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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

Composants pour les systèmes d'extinction d'incendie utilisant des agents gazeux — Exigences et méthodes d'essai — Vannes de réservoir et leurs dispositifs d'asservissement; vannes de sélection et leurs dispositifs d'asservissement; diffuseurs; connecteurs flexibles et rigides; et vannes d'arrêt et clapets de retenue

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Foreword

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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.

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ISO 16003 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*.

Introduction

This International Standard has been prepared by a specialist working group of ISO/TC 21/SC 8 as a companion document to ISO 14520 (all parts) and is compatible with corresponding documents prepared by CEN. It does not cover all components incorporated in gaseous fire extinguishing systems dealt with in ISO 14520 (all parts); rather, it is restricted to key components only, viz., container valve assemblies, flexible connectors, check valves and non-return valves, selector valves and associated actuators and discharge nozzles.

CO_2 system components are also covered by this International Standard (see ISO 6183).

NOTE The components requirements of this International Standard are also satisfied by the requirements of EN 12094 (all parts).

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

1 Scope

This International Standard specifies requirements and describes test methods for the following components used in gaseous fire-extinguishing systems: container valve assemblies, which include container valve, actuator and, if applicable, a diptube; selector valves and their actuators; agent distribution nozzles; flexible connectors; and check and non-return valves.

Container valve assemblies are designed to control the extinguishant flow from the container to the distribution pipe work. They are normally in the closed position. The automatic control device triggers the actuator and the valve opens. Where applicable, the requirements contained in the test methods also apply to separate container valves.

The design of the nozzles influences the area coverage, the height limitations, the discharge rate and the flow rate.

This International Standard is applicable to check valves installed between container valve and manifold and non-return valves installed in pilot lines, except those valves that are tested in combination with non-electrical control devices. It is required that non-return and check valves allow the passage in the direction of flow and prevent flow in the reverse direction.

NOTE For the purpose of this International Standard, the pressure in megapascals (bars) means gauge pressure, unless otherwise indicated.

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 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 7005 (all parts), *Metallic flanges*

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

IEC 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60730-2-14, *Automatic electrical controls for household and similar use — Part 2-14: Particular requirements for electric actuators*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

3 Terms and definitions

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

3.1
actuator
component that causes a valve to operate

3.2
check valve
valve that is installed between container and manifold and that permits flow in only one direction

3.3
container valve
valve that retains the extinguishing agent in a container, releasing it when actuated

3.4
CO_2 high-pressure installation
fire-extinguishing installation in which the CO_2 is stored at ambient temperature

NOTE At 21 °C, the vapour pressure of CO_2 is 5,88 MPa (58,8 bar) absolute, or 5,88 MPa (57,8 bar) gauge.

3.5
CO_2 low-pressure installation
fire-extinguishing installation in which the CO_2 is stored at low temperature, normally −18 °C, at which the nominal pressure is 2,07 MPa (20,7 bar)

3.6
diptube
pipe connected to a container valve inlet that allows the discharge of a liquid extinguishing medium out of a vertical container with the valve at the top

3.7
distribution characteristics
limitations of enclosure dimensions within which a nozzle is approved for use

3.8
fill ratio
mass of extinguishing medium related to the net capacity of a container

NOTE The fill ratio is expressed in units of kilograms per litre.

3.9
filter
component to prevent blockage of nozzles or other operating components by foreign materials

3.10
flexible connector
link between two parts employed to compensate for installation spacing tolerances or to provide allowance for relative movement

3.10.1
type 1 flexible connector
flexible connector for connecting a container to a manifold

3.10.2
type 2 flexible connector
flexible connector for use in distribution pipe work downstream of the manifold

3.10.3
type 3 flexible connector
flexible connector for use in a pneumatic pilot line

3.10.4
type 4 flexible connector
flexible connector for use in distribution pipework downstream of the manifold/selector valve for the connection of moving parts, which allow for dimensional adjustments

3.10.5
type 5 rigid connector
rigid connector for connecting a container to a manifold

3.11
flow rate
mass flow of extinguishing agent per unit of time

3.12
functional reliability
ability to function under different working conditions

3.13
halocarbon gas
extinguishing agent that contains as primary components one or more organic compounds containing one or more of the agent's fluorine, chlorine, bromine or iodine

EXAMPLES Include, but are not limited to, halons, hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), perfluorocarbons (PFCs) and fluoroketones (FKs).

3.14
halocarbon gas installation
fire-extinguishing installation in which the halocarbon gas is stored at ambient temperature

3.15
high-pressure container
container having a working pressure greater than 3,5 MPa (35 bar)

3.16
inert gas
non-liquefied gas or mixture of gases, such as argon, nitrogen, CO_2 or mixtures of these gases, that extinguishes fire mainly by reducing the oxygen-concentration in the protected space

3.17
inert gas installation
fire-extinguishing installation in which the inert gas is stored at ambient temperature

3.18
local application nozzle
nozzle from which the extinguishing agent is discharged onto the surface of a partially enclosed or open hazard

3.19
low-pressure container
container having a working pressure not greater than 3,5 MPa (35 bar)

NOTE For the purpose of this International Standard, the pressure in megapascals (bars) means gauge pressure, unless otherwise indicated.

3.20
manifold
pipe section connected to two or more extinguishing agent containers

3.21
non-return valve
component that permits flow in one direction only

NOTE This component is intended for installation in pilot lines.

3.22
nozzle
component to achieve a predetermined flow rate and a uniform distribution characteristic of the extinguishing agent into or onto a protected hazard

3.23
nozzle cover
component to prevent entry of foreign matter into a nozzle

3.24
pressure-relief device
device, such as a rupture disk, that protects an agent container against dangerous overpressure

3.25
pressure-relief valve
valve that protects a closed part of a pipe work against dangerous overpressure

3.26
resistance coefficient
factor used in calculating the pressure drop due to fluid flow through a component

3.27
selector valve
valve used to admit extinguishing agent into a section of a pipe system permitting the agent to flow to a specific hazard in a multi-hazard application

NOTE Also called a “directional” valve.

3.28 Valve

3.28.1
type 1 valve
valve without a pressure-relief device

3.28.2
type 2 valve
valve with a pressure-relief device relieving other than into the valve discharge outlet

3.28.3
type 3 valve
valve with a pressure-relief device relieving into the valve discharge outlet

3.29
working pressure
maximum pressure at which the component is used in the system

NOTE See Table 1.

4 Requirements

4.1 General design

4.1.1 Test samples

4.1.1.1 The test sample shall comply to the technical description (drawings, parts list, description of functions, operating and installation instructions) when checked in accordance with 5.3.

The body and internal parts of the component shall be made of materials of suitable strength and of corrosion resistance sufficient to satisfy the performance requirements of this International Standard.

4.1.1.2 All materials shall be chemically compatible with the agent(s) with which they come into contact.

4.1.1.3 The operation of a component shall not be adversely affected by ageing or environmental influences.

4.1.1.4 Non-metallic materials and elastomers shall not be altered, such that the operation of the component is impaired, after any of the tests or over the working life recommended by the manufacturer.

4.1.2 Maximum rated working pressure

Components subject to pressure, including flexible connectors of Type 1, shall be specified by the manufacturer for working pressure according to Table 1 or as otherwise specified by national standards.

Table 1 — Working pressure for components

Component	CO_2 high pressure component		CO_2 low pressure component		Inert gas component	Halocarbon gas component
	MPa	bar	MPa	bar		
Container valve [c], selector valve, non-return valve, check valve, type 1 flexible connector	14,0	140	[a]		[b]	[b]
Type 2 and type 4 flexible connectors	6,0	60	2,5	25	[a]	[a]
Type 5 connector	14,0	140	Not applicable		[a]	[a]
Pneumatic actuator [c], type 3 flexible connector	As specified by the manufacturer					

[a] To be determined.

[b] This value is given as the pressure developed in a container at its maximum fill ratio and developed pressure at 50 °C, where applicable.

[c] Actuators may have a different working pressure than container valves.

4.1.3 Selector valves

The operating positions of selector valves of the bimodal type (i.e. open or closed) shall be closed prior to actuation. The operating position of three-way fluid-flow directing ball valves, where used, shall be set to direct flow to the hazard to receive the fire-extinguishing agent prior to system actuation.

4.1.3.1 Valve operation

Selector valves shall be designed so that they change from the closed to the open position, only on operation of an actuator or by manual means. The design of three-way ball valves used to direct agent flow shall be such that the valve ball position occurs only on operation of an actuator or by manual means.

4.1.3.1.1 The closed position of a low-pressure valve shall not be maintained only by friction.

4.1.3.1.2 Selector valves shall be designed to operate over the approved operating pressure range and temperature range of the system.

NOTE A selector valve actuator can have a working pressure different from that of the selector valve it operates.

4.1.3.1.3 The open and closed position of a selector valve, or the operating position of a ball valve, shall be indicated at the valve and shall be defined by mechanical means at the valve actuator.

4.1.3.1.4 The pressure of the housing of a selector valve or a three-way flow-directing ball valve shall not exceed the working pressure in any operating condition.

NOTE Cold liquid CO_2 trapped in a closed, low-pressure CO_2 selector valve after flooding can cause pressures exceeding the working pressure when the temperature of the CO_2 and the valve increases.

4.1.4 Container-valve assemblies

4.1.4.1 Container

The system manufacturer shall specify the container sizes, the related minimum and maximum fill ratios or quantities and, for super-pressurized containers, the super-pressurization value at standard conditions.

4.1.4.2 Diptube

If the component incorporates a diptube, the diptube shall be made of materials of suitable strength, corrosion resistance and other performance requirements of this International Standard, and shall be fixed to the container valve by a threaded connection, using a suitable chemical sealant, or other mechanical means. Torque, sealant, geometry of the inlet of the diptube and the length of the diptube related to the container shall be specified by the manufacturer. Rigid, curved diptubes intended for use in containers not in the vertical position shall be provided with a means of alignment with a mark on the valve, indicating the correct attitude for installation.

Where cylinders intended for mounting in attitudes other than vertical are fitted with a curved rigid diptube, mounting instructions shall be affixed to the cylinder to indicate the correct attitude for installation.

4.1.4.3 Container-valve actuator

4.1.4.3.1 Pneumatic actuator

If the component incorporates a pneumatically powered actuator, the manufacturer shall specify nominal maximum and minimum values for the pressure supply.

4.1.4.3.2 Mechanical actuator

If the component incorporates a mechanical actuator, the manufacturer shall specify the force required for hand-operated actuators and the mass and the drop distance for gravity-powered actuators.

4.1.4.3.3 Electric actuator

If the component incorporates an electric powered actuator, the manufacturer shall specify

a) the minimum and maximum voltage,

b) the minimum current.

4.1.4.3.4 Pyrotechnic actuator

If the component incorporates a pyrotechnically powered actuator, the manufacturer shall specify

— the minimum all-fire current, minimum current duration and the wave form of the signal,

— the maximum monitoring current,

— the minimum voltage,

— the maximum storage time under specified storage conditions,

— the maximum lifetime under stand-by conditions (50 °C and 70 % relative humidity).

In addition, data shall be provided by the manufacturer to show the following:

a) that the failure rate of the device in the energy-transfer path does not exceed 1 in 10 000 at the recommended firing current; firing probability of the device shall be at least 99,9 % with 95 % confidence limits when supplied with the recommended firing current;

b) that the actuators achieve the required power output after being subjected to a 90 day ageing test at a test temperature of (90 ± 2) °C;

c) that the power output of the actuator at the end of its service life, as recommended by the manufacturer, is not less than three times that required to operate the valve under the most disadvantageous operating conditions.

4.1.4.3.5 Electric parts

The electric parts of an actuator shall be engineered in accordance with the requirements of IEC 60730-2-14.

4.1.4.3.6 Testing

Provision should be made for testing the actuator without actually releasing the extinguishing agent.

If the components do not include such a test facility, the system shall include a test facility that can be used to separately test each group of containers actuated at the same time to verify that the necessary type and level of power is provided.

4.1.5 Pressure-relief device

Where a pressure-relief device is incorporated as part of a container valve, it shall be rated in accordance with the relevant ISO International Standards or national requirements for pressure-relief devices. The integrity of the device shall be maintained throughout the following tests:

a) high temperature;

b) low temperature;

c) vibration (marine applications or where otherwise specified);

d) corrosion.

The operating pressure shall be verified in accordance with relevant national regulations.

4.2 Connection threads and flanges

Connection threads shall be in accordance with either ISO 7-1 or ISO 228-1. Pipe flanges shall be in accordance with ISO 7005 (all parts).

NOTE References to certain national standards such as ANSI/ASME B1.20.1 and ANSI/ASME B16.5 can also be acceptable; see Annex A for details.

4.3 Valve function

Container valves, selector valves, check valves and non-return valves in the design flow path shall remain in the open position until the end of the required discharge.

4.4 Temperature range

The components shall operate in the temperature range for which the system was approved. See 5.13.

4.5 Resistance to internal pressure

A component shall not suffer any permanent deformation when tested in accordance with the requirements of the relevant section of this International Standard (see Table 2). A rupture disc may deform but shall not rupture.

Table 2 — Pressure-resistance test reference

Component type	Reference for test procedure
Container-valve casing, closure mechanism and pressurized accessories	5.5.2
Selector-valve casing and pressurized actuator, resistance to pressure and leakage	5.5.3
Check valve and non-return valve	5.5 4
Flexible connector	5.5.5

A component under test shall not leak during the pressure-resistance test procedure.

4.6 Resistance to bursting

A component shall not burst when subjected to a test pressure of three times the working pressure, or twice the maximum relief pressure of the agent container pressure-relief device, whichever is less, when tested as described in 5.6.

4.7 Leakage

4.7.1 Container valves

The loss of content from a container valve assembly shall not exceed 0,5 % of the actual net charge mass of the specified smallest appropriate container, when tested in accordance with the requirements of 5.7.1.

4.7.2 Check valves and non-return valves

Check valves and non-return valves shall meet the requirements of 5.7.2.

4.7.3 Selector valve

Selector valves shall meet the requirements of 5.7.3.

4.7.4 Connectors

Connectors shall meet the requirements of 5.7.4.

4.8 Impact resistance, check valves

Check valves shall not be damaged, when tested in accordance with 5.16.

4.9 Resistance to internal pressure and leakage

This requirement applies to components that are not normally pressurized, except upon system discharge, to include:

a) selector valves;

b) check valves and non-return valves;

c) flexible connectors.

Components shall not leak or suffer any permanent deformation when tested in accordance with 5.5.

4.10 Operational reliability

There shall be no deterioration of performance, when a component is tested as described in 5.10. During operation no part of the component shall be ejected outside the confines of the component or into the discharge pipe work.

4.11 Nozzle distribution characteristics

Nozzle distribution characteristics shall be determined in accordance with 5.9.

4.12 Nozzle resistance to pressure and heat

The extinguishing nozzles shall be able to withstand the test pressures and temperatures given in Table 3.

4.13 Nozzle protection covers

If a protective cap or cover is used to prevent exterior dirt or foreign matter from entering the nozzle, the cover shall be ejected free and clear of the nozzle when the extinguishant pressure at the nozzle is between 0,01 MPa (0,1 bar) and 0,3 MPa (3 bar) when tested in accordance with 5.8. The ejected cover shall not adversely affect distribution of extinguishant.

Table 3 — Test pressure and temperature

Type of system	Test pressure		Test temperature
	MPa	bar	°C
High-pressure CO_2	6,0	60	600
Low-pressure CO_2	2,5	25	600
Other	As specified by the manufacturer		600

Nozzles shall show no signs of deterioration that can impair proper performance when tested in accordance with 5.12.2.

4.14 Type 2 flexible connector resistance of to pressure and heat

Type 2 flexible connectors shall not leak, and shall show no sign of damage that can impair proper function when tested at the appropriate pressure and temperature given in Table 3, when tested in accordance with 5.12.

4.15 Type 2 flexible connector resistance to heat and cold shock

Type 2 flexible connectors shall not leak, and shall show no sign of damage that can impair proper function when tested in accordance with 5.13.

4.16 Type 2 flexible connectors resistance to cold

Type 2 flexible connectors shall show no visible sign of damage when tested in accordance with 5.14.

4.17 Type 2 flexible connector resistance to flexing

Type 2 connectors shall not leak when tested in accordance with 5.15.

4.18 Flow characteristics

The flow characteristics of any component in the flow path shall be specified by the manufacturer either as an equivalent length or as a flow-resistance coefficient consistent with the requirements of ISO 14520-1:2006, 7.3, and shall be determined in accordance with 5.17 or 5.18, as appropriate.

Determination of the flow characteristics of an individual component may be omitted if flow characteristics are determined for an assembly containing that component.

EXAMPLE Flow characteristics can be determined for an assembly consisting of a diptube, a container valve and a flexible connector. Test results are valid only for combination tested.

4.19 Corrosion

A component shall operate satisfactorily after being subjected to the corrosion test in accordance with 5.19.

4.20 Stress corrosion

Any part used in a component that is made of copper alloy containing more than 15 % zinc shall not crack, when tested in accordance with 5.20.

4.21 Vibration resistance

Where applicable, the component shall not operate or be damaged when tested in accordance with 5.21. If the component incorporates a diptube, the diptube shall not fracture, become loosened or detached during the test.

NOTE The vibration test does not apply for single-piece nozzles.

4.22 Diptube

Where the component incorporates a diptube, the length and configuration of the diptube shall be such that the volume of water remaining in the cylinder at the end of the discharge is less than 5 % of the internal volume of the cylinder when tested in accordance with 5.23.

For containers in a vertical position with the valve at the top, the above requirement is fulfilled without testing when the highest point of the inlet of the diptube is not more than two times the internal diameter of the diptube above the base of the container, measured straight below the diptube inlet, and the flow to the inlet of the diptube is not hindered.

4.23 Operating force, container-valve actuator

The effective operating force of a mechanical actuator shall be at least two times, and in the case of a pyrotechnic actuator at least three times, the force necessary to open a container valve in at most 2 s under the most severe conditions, when tested in accordance with 5.23.

4.24 Operating force, selector-valve actuator

The effective force of a selector-valve actuator shall be sufficient to open the selector valve in at most 3 s when tested at the minimum and maximum operating temperatures in accordance with 5.24.

4.25 Functional reliability, valves and actuators

4.25.1 There shall be no deterioration of performance when a component incorporating an electric powered actuator is tested as described in 5.23. The valve shall operate within 2 s and open fully at the nominal, maximum and minimum specified voltage.

4.25.2 There shall be no deterioration of performance when a pneumatically powered actuator is tested in accordance with 5.23. The valve shall operate within 2 s and open fully at the nominal, maximum and minimum specified pressure.

4.25.3 There shall be no deterioration of performance when a gravity-powered actuator is tested in accordance with 5.23. The free travel of the falling mass shall not be inhibited and there shall be at least 50 mm clearance beyond the fully operated position. Account should be taken of factors such as cable stretching, elongation due to temperature variation and other relevant factors.

4.25.4 There shall be no deterioration of performance when a pyrotechnic actuator is tested in accordance with 5.23.

4.26 Manually powered actuators

NOTE The provisions of this subclause apply only to manually operated actuators where the power to operate the valve is provided directly by a person employing a mechanical mechanism, e.g. lever at the valve.

The force required to operate a manually powered actuator shall not exceed

a) 180 N for hand operation,

b) 50 N for finger-pull operation, or

c) 10 N for finger-push operation.

The actuator shall not require a movement of more than 360 mm to achieve actuation when tested as described in 5.23.

4.27 Marking and data

The marking of data for a component shall be in accordance with Table 4.

The marking on the product shall be permanent and legible.

Table 4 — Component marking

Element	Valve or valve-cylinder assembly	Actuator	Selector valve	Selector-valve actuator	Nozzle	Flexible connector	Check valve
Location of marking	On valve or valve – cylinder assembly	On the component or in a parts list incorporated in the user's manual	On the component or in a parts list incorporated in the user's manual	On the component or in a parts list incorporated in the user's manual	On the component or in a parts list incorporated in the user's manual	On the component or in a parts list incorporated in the user's manual	On the component or in a parts list incorporated in the user's manual
Applicable International or National Standard	X	X	X	—	X		
Manufacturer's or supplier's name or trademark	X	X	X	X	X	X	X
Nominal diameter, size or model designation	X	X	X	X	X	X	X
Working pressure	X	X for pneumatic types	X	X	—	X	X
Serial or batch number or date of manufacture	X	X for electric, mechanical, & pneumatic types	X	—	—	—	—
Date of manufacture	—	X for pyrotechnic types	—	—	—	—	—
Nominal voltage and current	—	X for electric types	—	X for electric types	—	—	—
Installation position	—	—	X	—	—	—	X
Direction of flow	—	—	X	—	—	—	X

4.28 Documentation

4.28.1 The manufacturer shall prepare and maintain documentation that specifies the installation, operation, routine testing and maintenance procedures applicable to the component and all other information relating to its incorporation within a fire-extinguishing system.

4.28.2 The manufacturer shall prepare installation and user documentation, which shall be submitted to the testing authority together with the sample(s). This documentation shall be comprised of at least the following:

a) general description of the component, including a list of its features and functions;

b) technical specification including

— the information specified in 4.1,

— sufficient information to permit an assessment of the compatibility with other components of the system (if applicable, e.g. mechanical, electric or software compatibility);

c) installation instructions including

— the suitability for use in different environments,

— mounting instructions,

— operating instructions,

— maintenance instructions.

4.28.3 The manufacturer shall prepare design documentation, which shall be submitted to the testing authority together with the sample(s). This documentation shall include drawings, parts lists, block diagrams (if applicable), circuit diagrams (if applicable) and a functional description in sufficient detail that compliance with this International Standard can be checked and that a general assessment of the design is possible.

4.28.4 An installation, operation and maintenance manual and a design manual (when applicable) shall either be provided with each automatic extinguisher or extinguishing system unit or be made available upon request. When these manuals are not included with each system, an owner's manual shall be shipped with each system.

5 Test methods

5.1 Test conditions

The components shall be assembled for test as specified in the technical description. The tests shall be carried out at a temperature of (25 ± 10) °C, except when otherwise specified for a particular test. The tolerance for all test parameters is ± 5 %, unless otherwise specified.

5.2 Test samples and order of tests

The number of samples of each component type and the order of testing of each component are given in the relevant table as follows:

— container valves and their actuators: Table 5;

— selector valves and their actuators: Table 6;

— nozzles: Table 7;

— flexible connectors: Table 8;

— check valves and non-return valves: Table 9.

Table 5 — Order of tests for container valves and their actuators

Test and reference		Order of tests for test sample [a,b]				
		A	B	C	D	E
5.3	Compliance	1	1	1	1	1
5.4	Function	3 and 9	—	—	—	4
5.5	Internal pressure	2	—	—	—	—
5.6	Strength	10	—	—	—	—
5.7	Leakage	—	—	2	2	—
5.10	Operational reliability	7	—	—	—	—
5.11	Temperature	5	—	—	—	—
5.17	Flow characteristics	4	—	—	—	—
5.19	Corrosion (method 1 or 2)	8	—	—	—	—
5.20	Stress corrosion	—	2	—	—	—
5.21	Vibration	—	—	—	—	3
5.22	Diptube	—	—	—	—	2
5.23	Operating force and functional reliability	6	—	—	—	—

[a] Number of samples: Mechanical components: 5, identified as A to E; pyrotechnic actuators: 151.

[b] The replacement of parts as set out in the manufacturer's operation and maintenance manual shall be carried out during testing. Such parts shall be provided with the test samples.

Table 6 — Order of tests for selector valves and their actuators

Test and reference		Order of tests for test sample [a]		
		A	B	C
5.3	Compliance	1	1	1
5.4	Function	3/9/14	3	3
5.5	Internal pressure	2	2	2
5.7	Leakage	10/12/15	—	—
5.6	Strength	16	—	—
5.10	Operational reliability	11	—	—
5.11.2	Temperature conditions	—	—	—
5.11.2.1	Low-temperature, including leakage	6	6 [1]	6 [1]
5.11.2.2	High-temperature, including leakage	5	5 [1]	5 [1]
5.17	Flow characteristics	4	4	4
5.19	Corrosion (method 1 or 2)	13	—	—
5.20	Stress corrosion	—	8	—
5.21	Vibration	8	—	—
5.23.2	Operating force and functional reliability	7	7 [b]	7 [b]

[a] Number of samples: 3, designated A to C. If there is a design series, three different diameters are chosen and designated as follows:

A largest cross-section

B medium cross-section

C smallest-cross section.

[b] Whether or not these tests are necessary depends on the construction.

Table 7 — Order of tests for nozzles

Test [a] and reference		Order of tests for test sample [b]			
		A [c]	B [d]	C [e]	D [f]
5.3	Compliance	1	1	1	1
5.8	Nozzle cover	—	—	—	2
5.9	Distribution characteristics	—	—	2	
5.12	Resistance to pressure and heat	3	—	—	—
5.19	Corrosion	2	—	—	—
5.20	Stress corrosion	—	—	—	3
5.21	Vibration	—	—	3	—

a The components shall be tested assembled as recommended for installation by the manufacturer.

b Number of samples: 4, designated A to D. When testing a nozzle type with only one size, four test samples are needed. When testing a series of identical design, four test samples in different sizes are required (bottom, middle and top end of the range).

c The tests described for sample A shall be run with all sizes, except for the corrosion and the following function test, which shall be carried out with the smallest size.

d The test described for sample B shall be run with the largest size.

e The test described for sample C shall be run with the size to give a flow rate to match the particular test facility for test 5.9.

f The tests described for sample D shall be run with the smallest size.

Table 8 — Order of tests for flexible connectors

Test and reference		Order of tests for test sample [a]						
		A	B	A	B	C	D	E
		Connector type						
		Types 1, 3 and 5		Types 2 and 4				
5.3	Compliance	1	1	1	1	1	1	1
5.7	Leakage	—	2 and 4 [b]	—	2 and 4	3	3	3
5.6	Strength	2	—	2	—	—	—	—
5.12.1	Resistance of type 2 and type 4 flexible connectors to pressure and heat	—	—	—	—	2	—	—
5.13	Resistance of type 2 and type 4 flexible connectors to heat and cold shock	—	—	—	—	—	2 [c]	—
5.14	Resistance of type 2 flexible connectors to cold	—	3 [3]	—	3	—	—	—
5.15	Resistance of type 2 flexible connectors to flexing	—	—	—	—	—	—	2 [d]

a Number of samples: 2, for types 1, 3 and 5, designated A and B; 5 for types 2 and 4, designated A to E.

b Not applicable for type 5 connectors.

c Only for CO_2 components.

d Only for type 2 connectors.

Table 9 — Order of tests for check valves and non-return valves

Test [a] and reference		Order of tests for test sample [b]		
		A/B	C	D
5.3	Compliance	1	1	1
5.5	Internal pressure	3	—	—
5.6	Strength	8	—	—
5.17	Flow characteristics [c]	—	2	—
5.7	Leakage	—	3	3
5.16	Impact*	—	—	2
5.4	Function	2 and 7	4	—
5.11.3	Temperature	4	—	—
5.19	Corrosion	6	—	—
5.20	Stress corrosion	—	—	4
5.21	Vibration	5	—	—

[a] Assemble the component for the test in accordance with the manufacturer's recommendations.

[b] Number of samples: 4, designated A to D.

[c] For check valves only.

5.3 Compliance

A visual and measurement check shall be made to determine whether the test samples correspond to the description in the technical literature (drawings, parts lists, description of functions, operating and installation instructions), and whether the samples comply with the requirements of 4.1.

5.4 Function test

5.4.1 Container valves

5.4.1.1 This test relates to the requirements of 4.4.

5.4.1.2 Mount the container valve in the attitude specified by the manufacturer or, if not given, in the attitude where maximum force is required. Verify compliance with the requirements of 4.4 by one of the two following methods.

— **Method 1**: Connect the inlet of the sample to a suitable gas supply and install a pressure-measuring device at the inlet of the sample. Start the gas flow through the sample increasing the pressure at the inlet of the sample to 0,3 MPa (3 bar). Check that the sample remains in its fully open position at a differential pressure between inlet and outlet of 0,3 MPa (3 bar).

— **Method 2**: Connect a force gauge to the centre of the sealing device. Move the sealing device by increasing the force to the fully open position. Measure the force to the fully open position of the valve. Calculate the pressure necessary to operate the valve to the fully open position.

5.4.1.3 The test pressure is

— (6,0 ± 0,5) MPa [(60 ± 5) bar] for CO_2 high-pressure container valves;

— the pressure developed in the container at 20 °C for other container valves.

Carry out the following test cycle five times.

a) Apply the test pressure to the inlet port of the valve using gaseous CO_2, air or nitrogen. The outlet shall be connected to a pipe with a nozzle at least (0,5 ± 0,1) m long with the nozzle having a nominal diameter of at least 3 mm.

b) Open the valve with the actuator under normal power condition.

c) Check the correct function of the sample and measure the opening time.

d) After (10 ± 5) s, close the inlet pressure source to the valve, depressurize to a value below 0,5 MPa (5 bar) and close the valve.

e) During each test cycle the supply pressure to the valve shall not drop below

— 5,0 MPa (50 bar) for CO_2 high-pressure container valves,

— 80 % of the test pressure for other container valves.

5.4.2 Selector valves

Carry out the following cycle five times.

a) Apply pressure corresponding nominally to the agent container pressure at normal storage temperature (normally –18 °C for low-pressure CO_2 and 21 °C for other agents) to the inlet port of a valve assembly using CO_2, air or nitrogen. Connect the outlet to a pipe with a nozzle (0,5 ± 0,1) m long with the nozzle having a nominal diameter of $3^{+0,5}_{0}$ mm.

b) Open the valve with the appropriate actuator. Check the correct function of the sample manually.

c) In the case of a low-pressure selector valve, close the valve after (10 ± 5) s with the appropriate actuator. Check the correct function of the sample and measure the closing time. In the case of a high-pressure selector valve, after (10 ± 5) s depressurize to a valve and close the sample manually.

d) During the test the supply pressure to the valve shall not drop below 75 % of the initial pressure.

NOTE Fit replacement parts at the end of each cycle on valves or actuators in those parts that are designed to be destroyed during the normal operation of the valve.

5.4.3 Check valves and non-return valves

5.4.3.1 Requirements

The test relates to the requirements specified in 4.4.

5.4.3.2 Manifold check-valves

The test set-up shall consist of a manifold with two inlet connections for agent containers. The test gas for inert systems shall be the extinguishant itself or dry nitrogen, with the same fill pressure; for CO_2 systems. CO_2 shall be used as the test gas; for halocarbon systems, the cylinder shall be filled to the same fill ratio with extinguishant, which is super-pressurized to the usual fill pressure with dry nitrogen.

Check-valves of the type subject to test shall be fitted to each manifold inlet. Connect an agent container of at least 40 l capacity to one inlet check-valve. The test medium shall be the agent intended for use. The manifold outlet shall be connected, via a ball valve, to a discharge pipe of the same diameter with a length of (0,5 ± 0,1) m.

A nozzle with at least a 5 mm diameter is connected to the discharge pipe outlet. Close the ball valve at the outlet of the manifold. Open the container valve. Verify that the check valve at the inlet connection without a container does not leak. After (5 ± 1) min, open the ball valve, venting the agent from the manifold. After discharge, verify that both test samples are undamaged and operate properly.

5.4.3.3 Non-return valves

Connect a non-return valve to a supply of air, nitrogen or CO_2 with a delivery pressure at least as great as that specified in Table 1 for the agent intended for use. Fit a nozzle downstream of the valve with a cross-section of half (± 10 %) the cross-sectional area of the non-return valve and allow the gas to flow through the valve for

a) (60 ± 5) s for CO_2 and inert gases,

b) (10 ± 1) s for halocarbons.

After the discharge verify that the non-return valve is not damaged and operates properly.

5.5 Resistance to internal pressure

5.5.1 Requirements

These tests relate to the requirements of 4.6.

5.5.2 Container valve casing, closure mechanism and pressurized accessories

5.5.2.1 The valve in its closed position shall be connected via the inlet to a suitable hydraulic pressure supply. All ports including the pressure-relief device port shall be blocked. Provision for venting shall be available.

Vent the system of air and increase the pressure at (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up to 1,5 times the working pressure or the nominal pressure of the bursting disc, whichever is higher.

Maintain this pressure for a period of 5^{+1}_{0} min. At the end of this period, release the hydraulic pressure.

5.5.2.2 The actuator shall be connected via the inlet to a suitable hydraulic pressure supply. All ports shall be blocked. Provision for venting shall be available.

Vent the system of air and increase the pressure at (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up to 1,5 times the working pressure.

Maintain this pressure for a period of 5^{+1}_{0} min. At the end of this period, release the hydraulic pressure.

5.5.2.3 Pressurize the valve with air or nitrogen to the working pressure. Examine the valve in a water bath for leakage. At atmospheric pressure in 1 min, no bubbles shall appear.

5.5.2.4 Pressurize the actuator with air or nitrogen to the working pressure. Examine the actuator in a water bath for leakage. The leakage shall be not more than 20 ml in 300^{+10}_{-1} s at atmospheric pressure.

5.5.3 Selector valves and pressurized actuators — Resistance to pressure and leakage

5.5.3.1 These tests relate to the requirements of 4.10.

5.5.3.2 The valve in its closed position shall be connected via the inlet to a suitable hydraulic pressure supply. Provision for venting shall be available.

Vent the system of air and increase the pressure at (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up to 1,5 times the working pressure for a period of 5^{+1}_{0} min. At the end of this period, release the hydraulic pressure.

5.5.3.3 Pressurize the valve inlet with air for nitrogen to the working pressure ± 5 %. Examine the valve in a water bath or leakage. The leakage shall not be more than 20 ml in the case of a high-pressure valve and 10 ml in the case of a low-pressure valve in 300^{+10}_{-1} s at atmospheric pressure.

5.5.4 Check valve and non-return valve

This test relates to the requirements specified in 4.6.

The non-return or check valve shall be connected via the outlet to a suitable hydraulic pressure supply. Provision for venting shall be available.

Vent the system of air and increase the pressure at (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up to 1,5 times the working pressure $\left(^{+5}_{0}\ \%\right)$.

Maintain this pressure for a period of 5^{+1}_{0} min. At the end of this period, release the hydraulic pressure.

5.5.5 Flexible connectors

This test evaluates the resistance to leakage.

Connect the inlet of the sample to a hydraulic pressure supply and block the outlet. Vent the system to eliminate all air, increase the pressure by (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up to the test pressure $\left(^{+5}_{0}\ \%\right)$.

Maintain this pressure for a period of 1^{+1}_{0} min. At the end of this period, release the hydraulic pressure and examine the sample for damage.

5.6 Resistance to bursting

5.6.1 Container valve assemblies

This test relates to the requirements of 4.7.

Valves in open position and actuators shall be connected via the inlet to a suitable hydraulic pressure supply. The outlet shall be blocked. Provision for venting shall be available.

Vent the system of air and increase the pressure at a rate of (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] to the test pressure, which shall be the lesser of $\left(^{+10}_{0}\ \%\right)$,

a) three times the working pressure,

b) twice the maximum relief pressure of the agent-container pressure-relief device.

Maintain the test pressure for 5^{+1}_{0} min. At the end of this period release the hydraulic pressure.

For pyrotechnic powered actuators the test procedure shall be set up with data provided by the manufacturer of the pyrotechnic elements to meet a similar strength requirement.

5.6.2 Selector valves

The valve in its open position with blocked outlet shall be connected via the inlet to a suitable hydraulic pressure supply. Provision for venting shall be available.

Vent the system of air and increase the pressure at (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up to the test pressure as specified in 5.6.1.

Maintain the test pressure for a period of 5^{+1}_{0} min. At the end of this period, release the hydraulic pressure.

5.6.3 Check valves and non-return valves

This test relates to the requirements specified in 4.7.

Connect the inlet of the test sample to a suitable hydraulic pressure supply and block the outlet. Vent the system and increase the pressure at (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up to the test pressure as specified in 5.6.1.

Maintain the test pressure for a period of 5^{+1}_{0} min. At the end of this period, release the hydraulic pressure.

5.6.4 Flexible connectors

Connect the inlet of the sample to a hydraulic pressure supply and block the outlet. Vent the system and increase the pressure at (0,5 ± 0,1) MPa/s [(5 ± 1) bar/s] up to the test pressure as specified in 5.6.1.

Maintain the test pressure for a period of 10^{+1}_{0} min. At the end of this period, release the hydraulic pressure and examine the sample.

5.7 Leakage test

5.7.1 Container-valve assemblies

5.7.1.1 Requirements

This test relates to the requirements of 4.8, which can be satisfied by employing the method explained in 5.7.1.2.

5.7.1.2 Method

5.7.1.2.1 Conditioning

Components for non-liquefied extinguishants (e.g. inert gases) and for liquefied extinguishants without super-pressurization (e.g. CO_2) shall be tested in conjunction with the smallest container for which the valve is designed. The container samples shall be charged to the maximum specified fill ratio.

Components for liquefied extinguishants with super-pressurization shall be tested in conjunction with the smallest container for which the valve is designed. One of the specified container samples shall be charged to the minimum fill ratio and the other to the maximum fill ratio. Both containers shall be super-pressurized to the super-pressurization pressure.

Measure and record the charge mass to an accuracy of ± 0,1 %.

For super-pressurized, liquefied extinguishants, in addition, measure and record the charge pressure to an accuracy of ± 0,1 %.

Expose the assembly to changes of temperature in air.

a) The lower temperature shall be the manufacturer's recommended minimum operating temperature $^{0}_{-2}$ °C.

b) The higher temperature shall be the manufacturer's recommended maximum operating temperature $^{0}_{-2}$ °C.

c) The duration of exposure at each temperature is (24 ± 0,5) h.

d) The number of cycles is three times on one sample.

After completion of the cycling period, which takes 6 d, store the assembly at (20 ± 5) °C for (28 ± 2) d.

Carry out this sequence of cycling, followed by storage, a total of three times.

Subsequently measure and record the charge mass and, if applicable, the charge pressure to the accuracy stated. Record any loss and calculate any loss as a percentage of the initial charge conditions.

System units intended for transportation and storage in the vertical position only are not required to be tested in the horizontal position.

5.7.1.2.2 30-day elevated temperature test

An extinguishing-system cylinder-valve assembly, including pressure-retaining accessories, shall be conditioned at its maximum storage temperature for a period of 30 days and shall not show

— any measurable leakage after the conditioning,

— elastomeric seal degradation or separation after being discharged.

Representative sample extinguishing-system units pressurized to their operating pressure at 21 °C (70 °F) shall be placed in the horizontal and the vertical position and maintained at the maximum storage temperature for 30 days. The units are then conditioned to 21 °C (70 °F) for 24 h and checked for pressure loss. The units are then discharged through a representative pipe arrangement. The valves are disassembled and the seals examined.

5.7.1.2.3 Temperature cycling test

An extinguishing-system cylinder-valve assembly, including pressure-retaining accessories, shall not show any measurable leakage after being subject to the temperature cycling test.

Representative sample extinguishing-system units pressurized to their operating pressure at 21 °C (70 °F) shall be placed in the horizontal and the vertical position and maintained at the minimum storage temperature for 24 h, then at the maximum storage temperature for 24 h, and then again maintained at the minimum storage temperature for 24 h. The units are then conditioned to 21 °C (70 °F) for 24 h and checked for pressure loss.

5.7.1.2.4 One-year time leakage test — Inert gas agents

Representative sample extinguishing-system units pressurized to their operating pressure shall be stored in the vertical position at 21 °C (70 °F) and their pressure checked after 1 month, 3 months, 6 months and 12 months. Any loss in pressure or mass is an indication of leakage.

5.7.1.2.5 One-year time leakage test — Halocarbon agents

Representative samples of the charged extinguishing-system units shall be maintained at a temperature of 22 ± 4 °C (72 ± 7 °F) for 360 days. Samples are placed in the horizontal and the vertical positions and their pressures checked after 1 month, 3 months, 6 months and 12 months. Any loss of pressure or mass is an indication of leakage. At least one of the units shall be discharged and the valve pressure gauge and other components that are exposed to the extinguishing agent examined for signs of corrosion caused by the exposure.

5.7.2 Check valves and non-return valves

This test relates to the requirements specified in 4.8.

The test unit consists of a pipe (0,5 ± 0,1) m long with the same diameter as the nominal diameter of the valve.

The check valve shall be installed with its outlet to the test pipe. Air, nitrogen or CO_2 supply shall be connected via a container valve. The check valve shall be pressurized to (2,0 ± 0,2) MPa [(20 ± 2) bar] and plunged in a water bath at an ambient temperature of (20 ± 5) °C. The pressure is maintained for a period of 2 min. The leakage shall be not more than 20 ml in 300^{+10}_{-1} s at atmospheric pressure.

The non-return valve shall be installed with its outlet to the test pipe. An air, nitrogen or CO_2 supply shall be connected via a container valve. The non-return valve shall be pressurized with (0,3 ± 0,01) MPa [(3 ± 0,1) bar] and plunged in a water bath at an ambient temperature of (20 ± 4) °C. The pressure is maintained for a test period of 2 min. Then the pressure is increased to the working pressure and maintained for another test period of 2 min. In both test periods, no bubbles shall be formed downstream of the valve.

5.7.3 Selector valve

The valve shall be pressurized with air or nitrogen to the working pressure. With the component maintained at the required test temperature, the leakage shall be measured using a water bath.

The leakage shall not exceed 10 ml in case of CO_2 low-pressure valves and 100 ml in case of other valves in 300 s at atmospheric pressure.

5.7.4 Connectors

Connect the inlet of the sample to a hydraulic pressure supply and block the outlet. Vent the system and increase the pressure by (0,2 ± 0,1) MPa/s [(2 ± 1) bar/s] up the pressure of 1,5 times the working pressure.

The sample shall not leak or show any sign of damage that can impair proper function.

5.8 Nozzle cover

The test relates to the requirements of 4.3. The nozzle with cover shall be mounted on pipe equipped with a pressure gauge. The pressure in the pipe shall be raised by (0,1 MPa/min) (1 bar/min). The pressure required to open the cover shall be measured.

5.9 Nozzle distribution characteristics

The nozzles shall be tested for discharge characteristics, including area coverage and height limitations (see also ISO 14520-1:2006, Annex C), or shall be approved under the procedure described in national standards or International Standards dealing with nozzle-discharge characteristics.

5.10 Operational reliability

5.10.1 Requirements

This test relates to the requirements of 4.11.

5.10.2 Container valve assemblies

Carry out 100 test cycles as described in 5.4.1, but without measuring the opening time.

5.10.3 Selector valves

The test cycle shall be carried out 100 times in accordance with 5.4.2, but without measuring the opening/closing time.

5.11 Performance at temperature extremes

5.11.1 Container valves

These tests relate to the requirements of 4.5.

5.11.1.1 Low-temperature test

Condition the sample at the minimum service temperature, ${}_{-2}^{\ 0}$ °C, recommended by the manufacturer for (2 ± 0,5) h.

Carry out five test cycles as described in 5.4.1.3 at test temperature.

5.11.1.2 High-temperature test

Condition the sample at the maximum service temperature, ${}_{-2}^{\ 0}$ °C, recommended by the manufacturer for (2 ± 0,5) h.

Carry out five test cycles as described in 5.4.1.3 at test temperature.

5.11.2 Selector valves

5.11.2.1 Low-temperature test

Cool the test assembly to the minimum service temperature recommended by the manufacturer, and maintain at this temperature for (2 ± 0,5) h.

Ensure that no water is in the test sample. Carefully close the valve before.

Cary out the test cycle five times in accordance with 5.4.1.3.

Subsequently, conduct a leakage test in accordance with 5.7 at the test temperature.

5.11.2.2 High-temperature test

Heat the test assembly to the maximum service temperature, ${}_{-2}^{\ 0}$ °C, recommended by the manufacturer for (2 ± 0,5) h.

Cary out the test cycle five times in accordance with 5.4.1.3.

Subsequently, conduct a leakage test in accordance with 5.7 at the test temperature.

5.11.3 Check valves and non-return valves

5.11.3.1 Low-temperature test

Condition the test sample and the pressure supply at the minimum service temperature, ${}_{-2}^{\ 0}$ °C, recommended by the manufacturer for (2 ± 0,5) h. Repeat the test in accordance with 5.4.3.2 for check valves and 5.4.3.3 for non-return valves at the pressure developed in the system at the minimum service temperature.

5.11.3.2 High-temperature test

Condition the test sample and the pressure supply at the maximum service temperature, ${}_{-2}^{\ 0}$ °C, recommended by the manufacturer for (2 ± 0,5) h. Repeat the test in accordance with 5.4.3.2 for check valves and 5.4.3.3 for non-return valves at the pressure developed in the system at the maximum service temperature.

5.12 Test for resistance to pressure and heat

5.12.1 Type 2 and type 4 flexible connectors

Connect the sample to a reservoir capable of delivering gaseous CO_2, nitrogen or air at the following test pressure:

— (6,0 ± 0,5) MPa [(60 ± 5) bar] for CO_2 high-pressure container valves;

— pressure developed in the container at 20 °C for other container valves.

Place the unpressurized sample in a (600 ± 30) °C furnace for a period of 10^{+2}_{0} min. Then pressurize the heated sample for (30 ± 5) s with gaseous CO_2, nitrogen or air to the test pressure. Remove the sample from the furnace and test for leakage in accordance with 5.5.5.

5.12.2 Nozzles

A nozzle is connected to the test vessel. The nozzle is connected with a pressure source and is subjected to test temperature for a period of 10 min. Then the gaseous test medium, e.g. gaseous-phase CO_2, nitrogen or air, shall flow through the heated nozzle body for at least 10 s.

In case of test pressures exceeding 6 MPa (60 bar), the nozzle outlet(s) may be partly or fully blocked by suitable means (without affecting the strength characteristics of the component) to prevent damage of the test equipment by excessive gas flow.

The pressure shall be measured at a distance of (1 ± 0,1) m upstream from the nozzle. The nominal diameter of the pipe between pressure measuring point and nozzle shall be not less than the nominal size of the connection thread of the nozzle tested.

5.13 Test for resistance of type 2 and type 4 flexible connectors to heat and cold shock

Connect the sample to a CO_2 vessel that incorporates a diptube and is capable of delivering liquid CO_2 at an absolute pressure of (2,0 ± 0,1) MPa [(20 ± 1) bar]. A two-position, three-port ball valve (bypass-valve) shall be installed in the pipe work between the vessel and the sample, which allows control of the CO_2 flow from the vessel. The nominal diameter of the pipe work between the vessel and the bypass-valve shall be at least 25 mm. The nominal diameter of the bypass-valve and the connected pipe to the sample shall be 25 mm. The length of the connected pipe shall be (1 ± 0,1) m. In one position, the test position, the bypass-valve allows the CO_2 to pass through the sample. In the other position, the bypass position, the outlet to the sample is closed and the CO_2 flow is diverted via appropriate pipe work, which is dimensioned to reach a stable flow of liquid CO_2 at the bypass-valve within 30 s. At the outlet of the sample, connect a nozzle with a 10 mm orifice. Subject the sample to a temperature of (600 ± 30) °C in a furnace for a period of 10^{+2}_{0} min. Just before completion of the heating period, commence CO_2 flow through the bypass. Upon stabilization of the liquid CO_2 flow and completion of the heating period, divert flow through the sample for a period of 30^{+10}_{-2} s. Remove the sample from the furnace and test for leakage in accordance with 5.5.5.

5.14 Test of type 2 flexible connectors for resistance to cold

The sample is conditioned at its minimum storage temperature for 24 h. The length of the complete hose is then bent to the minimum bending radius as specified by the manufacturer within a period of 8 s to 12 s, while still in the cold chamber. The hose sample is to be examined for evidence of cracking or other damage in the tubing, cover or reinforcement and then subjected to a resistance to bursting test as indicated in section 5.6.4.

5.15 Test of type 2 flexible connectors for resistance to flexing

This test relates to the requirements of 4.8.

Use a bending rig to bend the sample around the minimum radius specified by the manufacturer. One bending cycle consists of bending the sample from straight to the maximum angle of deflection specified by the manufacturer (or, if not specified, to the maximum possible angle of deflection) and back to straight. Carry out 3 000 bending cycles.

5.16 Impact test for check valves

This test relates to the requirements specified in 4.9.

The test unit consists of a pipe (0,5 ± 0,1) m long with the same diameter as the nominal diameter of the valve.

A check valve that is normally in the open position shall be installed with its outlet to the test pipe. A check valve that is normally in the closed position shall be installed with its inlet to the test pipe. An air, nitrogen or CO_2 supply shall be connected via a quick-opening high-pressure container valve. The valve shall be pressurized 10 times with working pressure ± 0,5 MPa (± 5 bar) in accordance with Table 1.

5.17 Flow characteristics of container valves

The test relates to the requirements of 4.18.

The flow characteristic of the container valve is determined in combination with the diptube.

The hoses or container connection pipes (see relevant International or national Standards) and the check valve (see relevant International or national Standards) should be tested as a sample together with the container valve.

If different combinations of valve, hose or check valve are used, the flow characteristics shall be determined in each case as new.

The tests may be done using

a) CO_2 as the test medium for CO_2 high-pressure container valves,

b) a permanent gas as the test medium for inert-gas container valves,

c) the extinguishant (including super-pressurization, if applicable) as the test medium for halocarbon-gas container valves,

d) water, where deemed appropriate.

The results obtained shall be capable of being used with the approved flow calculation method.

5.18 Flow characteristics of selector valves

5.18.1 The test relates to the requirements of 4.18.

5.18.2 The test shall be done using

— CO_2 as the test medium for CO_2 high- and CO_2 low-pressure selector valves,

— a permanent gas as the test medium for inert-gas selector valves,

— the extinguishant (including super-pressurization, if applicable) as the test medium for halocarbon-gas selector valves.

5.18.3 The supply container shall be kept for at least 10 h at a pressure of

— (5,63 ± 0,15) MPa [(56,3 ± 1,5) bar] in the case of CO_2 high-pressure selector valves,

— (1,95 ± 0,1) MPa [(19,5 ± 1) bar] in the case of CO_2 low-pressure selector valves,

— the pressure developed in the container at 20 °C for selector valves other than for CO_2 and not specified for use in systems with reduced and controlled pressure only, and

— the specified working pressure for selector valves other than for CO_2 and specified for use in systems with reduced and controlled pressure only.

The sample shall be connected to the supply container. A straight pipe shall be connected to the sample's outlet. The pressure-measuring point shall be selected on the pipe at a distance of at least 10 times the internal diameter of the pipe. One or more nozzle(s) shall be fitted at the end of the measuring line.

It can be necessary to carry out several measurements with different flow rates.

5.19 Corrosion

5.19.1 Requirements

The test relates to the requirements of 4.19. The requirement may be satisfied by employing either method 1 (5.19.2), method 2 (5.19.3) or method 3 (5.19.4).

5.19.2 Method 1 — 5 % sodium chloride solution salt spray

Expose the sample to a salt spray within a fog chamber.

Seal the valve opening.

Fit an open bend to the outlet to prevent direct influence of the salt spray to the valve's interior.

Use the following essential components and properties of the reagents and the test configuration:

— solution: sodium chloride (NaCl) in distilled water;

— pH value: 6,5 to 7,5;

— concentration of the solution: (5 ± 1) %;

— spray pressure: 0,06 MPa to 0,15 MPa (0,6 bar to 1,5 bar);

— spray volume: 1 ml·h^{-1} to 2 ml·h^{-1} on an area of 80 cm^2;

— temperature in test cabinet: $35^{+1,0}_{-1,7}$ °C;

— position of the sample: 15° to the vertical axis;

— spray time: (240 ± 2) h;

— drying time: (168 ± 5) h at a maximum humidity of 70 %.

5.19.3 Method 2 — 20 % sodium chloride solution salt spray

5.19.3.1 The following shall be subjected to the described test:

a) all parts of a fully charged extinguishing-system unit, including the finishes on coated or painted parts, nameplates as secured in place and the attachments required for installation;

b) any other operating components (components having moving parts) that have externally exposed materials without corrosion resistance equivalent to a polymeric material, brass or stainless steel.

5.19.3.2 After exposure, an extinguishing-system unit shall comply with the following.

a) The extinguishing-system unit shall show no evidence of corrosion on any surface, other than corrosion that is capable of being easily wiped off after rinsing with tap water. When any part of the system has a corrosion-resistant coating, the coating shall be intact and shall show no signs of becoming detached or peeling.

b) No galvanic corrosion shall be visible on the system unit.

c) When the system has a pressure gauge, the gauge shall not have moisture inside and it shall operate as intended.

d) When a component being tested is normally charged with a clean agent, air or nitrogen or an equivalent shall be used in lieu of the clean agent.

e) There shall be no significant deterioration of the legibility of a pressure-sensitive nameplate, such as darkening, fogging or blistering, nor any cracking or bucking at the edges.

5.19.3.3 The test samples shall be supported vertically and exposed to salt spray (fog) using the salt spray (fog) testing apparatus in accordance with ASTM B117-1994. The apparatus used for salt-spray exposure shall consist of a fog chamber, 1,2 m by 0,8 m by 0,9 m (48 in by 30 in by 36 in) inside dimensions, having a salt-solution reservoir, a supply of conditioned compressed air, a dispersing tower for producing a salt fog, sample supports, provision for heating the chamber and required means of control. The dispersion tower shall be located in the centre of the chamber and shall be supplied with salt solution and the warmed, humidified air at a pressure between 117 kPa and 131 kPa (17 psig and 19 psig) to disperse the salt solution in the form of a fine mist of fog throughout the interior to the chamber. The temperature within the chamber shall be maintained between 33,3 °C and 36,1 °C (92 °F and 97 °F). Condensate accumulation on the cover of the chamber shall not drop onto the test samples, and drops of the solution that fall from the samples shall not be recirculated but shall be removed through a drain located in the floor of the chamber.

5.19.3.4 The salt solution is to consist of 20 % mass fraction of common salt (sodium chloride) and distilled water and the test duration is to be 240 h. The pH value of this solution as collected after being sprayed in the test apparatus shall be between 6,5 and 7,2, and the specific gravity shall be between 1,126 and 1,157 at 36,3 °C (95,5 °F).

5.19.4 Method 3 — Sulfur dioxide

The sample shall be suspended freely in its normal installation attitude.

The test set-up is comprised of a container with a volume of 5 l, made of heat-resistant glass and with a corrosion-resistant cover that is shaped to prevent condensate dripping onto the samples. If a container with a 10 l volume is used, the quantities of chemicals given below shall be doubled. The container is heated electrically and the side walls are cooled with water. A thermostat regulates the heating so as to maintain a temperature of approximately 45 °C inside the container. During testing, water is passed through a cooling coil wrapped around the container; it shall flow fast enough that its temperature at the discharge point is below 30 °C.

The combination of heating and cooling is designed to ensure that vapours condense on the surface of the samples. The sulfur dioxide atmosphere is generated in the 5 l container with a solution of 20 g of sodium thiosulphate ($Na_2S_2O_3 \cdot 5 H_2O$) in 500 cm^3 of distilled water, to which 20 cm^3 of diluted sulfuric acid is added daily. The diluted sulfuric acid is comprised of 128 cm^3 of 1 M sulfuric acid (H_2SO_4) dissolved in 1 l of distilled water. The test samples shall be removed from the container after 8 days; the container shall be cleaned. Then the procedure described above is repeated for a further period of 8 days.

After a total of 16 days, the samples are removed from the container and allowed to dry for 7 days at a temperature of (20 ± 5) °C at maximum relative humidity of 70 %.

5.20 Stress corrosion

This test relates to the requirements of 4.20.

Use a suitable container of known volume fitted with a capillary tube vent. The aqueous ammonia solution shall have a specific gravity of 0,94 kg/l ± 2 %. The container is filled with (10 ± 0,5) ml of the solution for each litre of container volume.

Each test sample shall be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses shall be applied to the sample prior to, and shall be maintained during, the test. Samples with threads intended for the purpose of installing the product in the field shall have the threads engaged and tightened to the torque specified in Table 10. Teflon tape or pipe compound shall not be used on the threads.

Table 10 — Torque requirements for threaded connections

Nominal thread size mm (in)	**Torque** N-m (lb-in)
25 (1)	136 (1 200)
32 (1 1/4)	164 (1 450)
38 (1 1/2)	175 (1 550)
50 (2)	186 (1 650)
64 (2 1/2)	198 (1 750)
76 (3)	203 (1 800)

Degrease the sample for test and expose for 10^{+1}_{0} d to the moist atmosphere of ammonia and air, at a temperature of (34 ± 2) °C. Position the samples (40 ± 5) mm above the level of the liquid.

After testing, clean and dry the sample and subject it to careful visual examination. To make cracking clearly visible, use the liquid-penetration method.

5.21 Vibration

5.21.1 Requirements and general test conditions

This test relates to the requirements of 4.21, which can be satisfied by employing either method 1 (5.21.2) or method 2 (5.21.3).

If the component incorporates a diptube, the vibration test shall be carried out with valve assembled with the longest specified diptube and the actuator.

In other cases, the vibration test shall be carried out with the component only.

The sample is attached to a vibration table using fixing materials provided by the manufacturer.

5.21.2 Method 1

The test apparatus and procedure shall be in accordance with IEC 60068-2-6:

- frequency range: 10 Hz to 150 Hz;
- acceleration amplitude 10 Hz to 50 Hz: 1,0 g;
- acceleration amplitude 50 Hz to 150 Hz: 3,0 g;
- sweep rate: 1 octave per 30 min;
- number of sweep cycles: 0,5 per axis;
- number of axes: 3, mutually perpendicular.

The sample shall not operate during the test caused by the vibrations. No deterioration or detachment of parts shall occur. The samples shall be able to function after the vibration test.

5.21.3 Method 2

5.21.3.1 The test sample shall be subjected to vibration tests in each of the three rectilinearly orientated axes: horizontal, lateral and vertical. The tests specified in 5.21.2.2 and 5.21.2.3 shall be completed in one plane or vibration mode before the sample is tested in another plane.

5.21.3.2 The test sample shall be vibrated over the range of 10 Hz to 60 Hz at discrete frequency intervals of 2 Hz at the table displacement specified in Table 11. The vibration at each frequency shall be maintained for 5 min.

5.21.3.3 The test sample shall be vibrated for 2 h at the frequency that produced the maximum resonance during the vibration testing in 5.21.2.2 or, when no resonance has been observed, at a frequency of 60 Hz. The table displacement shall be as specified in Table 11.

NOTE Method 2 has been in use for carbon dioxide, halon, and halon-alternative systems since prior to 1975.

Table 11 — Vibration amplitude

Frequency of vibration Hz	Table displacement mm (in) ± 10 %	Amplitude mm (inch) ± 10 %
10 to 19	1,52 (0,06)	0,76 (0,030)
20 to 39	1,02 (0,040)	0,51 (0,020)
40 to 60	0,51 (0,020)	0,25 (0,010)

5.22 Diptube

This test relates to the requirements of 4.22.

The container fitted with the container valve and diptube charged with water to 50 % of the container capacity and pressurized with nitrogen to 2,5 MPa (25 bar). Measure the mass of the assembly to an accuracy of ± 0,1 kg.

Mount the container on the test rig in the attitude specified by the manufacturer. The outlet of the valve shall not be reduced.

Open the valve to its fully open position and determine the mass, with the same accuracy as before, of the remaining volume of water at the end of the discharge.

5.23 Operating force and functional reliability

5.23.1 Container valve

5.23.1.1 These tests relate to the requirements of 4.1.4.3.

5.23.1.2 Pressurize the container valve with air or nitrogen to the pressure that requires the highest operating force.

5.23.1.3 For components with pneumatically powered actuator, connect the pneumatic actuator to a pressure supply at the specified minimum, nominal and maximum pressure. Trigger the actuator and check the valve for correct operation three times at each pressure.

5.23.1.4 Connect the pneumatic actuator to a pressure supply at 5 % of the specified minimum pressure. Trigger the actuator and check the valve for correct operation three times.

For components with an electrically powered actuator, connect the actuator to a power supply at the specified minimum, nominal and maximum voltage. Trigger the actuator, measure the current and check the valve for correct operation three times at each voltage.

Verify, by a suitable method, that the minimum force given by the actuator is not less than twice the maximum force necessary to open the valve.

5.23.1.5 For components with a gravity-powered actuator, connect the component with the specified mass and drop distance to a suitable test rig. Trigger the actuator and check the valve for correct operation three times.

Reduce the drop mass to 50 % of the specified drop mass. Trigger the actuator and check the valve for correct operation three times.

5.23.1.6 For components with pyrotechnic elements, connect the actuator to a suitable power supply giving the specified signal at the specified minimum all-fire current. Trigger the actuator and check the valve for correct operation ten times.

Verify, by a suitable method, that the minimum force given by the actuator is not less than three times the maximum force necessary to open the valve.

5.23.1.7 For components with a manually powered actuator, measure the force and movement of the handle at the centre of the area provided for this purpose with suitable instrumentation.

5.23.2 Selector valve

The test relates to the requirements of 4.1.3.

Fit the selector valve and actuator to a test set-up pressurized with air or nitrogen to a pressure that gives the most severe conditions.

Connect a force gauge, so that the centre of the force applied is at the centre of the area provided for this purpose. Operate the valve and record the maximum force observed and the displacement of the point at which the force is applied that is required to achieve actuation.

5.24 Other tests

Where special designs or new manufacturing methods make it necessary to conduct additional testing, this shall be carried out after consultation with the manufacturer.

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