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ISO 21013-4

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Cryogenic vessels — Pilot operated pressure-relief devices —

Part 4: Pressure-relief accessories for cryogenic service

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Récipients cryogeniques — Dispositifs de sécurité pour le service cryogénique —

Partie 4: Dispositifs de sécurité pour la pression à pilotage automatique

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Contents

Page

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 21013-4:2012
https://standards.iteh.ai/catalog/standards/sist/af7eb548-f7ac-48bb-b144-c3a34185ada7/iso-21013-4-2012

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Foreword

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

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

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

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

ISO 21013-4 was prepared by Technical Committee ISO/TC 220, *Cryogenic vessels*.

ISO 21013 consists of the following parts, under the general title *Cryogenic vessels — Pressure-relief accessories for cryogenic service*:

— *Part 1: Reclosable pressure-relief valves*

— *Part 2: Non-reclosable pressure-relief devices*

— *Part 3: Sizing and capacity determination*

— *Part 4: Pressure-relief accessories for cryogenic service*

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Cryogenic vessels — Pilot operated pressure-relief devices —

Part 4: Pressure-relief accessories for cryogenic service

1 Scope

This part of ISO 21013 specifies the requirements for the design, manufacture and testing of pilot operated pressure-relief valves for cryogenic service, i.e. for operation with cryogenic fluids in addition to operation at temperatures from ambient to cryogenic. This part of ISO 21013 is restricted to valves not exceeding a size of DN 300 designed to relieve single phase vapours, gases, or mixtures of gases and/or vapours.

This part of ISO 21013 does not provide methods for determining the capacity of relief valve(s) for a particular cryogenic vessel. Such methods are provided in ISO 21013-3.

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.

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ISO 4126-4:2004, *Safety devices for protection against excessive pressure — Part 4: Pilot operated safety valves*

ISO 15761, *Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries*

ISO 21013-4:2012
https://standards.iteh.ai/catalog/standards/sist/af7eb548-f7ac-48bb-b144-c3a34185ada7/iso-21013-4-2012

ISO 21010, *Cryogenic vessels — Gas/materials compatibility*

ISO 21028-1, *Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 1: Temperatures below – 80 °C*

ISO 21028-2, *Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 2: Temperatures between – 80 °C and – 20 °C*

ISO 23208, *Cryogenic vessels — Cleanliness for cryogenic service*

ASME B16.34, *Valves flanged, threaded and welding end*

EN 12516-2:2004, *Industrial valves — Shell design strength — Part 2: Calculation method for steel valve shells*

EN 12516-3:2002, *Valves — Shell design strength — Part 3: Experimental method*

EN 12516-4:2008, *Industrial valves — Shell design strength — Part 4: Calculation method for valve shells manufactured in metallic materials other than steel*

3 Terms and definitions

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

3.1
valve
complete assembly consisting of the main valve and its pilot valve

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3.2
DN (nominal size)
alphanumeric designation of size for components of a pipework system, which is used for reference purposes

NOTE It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections.

[SOURCE: ISO 6708:1995, 2.1]

3.3
pressure
algebraic difference between the absolute pressure and the atmospheric pressure

NOTE This is also known as gauge pressure.

3.4
rated minimum temperature
lowest temperature for which the pressure-relief valve is rated by the manufacturer

3.5
cryogenic fluid
refrigerated liquefied gas which is partially liquid because of its low temperature

NOTE 1 This includes totally evaporated liquids and supercritical fluids.

NOTE 2 In the context of this part of ISO 21013, the refrigerated but non-toxic gases and gas mixtures given in Table 1 are referred to as cryogenic fluids.

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Table 1 — Refrigerated but non-toxic gases

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Classification Code	Identification number, name and description [a]	
3 °A	**Asphyxiant gases**	
	1913	Neon, refrigerated liquid
	1951	Argon, refrigerated liquid
	1963	Helium, refrigerated liquid
	1970	Krypton, refrigerated liquid
	1977	Nitrogen, refrigerated liquid
	2187	Carbon dioxide, refrigerated liquid
	2591	Xenon, refrigerated liquid
	3136	Trifluoromethane, refrigerated liquid
	3158	Gas, refrigerated liquid, N.O.S. (not otherwise specified)
3 °O	**Oxidizing gases**	
	1003	Air, refrigerated liquid
	1073	Oxygen, refrigerated liquid
	2201	Nitrous oxide, refrigerated liquid, oxidizing
	3311	Gas, refrigerated liquid, oxidizing, N.O.S.

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Table 1 *(continued)*

Classification Code	Identification number, name and description [a]	
3 °F	**Flammable gases**	
	1038	Ethylene, refrigerated liquid
	1961	Ethane, refrigerated liquid
	1966	Hydrogen, refrigerated liquid
	1972	Methane, refrigerated liquid or natural gas, refrigerated liquid with high methane content
	3138	Ethylene, acetylene and propylene mixture, refrigerated liquid, containing at least 71,5 % ethylene with not more than 22,5 % acetylene and not more than 6 % propylene
	3312	Gas. Refrigerated liquid, flammable, N.O.S.

[a] Classification codes, identification number, name and description according to the United Nations.

3.6
rated pressure
PR
maximum pressure difference between the inside and outside of any pressure retaining boundary for which it is designed to be operated at 20 °C

NOTE PR of the valve is the lowest PR of any component of the valve.

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3.7
type 1 valve
relief valve which will open below a specified multiple of set pressure (e.g. 1.3 × set pressure) with the pilot disabled

ISO 21013-4:2012
https://standards.iteh.ai/catalog/standards/sist/af7eb548-f7ac-48bb-b144-c3a34185ada7/iso-21013-4-2012

3.8
type 2 valve
relief valve which will not open below a specified multiple of set pressure (e.g. 1.3 × set pressure) with the pilot disabled

3.9
valve category A
relief valve type which passed the test of the repeatability of seat tightness at re-seat of 1 000 cycles

3.10
valve category B
relief valve type which passed the test of the repeatability of seat tightness at re-seat of 20 cycles

4 Requirements

4.1 General

The valve shall satisfy all the requirements of ISO 4126-4 except in the event of conflicting or different requirements, when this part of ISO 21013 shall take precedence over ISO 4126-4.

4.2 Design

4.2.1 Design temperature

The valve shall be suitable for operation at all temperatures between the rated minimum temperature and + 65 °C within the intended pressure range.

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4.2.2 Disc guiding

The design of guiding shall avoid malfunction of the valve due to deposition and freezing of atmospheric moisture on and within the valve during normal operation. The valve shall be sufficiently robust such that the effectiveness of the guiding cannot be defeated by normal handling.

4.2.3 Inserts

Where a disc soft insert is used to ensure leak-tight shut off, the design shall be such as to prevent cold flow of the insert to a degree that results in the valve failing to operate correctly.

4.2.4 Sublimating fluids service

Where the valve is specified as suitable for service with products that, when vented at valve operating conditions, condense from gas or vapour directly to solid, e.g. CO_2, the design shall be such as to avoid the valve failing to operate correctly due to deposition of solid product within the valve body or its outlet. In particular, the pilot shall be provided with some means to ensure its safe operation in case of deposition of solids within it.

4.2.5 Electric continuity

For valves in flammable fluids service, the maximum electrical resistance shall not exceed 1 000 Ω with no more than 28 volts between the ports in order to ensure electrical continuity to prevent build-up of static electricity.

4.2.6 Set pressure

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Set pressure of the valve shall not exceed its PR.

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4.2.7 Minimum shell thickness

ISO 21013-4:2012
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The minimum shell thickness shall be as specified in ISO 15761, ASME B16.34 or EN 12516-2, EN 12516-3 or EN 12516-4 as applicable for the pressure rating and size of the valve.

4.3 Materials

4.3.1 General

Material shall be in conformance with an internationally recognized standard and be compatible with the fluid. Galling, frictional heating, and galvanic corrosion shall also be considered in the selection of materials. Materials shall also be oxygen compatible if relevant (see 4.3.5.1).

Materials not listed in an internationally recognized standard shall be controlled by the manufacturer of the pressure-relief valve by a specification ensuring control of chemical content and physical properties, and quality at least equivalent to an internationally recognized standard. A test certificate providing the chemical content and physical property test results shall be provided with the pressure-relief valve.

4.3.2 Metallic materials

Metallic materials to be used in the construction of cryogenic valves shall meet the requirements of ISO 21028-1 or ISO 21028-2 as appropriate for the rated minimum temperature.

These requirements apply only to the valve parts exposed to low temperatures in normal service. Metallic materials which do not exhibit ductile/brittle transition, and non-ferrous materials which can be shown to have no ductile/brittle transition, do not require additional impact tests.

Forged, rolled, wrought, and fabricated valve components from raw materials from these processes need not be impact tested if the rated minimum temperature is higher than the ductile/brittle transition range temperatures of the material. Castings meeting the requirements of one of the applicable mandatory Appendices I and IV or II and III for forgings and rolled or wrought material of ASME B16.34 need not be impact tested if the rated minimum temperature is higher than the ductile/brittle transition range temperatures of the material. At least

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one randomly selected valve body (including bonnet, if applicable) material from each production lot casting not meeting the requirements of this subclause shall be impact tested at the rated minimum temperature.

4.3.3 Non-metallic materials

Non-metallic materials are well established only for use for inserts on the disc or seat to provide leak tightness across the seat when the valve is closed. If such materials are to be used for significant structural parts, they shall have the properties appropriate to the application. The ductile/brittle transition temperature of the material shall be below the rated minimum temperature of the valve, so as to

— have mechanical properties that will allow the valve to pass the type approval test defined in 5.2,

— be resistant to sunlight, weather and aging, and

— be compliant with 4.3.5.

4.3.4 Corrosion resistance

In addition to resistance to normal atmospheric corrosion, particular care must be taken to ensure that the valve cannot be rendered inoperative by accumulation of corrosion products. Some copper alloys are susceptible to stress corrosion cracking, consequently careful consideration shall be given before selection of these materials for components under stress.

4.3.5 Gas material compatibility

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4.3.5.1 Oxygen

If the rated minimum temperature is equal to or below the boiling point of air or the valve is intended for service with oxygen or oxidizing products, the materials in contact with liquid air or oxidizing products shall be oxygen compatible in accordance with ISO 21010.

ISO 21013-4:2012
https://standards.iteh.ai/catalog/standards/sist/af7eb548-f7ac-48bb-b144-c3a34185ada7/iso-21013-4-2012

4.3.5.2 Hydrogen

For hydrogen service, see ISO 11114-1 and 11114-2.

4.3.5.3 Acetylene

Metallic materials shall contain less than 70 % copper if specified for use with mixtures containing acetylene. See also ISO 11114-1.

5 Qualification and testing

5.1 Type approval

5.1.1 Verification of the design

A valve from the first production batch of each size and design shall be inspected and tested to ensure that the valve complies with the design documentation and the requirements of this part of ISO 21013. The sample valve shall pass the tests in 5.2. The design of the valve shall comply with the requirements of ISO 4126-4 as applicable.

5.1.2 Model number

A unique model number shall be assigned to the valve (equipped with all accessories, see 5.2) which has passed the type approval requirements. Any variation in configuration, including accessories, shall require a new model number.

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