2 compliant installations and therefore specifically addressed to protect valuable industrial process applications such as gas turbines, generators, turbo compressors, etc. The actuators can be installed directly onto the CO_2 valve or connected to a separate nitrogen pilot cylinder when a separate source of actuation is preferred.



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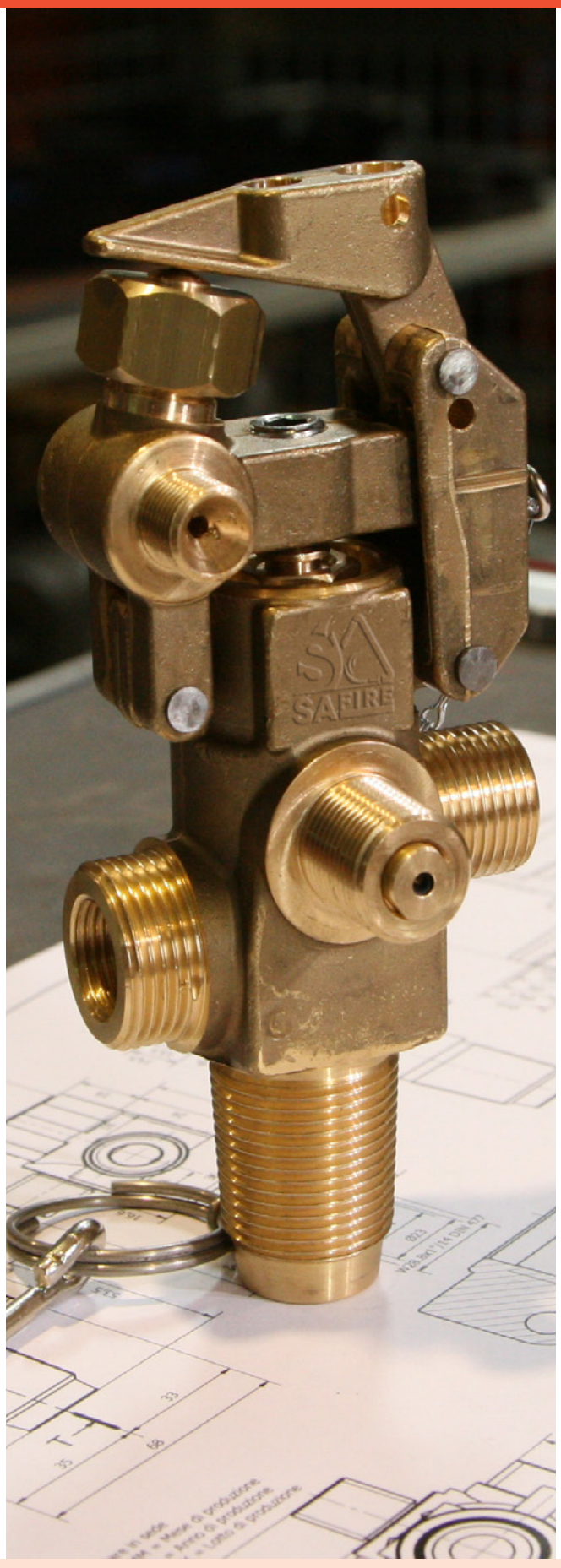
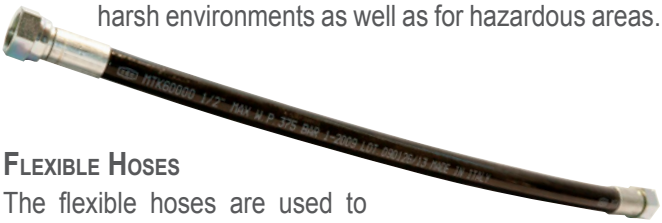


Check Valve

Check valves are available in brass, bronze or stainless steel. There are two types of check valve installed into the SA HP carbon dioxide fire extinguishing system. The standard check valve is used for flow control purposes, allowing carbon dioxide 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

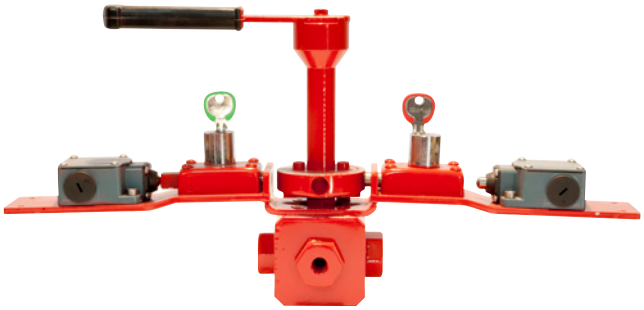
Minor gas losses within valve and valve components may happen in a gaseous based fire extinguishing system. The weighting device is a system that monitors the cylinder weight overtime and gives visual and remote indication in the case of cylinder weight losses. The weighing device is a concentric brass and stainless steel mechanism that connects a counterweight with a cylinder. The counterweight is then calibrated to be in perfect equilibrium with the charged CO_2 cylinder in a way to detect very precisely any loss of weight from the container. In the case of loss of gas, 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 industrial harsh environments as well as for hazardous areas.



Flexible Hoses

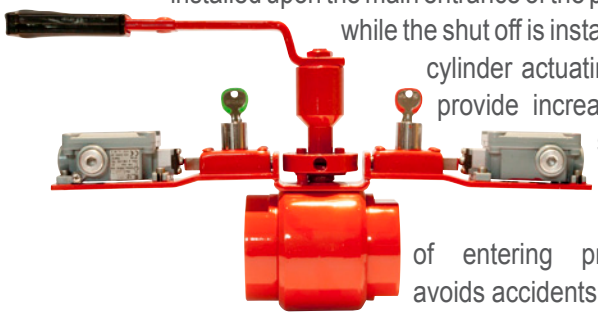
The flexible hoses are used to connect discharge valves with a manifold and to interconnect pneumatic actuation circuits with each valve. Flexible hoses are designed for multiple connection types and lengths depending on the service they should provide within the extinguishing system. Like the other 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.



Lock off & shut off units

Lock off and shut off units are devices used to isolate the SA 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. Both provide increased personnel safety and allow for the establishment of entering procedure that avoids accidents. Both units are equipped with locks and micro switches providing indication on the system status to the remote fire panels.

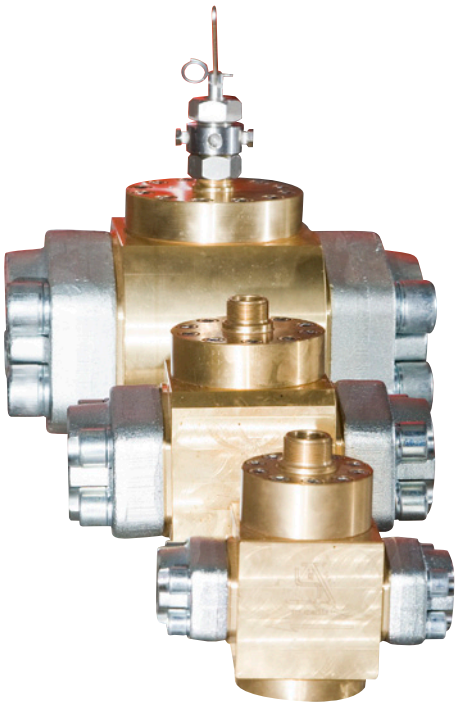


Pneumatic discharge time delayer

The pneumatic delay unit is used to delay the carbon dioxide discharge 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.

Odorizer

When carbon dioxide is discharged in local application systems or even in total flooding, the possibility that carbon dioxide clouds 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, SA has developed a safety odorizer 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 CO_2 flow only in the compartment which requires the CO_2 to be discharged.

Nozzles

SA HP Carbon dioxide nozzles are designed for total flooding and local application systems. They are manufactured in brass or stainless steel and may be provided with protection caps to avoid nozzle clogging in dirty environments. The nozzles are designed for multiple threaded connection (½" and ¾") M. NPT and ensure a perfect gas distribution thanks to the several geometric options available.

Cylinder Rack & Cabinet

Cylinder used in the carbon dioxide fire extinguishing systems shall be secured together to form an assembly. The cylinders installation options available are various: wall type, open rack, closed cabinet.

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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 galvanized steel channels & brackets with bolts. The *open rack type assembly* is a self standing structure made of galvanized 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 c*losed cabinet* is a fully covered, self standing structure with one or more doors allowing for system inspections. The cabinet is manufactured using a galvanized 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. Rack 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 SA HP carbon dioxide extinguishing system 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 valves resulting in their sequential opening. In this installation, all the CO_2 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 valves. In this case, the pilot cylinder(s) are represented by the same CO_2 cylinders present in the system. Upon actuation, the CO_2 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 SA HP carbon dioxide fire extinguishing system is mainly used for the protection of industrial fire risks involving valuable equipment. In this respect the SA HP system is featured with several accessories and configurations developed in order to fulfil all safety and process requirements for securing an 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 SA HP CO_2 system 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 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 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, SA has developed a special series of actuators which complies with IEC 61508 & IEC 61511 meeting the requirements of Safety Integrity Level (SIL 2). 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 two should fail.

Personnel Safety Systems

Carbon dioxide fire extinguishing systems are a very effective solution for fire protection. However, due to the physical property 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 carbon dioxide is the accidental release of the extinguishing agent while personnel are present within the protected zone.

To avoid such situations, NFPA 12 has included in its latest 2008 edition the introduction of lock off units to prevent accidental carbon dioxide discharge into the protected space.

SA manufactures a series of NFPA 12 compliant lock off devices with interlocks that allow the implementation of "safe to enter" procedure controlled by position switches and remote signalling of system 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. Both solutions provide safe entering of personnel by means of a set safety procedure as well as reporting the possibility to report the system status to remote control panels or DCS.

Application

The SA HP carbon dioxide fire extinguishing system is used mainly to protect industrial fire risk involving valuable machinery or processes such as: Electronic Room; Gas Turbines; Generators; Compressors; Engine Rooms; Flammable Storage areas; Process equipment; Polling Mills; Printing & packaging; etc

Approvals

CPD/CPR EN 12094 Approved

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