INTERNATIONAL STANDARD

ISO 6183

Third edition
2022-03

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

Reference number
ISO 6183:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 6183:2009), which has been technically revised. It also incorporates the Amendment(s) ISO 6183:2009/Amd. 1:2017 and ISO 6183:2009/Amd. 2:2019.

The main changes are as follows:

— guidance on container storage has been updated;

— alerts when removing actuators have been added;

— a commissioning check list has been included in Annex A;

— pictorial examples have been added to Annex C.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

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

This document applies only to carbon dioxide fixed fire-extinguishing systems in buildings and other premises on land. Although the general principles can apply to other uses (e.g. maritime use), for these other uses, it is likely that additional considerations will have to be taken into account and the application of the requirements given in this document 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 this document 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 the unnecessary release of carbon dioxide. New requirements to minimize the need to release carbon dioxide during testing and commissioning procedures are included in this third 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, in the planning of comprehensive schemes, it should be remembered that there can be hazards for which this media is not suitable, and 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 if more appropriate extinguishing agents are available. 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, albeit 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 needs to be made, as appropriate, to the other national standards and statutory regulations of a given 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 the peril of 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 document specifies requirements and gives recommendations for the design, installation, testing, maintenance and safety of fixed carbon dioxide firefighting systems in buildings, plants or other structures. It is not applicable to extinguishing systems on ships, in aircraft, on vehicles or on 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 7240-2, *Fire detection and alarm systems — Part 2: Fire detection control and indicating equipment*

ISO 7240-23, *Fire detection and alarm systems — Part 23: Visual alarm devices*

ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 8201, *Alarm systems — Audible emergency evacuation signal — Requirements*

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

ISO 16003, *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.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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

Note 1 to entry: In determining the acceptability of installations or procedures, equipment or materials, the authority can base acceptance on compliance with the appropriate standards.

1) Under preparation. Stage at the time of publication: ISO/DIS 14520-1:2022.

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 1 to entry: 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

Note 1 to entry: Examples of a deep-seated fire include baled, stacked or piled materials such as paper, wool and grain.

3.6
design concentration
concentration of carbon dioxide, including a *safety factor* (3.24), 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 document

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* (3.24)

3.9
fill density
mass of carbon dioxide per unit *volume* (3.11) of container

3.10
design quantity
mass of carbon dioxide required to achieve the *design concentration* (3.6) within the protected *volume* (3.11)

3.11
volume
protected space enclosed by the building elements

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

3.13
hold time
period of time during which a concentration of carbon dioxide greater than the fire *extinguishing concentration* (3.8) is maintained

Note 1 to entry: See 7.6.2.

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

Note 1 to entry: 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 to entry: The actuation of this device provides an indication of system isolation.

Note 2 to entry: 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
automatic or manual fire extinguishing system in which a fixed supply of carbon dioxide is permanently connected to fixed piping with nozzles arranged to discharge the carbon dioxide directly to a fire occurring in a defined area that has no enclosure surrounding it, or is only partially enclosed, and that does not produce an *extinguishing concentration* (3.8) throughout the entire *volume* (3.11) containing the protected hazard

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

Note 1 to entry: The pressure in this type of storage is approximately 21 bar[2)].

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

Note 1 to entry: 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 to entry: For *high-pressure storage* (3.12), at the maximum *fill density* (3.9). For a container in transit, the equilibrium pressure can differ from that in storage within a building.

Note 2 to entry: For *low-pressure storage* (3.18), the pressure corresponding to the maximum controlled temperature of −18 °C.

3.21 Terms related to occupied and unoccupiable areas

3.21.1
normally occupied area
area intended for occupancy

2) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

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 consisting of a supply of extinguishant of specified capacity coupled to pre-calculated pipework and nozzle arrangement up to maximum permitted limits

Note 1 to entry: No deviation is permitted from the limits specified by the manufacturer or *authority* (3.2).

3.23
pre-liquid vapour flow time
time from the opening of the container or *selector valve* (3.25) to the start of predominantly liquid flow at the most unfavourable nozzle

3.24
safety factor
multiplier of the carbon dioxide *extinguishing concentration* (3.8), used to determine minimum *design concentration* (3.6)

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 1 to entry: 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* (3.6)

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 performed by qualified personnel and companies.

4.2 Uses for carbon dioxide systems

Carbon dioxide, local application, total flooding and manual hose reel fire-extinguishing systems are useful within the limits of this document in extinguishing fires involving specific hazards or equipment.

NOTE Some national regulations do not allow manual hose reel systems.

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 does not extinguish certain fuels containing their own oxygen of combustion, it does not react dangerously with these materials or increase their burning rate. Carbon dioxide, if used in this situation in a total flooding system, provides 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 a 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 the 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 document does not affect the user's statutory responsibility to conform to the appropriate safety regulations.

NOTE The safety precautions required by this document 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 be audible in all areas within the protected space and, where used, carbon dioxide powered alarms shall not result in the development of an unsafe atmosphere.

   NOTE 1 National regulations can require the use of product standards, for example the EN 12094 series in Europe.

b) An automatic/manual switch, with associated status indication.

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

   NOTE 2 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.

   NOTE 3 National regulations can require the use of product standards, for example the EN 12094 series, in Europe.

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);

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

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

For carbon dioxide systems protecting occupiable areas, appropriate warning and instruction signs shall be provided adjacent to access points to the protected space or as specified by national requirements. Examples of a typical notices are shown in Figures 1 – 5.

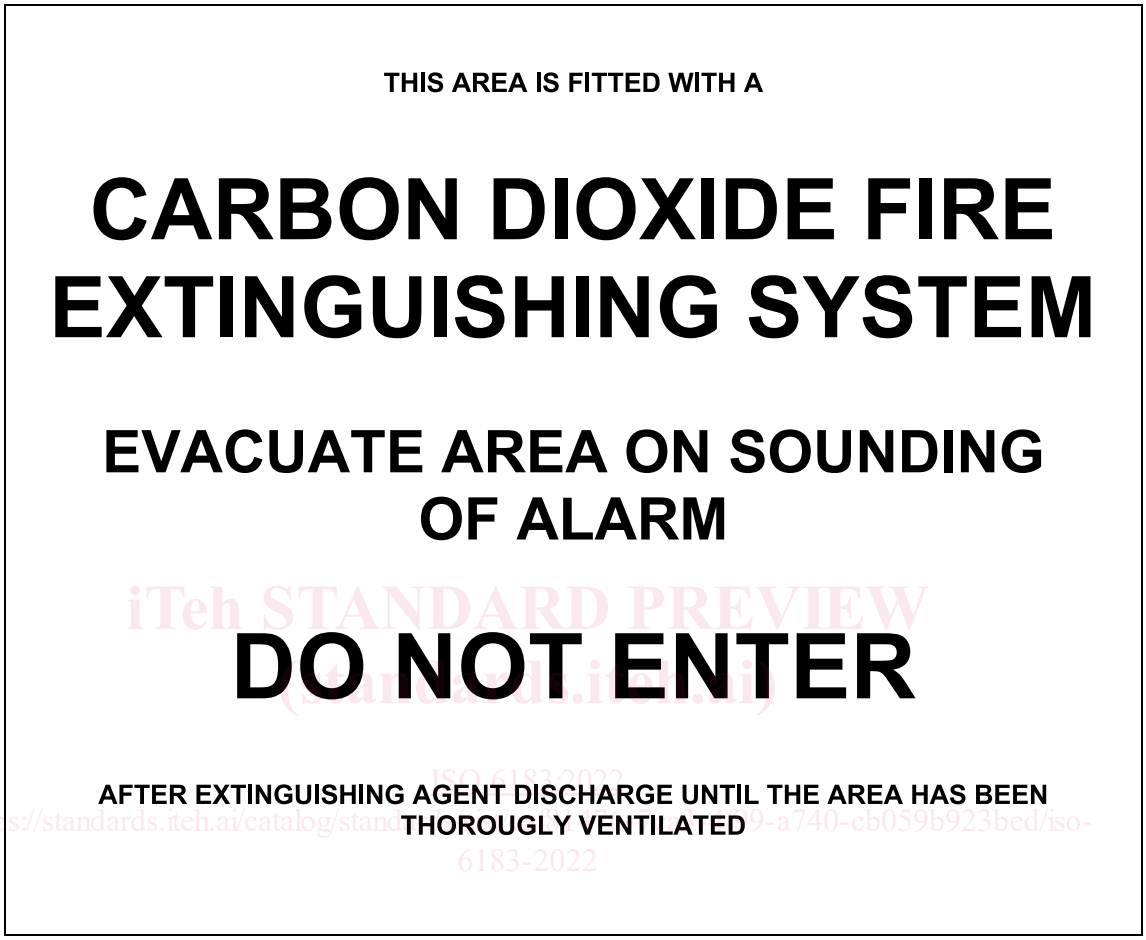

Figure 1 — Typical instruction notice to be displayed at each entry to the protected area or enclosure

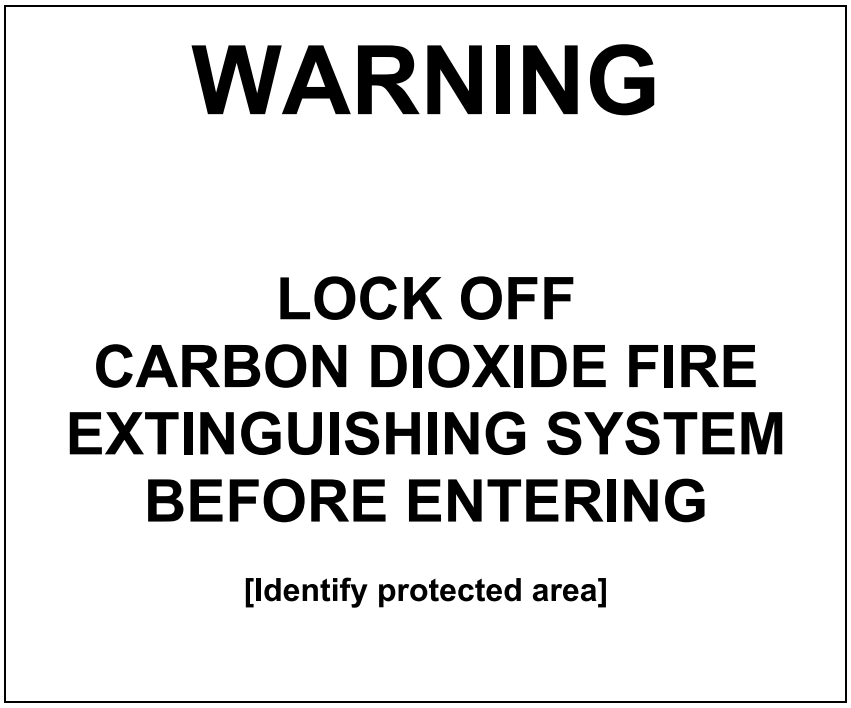

Figure 2 — Typical lock-off warning system notice

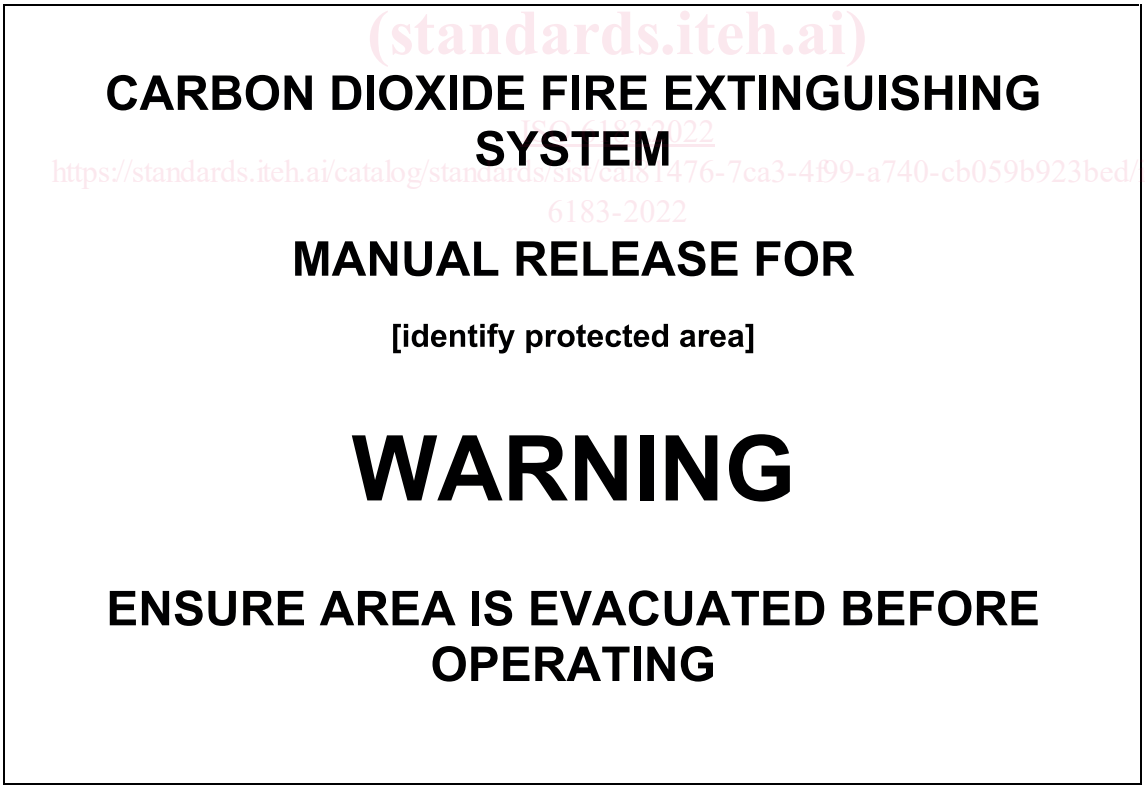

Figure 3 — Typical instruction notice to be displayed at the manual release

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 or as specified by national requirements. 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).