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Fire protection equipment — Carbon dioxide extinguishing systems for use on premises — Design and installation

Équipement de protection contre l'incendie — Installations fixes d'extinction par dioxyde de carbone utilisées dans les bâtiments — Conception et installation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6183 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 8, *Gaseous media and firefighting systems using gas*.

This second edition cancels and replaces the first edition (ISO 6183:1990) together with ISO 5923:1989, which have been technically revised.

This corrected version of ISO 6183:2009 incorporates a change to the cancellation and replacement statement in the Foreword: ISO 6183:2009 cancels and replaces not only ISO 6183:1990 but also ISO 5923:1989.

Introduction

This International Standard is intended for use by those concerned with purchasing, designing, installing, testing, inspecting, approving, operating and maintaining carbon dioxide (CO_2) extinguishing systems.

This International Standard applies only to carbon dioxide fixed fire-extinguishing systems in buildings and other premises on land. Although the general principles could well apply to other uses (e.g. maritime use), for these other uses additional considerations will almost certainly have to be taken into account and the application of the requirements given in this International Standard is therefore unlikely to be fully satisfactory. General information about carbon dioxide as an extinguishing medium is given in Annex D. This can be useful background information for those unfamiliar with the characteristics of this medium.

It has been assumed in the preparation of ISO 6183 that the execution of its provisions will be entrusted to those persons appropriately qualified and experienced in the specification, design, installation, testing, approval, inspection, operation and maintenance of systems and equipment, for whose guidance it has been prepared, and who can be expected to exercise a duty of care to avoid unnecessary release of carbon dioxide. New requirements to minimize the need to release carbon dioxide during testing and commissioning procedures are included in this edition. These are linked to the inclusion of enclosure integrity testing.

Carbon dioxide has for many years been a recognized effective medium for the extinction of flammable liquid fires as well as fires in the presence of electrical and ordinary Class A hazards. Nevertheless, it ought not be forgotten, in the planning of comprehensive schemes, that there could be hazards for which this media is not suitable, or that in certain circumstances or situations there can be dangers in its use requiring special precautions.

The use of carbon dioxide is no longer recommended for total flooding of occupied areas. ISO 14520 provides requirements for other extinguishing agents that can be more appropriately used in these areas.

It is important that the fire protection of a building or plant be considered as a whole. Carbon dioxide systems form only a part, though an important part, of the available facilities. It cannot be assumed that their adoption necessarily removes the need to consider supplementary measures, such as the provision of portable fire extinguishers or other mobile appliances for first aid or emergency use, or to deal with special hazards.

Advice on these matters can be obtained from the appropriate manufacturer of the carbon dioxide or the extinguishing system. Information can also be sought from the appropriate fire authority, the health and safety authorities and insurers. In addition, reference will need to be made, as necessary, to other national standards and statutory regulations of the particular country.

It is essential that firefighting equipment be carefully maintained to ensure instant readiness when required. Routine maintenance is liable to be overlooked or given insufficient attention by the owner of the system. It is, however, neglected at peril to the lives of occupants of the premises and at the risk of crippling financial loss. The importance of maintenance cannot be too highly emphasized. Inspection — preferably by a third party — should include an evaluation concluding that the extinguishing system continues to provide adequate protection for the risk (protected zones as well as state of the art can change over time).

Fire protection equipment — Carbon dioxide extinguishing systems for use on premises — Design and installation

1 Scope

This International Standard specifies requirements and gives recommendations for the design, installation, testing, maintenance and safety of fixed carbon dioxide firefighting systems in buildings, plant or other structures. It is not applicable to extinguishing systems on ships, in aircraft, on vehicles and mobile fire appliances, or to below-ground systems in the mining industry; nor does it apply to carbon dioxide pre-inerting systems.

Design of systems where unclosable opening(s) exceed a specified area and where the opening(s) can be subject to the effect of wind is not specified, although general guidance on the procedure to be followed in such cases is given (see 7.4.3.2).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1182:2002, *Reaction to fire tests for building products — Non-combustibility test*

ISO 3864-1:2002, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas*

ISO 5923:1989, *Fire protection — Fire extinguishing media — Carbon dioxide*

ISO 14520-1:2006, *Gaseous fire extinguishing systems — Physical properties and system design — Part 1: General requirements*

ISO 16003:2008, *Components for fire extinguishing systems using gas — Requirements and test methods — Container valve assemblies and their actuators; selector valves and their actuators; nozzles; flexible and rigid connectors; and check valves and non-return valves*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
approved
acceptable to a relevant **authority** (3.2)

NOTE In determining the acceptability of installations or procedures, equipment or materials, the authority could base acceptance on compliance with the appropriate standards.

3.2
authority
organization, office or individual responsible for approving equipment, installations or procedures

3.3
automatic/manual switch
means of converting the system from automatic to manual actuation

NOTE This can be in the form of a manual switch on the control panel or other units, or a personnel door interlock. In all cases, this changes the actuation mode of the system from automatic and manual to manual only or vice versa.

3.4
clearance
air gap between equipment, including piping and nozzles and unenclosed or uninsulated live electrical components at other than ground potential

3.5
deep-seated fire
fire involving solids subject to smouldering

3.6
design concentration
concentration of carbon dioxide, including a safety factor, required for system design purposes

3.7
engineered system
system in which the supply of carbon dioxide is discharged through a system of pipes and nozzles in which the size of each section of pipe and nozzle orifice has been calculated in accordance with the requirements of this International Standard

3.8
extinguishing concentration
minimum concentration of carbon dioxide required to extinguish a fire involving a particular fuel under defined experimental conditions excluding any safety factor

3.9
fill density
mass of carbon dioxide per unit volume of container

3.10
design quantity
mass of carbon dioxide required to achieve the design concentration within the protected volume

3.11
volume
volume enclosed by the building elements around the protected enclosure

3.12
high-pressure storage
storage of carbon dioxide in pressure containers at ambient temperatures

3.13
hold time
period of time during which a concentration of carbon dioxide greater than the fire extinguishing concentration is maintained

NOTE See 8.2.3.11.

3.14
inspection
visual check to give reasonable assurance that the extinguishing system is fully charged and operable

NOTE This is done by seeing that the system is in place, that it has not been activated or tampered with, and that there is no obvious physical damage or condition to prevent operation.

3.15
liquid discharge time
time during which predominantly liquid carbon dioxide is present at the nozzle

3.16
lock-off device
manually operated shut-off valve installed in the discharge piping downstream of the carbon dioxide containers, or other type of device that mechanically prevents agent container actuation

NOTE 1 The actuation of this device provides an indication of system isolation.

NOTE 2 The intent is to prevent the discharge of carbon dioxide into the hazard area when the lock-off device is activated.

3.17
local application system
carbon dioxide supply permanently connected to fixed piping with nozzles arranged to discharge the carbon dioxide directly onto the burning material or identified hazard

3.18
low-pressure storage
storage of carbon dioxide in pressure containers at a controlled low temperature, normally –18 °C to –20 °C

3.19
maintenance
thorough check to verify that the extinguishing system will operate as intended

NOTE It includes a thorough examination and any necessary repair or replacement of system components.

3.20
maximum working pressure
equilibrium pressure within a container at the maximum working temperature

NOTE 1 For high-pressure storage, at the maximum fill density. For a container in transit, the equilibrium pressure can differ from that in storage within a building.

NOTE 2 For low-pressure storage, the pressure corresponding to the maximum controlled temperature of –18 °C.

3.21 Occupied and unoccupiable areas

3.21.1
normally occupied area
area intended for occupancy

3.21.2
normally unoccupied area
area not normally occupied by people but which may be entered occasionally for brief periods

3.21.3
unoccupiable area
area which cannot be occupied by people due to dimensional or other physical constraints

EXAMPLE Shallow voids and cabinets.

3.22
pre-engineered system
system that has predetermined flow rates, nozzle placement, and quantities of carbon dioxide and that incorporates specific nozzles and methods of application that can differ from those detailed in this International Standard

NOTE No deviation is permitted from the limits specified by the manufacturer or authority.

3.23
pre-liquid-vapour flow time
time from the opening of the container or selector valve to the start of predominantly liquid flow at the most unfavourable nozzle

3.24
safety factor
multiplier of the carbon dioxide extinguishing concentration, used to determine minimum design concentration

3.25
selector valve
valve installed in the discharge piping downstream of the storage containers, used to direct the carbon dioxide to the appropriate hazard

NOTE It is used where one or more storage containers are arranged to selectively discharge carbon dioxide to any of several separate hazards.

3.26
surface fire
fire involving combustible or flammable liquids, gases and solids not subject to smouldering

3.27
total flooding system
system arranged to discharge carbon dioxide into an enclosed space to achieve the appropriate design concentration

4 Use and limitations

4.1 General

The design, installation, service and maintenance of carbon dioxide fire-extinguishing systems shall be performed by those competent in fire extinguishing system technology. Maintenance and installation shall only be done by qualified personnel and companies.

4.2 Uses for carbon dioxide systems

Carbon dioxide, local application and total flooding fire-extinguishing systems are useful within the limits of this International Standard in extinguishing fires involving specific hazards or equipment. The following are typical of such hazards, but the list is not exhaustive:

a) combustible or flammable liquid and gases;

b) electrical hazards such as transformers, switches, circuit breakers, rotating equipment, and electronic equipment;

c) engines utilizing gasoline and other flammable liquid fuels;

d) ordinary combustibles such as paper, wood, and textiles.

4.3 Limitations for carbon dioxide systems

Carbon dioxide cannot extinguish fires involving certain types of materials such as

a) chemicals containing their own supply of oxygen, such as cellulose nitrate, or

b) metals and chemicals which react with carbon dioxide, e.g. alkali metals and metal hydrides.

While carbon dioxide will not extinguish certain fuels containing their own oxygen of combustion, it will not react dangerously with these materials or increase their burning rate. Carbon dioxide, if used in this situation in a total flooding system, will provide protection for adjacent combustibles or can be successfully used if the reactive metals or hydride are first covered by another material. Examples of the latter condition are sodium stored or used under kerosene, cellulose nitrate in solution of lacquer thinner, and magnesium chips covered with heavy oil.

4.4 Temperature limitations

All devices shall be designed for the service they will encounter and shall not be readily rendered inoperative or susceptible to accidental operation. Devices shall normally be designed to function properly from −20 °C to +50 °C, or marked to indicate temperature limitations, or in accordance with manufacturer's specifications, which shall be marked on the name-plate, or (where there is no name-plate) in the manufacturer's instruction manual.

5 Safety

5.1 Hazard to personnel

The discharge of carbon dioxide in fire-extinguishing concentration creates serious hazards to personnel, such as suffocation and reduced visibility during and after the discharge period. Hazards to personnel created by the discharge of carbon dioxide shall be considered in the design of the system.

Carbon dioxide gas is heavier than air and will collect in pits, wells, shaft bottoms or other low-lying areas, and can migrate into adjacent places outside the protected space. Consideration shall also be given to places to which the carbon dioxide can migrate or collect in the event of a discharge from a safety relief device of a storage container.

Conformance with this International Standard does not remove the user's statutory responsibility to comply with the appropriate safety regulations.

NOTE The safety precautions required by this International Standard do not address toxicological or physiological effects associated with the products of combustion caused by fire.

5.2 Safety precautions

5.2.1 Normally occupied and normally unoccupied areas

The use of carbon dioxide is not recommended for total flooding of normally occupied and normally unoccupied areas as long as comparable alternative firefighting methods are available. However, where carbon dioxide systems are used to protect these areas, they shall be provided with the following.

a) A non-electrical time delay device and an electrical and pneumatic pre-discharge alarm that is distinct from all other alarm signals or other approved combination of devices providing equivalent level of safety and reliability. The pre-discharge alarm shall operate immediately on commencement of the time delay. Factors such as the time for egress and the risk to the occupants by the fire should be considered when determining the system discharge time delay.

b) Automatic/manual switch, with associated status indication.

c) Lock-off device, supervised to indicate a system fault if the valve is more than one eighth closed.

NOTE The purpose of the lock-off device is to physically prevent discharge of carbon dioxide into the protected space — for example, during maintenance or if safe evacuation is not possible during the pre-warning time.

d) Emergency lighting and adequate direction signs for exit routes: continuous visual and audible alarms at entrances and designated exits inside the protected area and continuous visual alarms outside the protected area that operate until the protected area has been declared safe.

e) Designated exit doors that are outward swinging, self-closing and able to be opened from the inside, even when locked from the outside.

f) Appropriate warning and instruction signs (see 5.2.2).

g) Means for prompt natural or forced-draft ventilation of such areas after any discharge of carbon dioxide. Forced-draft ventilation will often be necessary. Care shall be taken to completely dissipate hazardous atmospheres, and not just move them to other locations, as carbon dioxide is heavier than air.

Where it is possible for carbon dioxide gas to collect in pits, wells, shaft bottoms or other low-lying areas, consideration shall be given to adding an odoriferous substance to the carbon dioxide.

Instructions to, and drills of, all personnel within or in the vicinity of protected areas, including maintenance or construction personnel who could be brought into the area, shall be given to ensure their correct actions when the system operates. Following discharge of the system, personnel should not enter the enclosure until it has been declared as being safe to do so. Additional safety aspects such as breathing apparatus should be considered.

The need to comply with national regulations or standards requiring other precautions shall be considered.

5.2.2 Warning notices for occupiable areas

Notices shall be provided at the following locations:

a) at all entrances to the protected enclosure (see Figures 1 and 2, and below);

b) at each emergency manual release point (see Figure 3);

c) at each lock-off valve (see Figure 4).

Where a lock-off valve is fitted, the notice illustrated in Figure 2 is complementary to the notice in Figure 1 and should be located adjacent to it. Alternatively, the text may be incorporated in the same display notice.

Warning notices shall be coloured in accordance with ISO 3864-1 and shall be of a letter size equal to or greater than that shown in Figures 1 to 4.

THIS AREA IS FITTED WITH A

CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM

EVACUATE AREA ON SOUNDING OF ALARM

DO NOT ENTER

AFTER EXTINGUISHING AGENT DISCHARGE UNTIL THE AREA HAS BEEN THOROUGLY VENTILATED

Figure 1 — Typical instruction notice to be displayed at each entry to the protected area or enclosure

WARNING

LOCK OFF CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM BEFORE ENTERING

[Identify protected area]

Figure 2 — Typical lock-off warning system notice

CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM

MANUAL RELEASE FOR

[identify protected area]

WARNING

ENSURE AREA IS EVACUATED BEFORE OPERATING

Figure 3 — Typical instruction notice to be displayed at the manual release

CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM LOCK-OFF VALVE FOR

[identify protected area)]

WARNING

ENSURE AREA IS CLEAR OF PERSONNEL BEFORE OPENING VALVE

[identify protected area]

Figure 4 — Typical lock-off valve notice

5.2.3 Warning notices for unoccupiable areas

For carbon dioxide systems protecting unoccupiable areas, appropriate warning and instruction signs shall be provided adjacent to access points to the protected space. An example of a typical notice is shown in Figure 5.

Additional notices may be provided at each emergency manual release point (see Figure 3).

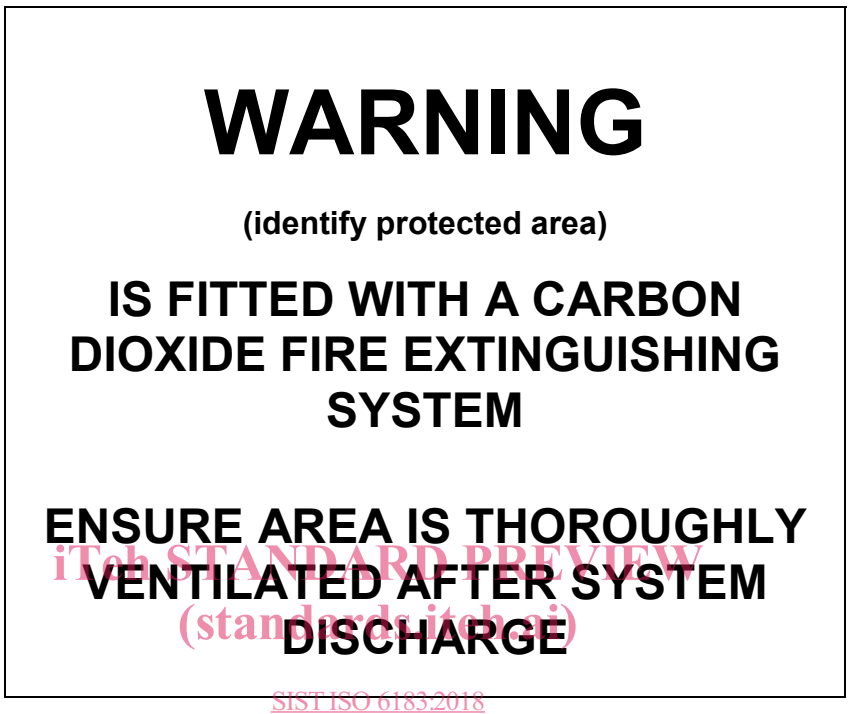

Figure 5 — Typical warning notice to be displayed at access point to the protected unoccupiable area

5.3 Electrical hazards

Where exposed electrical conductors are present, clearances no smaller than those given in Table 1 shall be provided, where practicable, between the electrical conductors and all parts of the system able to be approached during maintenance. Where these clearance distances cannot be achieved, warning notices shall be provided and a safe system of maintenance work shall be adopted.

The system should be arranged so that all normal operations can be carried out safely by the operator.