SLOVENSKI STANDARD
oSIST prEN ISO 24490:2024

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Kriogene posode - Centrifugalne črpalke za kriogeno območje (ISO/DIS 24490:2024)

Cryogenic vessels - Centrifugal pumps for cryogenic service (ISO/DIS 24490:2024)

Kryo□Behälter - Pumpen für den Kryo-Betrieb (ISO/DIS 24490:2024)

Récipients cryogéniques - Pompes centrifuges pour service cryogénique (ISO/DIS 24490:2024)

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Récipients cryogéniques — Pompes centrifuges pour service cryogénique

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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

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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.

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).

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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 *220 Cryogenic vessels.*

This third edition cancels and replaces the second edition (ISO 24490:2016), which has been technically revised.

The main changes are as follows:

— Modified title and scope to only include centrifugal pumps;

— Updated descriptions in section 4.1;

— Updated description in Section 4.3.9;

— Updated Table B.1;

— Added Figure B.1 and B.2.

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.

Cryogenic vessels — Centrifugal pumps for cryogenic service

1 Scope

This International Standard specifies the minimum requirements for the design, manufacture and testing of centrifugal pumps for cryogenic service.

This International Standard does not apply to reciprocating pumps.

This International Standard also gives guidance on the design of installations (see Annex A).

It does not specify requirements for operation or maintenance.

NOTE For general requirements for materials used in cryogenic fluid service, see ISO 21029-1, ISO 20421-1 and/or ISO 21009-1.

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 11114-1, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials*

ISO 11114-2, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials*

ISO 11114-4, *Transportable gas cylinders*

ISO 21010, *Cryogenic vessels — Gas/material 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 degrees C and -20 degrees C*

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

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

Note 1 to entry: 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.

Note 2 to entry: The number following the letters DN does not represent a measurable value and is not to be used for calculation purposes except where specified in the relevant standard.

Note 3 to entry: In those standards which use the DN designation system, any relationship between DN and component dimensions is given, e.g. DN/OD or DN/ID.

[SOURCE: ISO 6708:1995, 2.1, modified]

3.2
nominal pressure
PN
alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system

Note 1 to entry: It comprises the letters PN followed by a dimensionless number equal to at least the maximum allowable pressure in bar.

Note 2 to entry: For a pump, PN can be different for inlet and outlet.

Note 3 to entry: For Europe, PN equals the design pressure (PS) as defined in the Pressure Equipment Directive (2014/68/EU).

3.3
specified minimum temperature
lowest temperature for which the pump is specified

3.4
duty point
performance point defined by pressure or head and volume or mass flow rate

3.5
net positive suction head
NPSH
inlet total head increased by the head (in flowing liquid) corresponding to the atmospheric pressure at the test location and decreased by the sum of the head corresponding to the vapour pressure of the pump liquid at the inlet temperature and the inlet impeller height

Note 1 to entry: See also ISO 5198:1987, Table 1.

4 Requirements for pumps

4.1 Types

4.1.1 General

Cryogenic centrifugal pumps shall comply with appropriate general standards. The appropriate general standard(s) shall be subject to the particular circumstances and applicable regulations and should be agreed between the manufacturer and the purchaser.

NOTE Commonly used standards are, e.g. ISO 5199, ISO 13709 (ANSI/API 610) or EN 809.

In the event of conflict, the requirements of this International Standard shall take precedence over the general standards.

4.1.2 Horizontal Cryogenic Pump Systems [1)]

Horizontal cryogenic pumps are used for liquid backup and transfer and truck loading as well as for process applications. These pumps usually have one or two impellers or stages and can be installed in a pump insulation enclosure or be non-insulated as necessary for continuous or noncontinuous (intermittent) service. The degassing piping of a horizontal cryogenic pump may be connected to the discharge side. Personnel may need to stand, at least temporarily, in close proximity for manual valve operation and to supervise the cooldown and startup.

The cooldown time and procedure of a horizontal cryogenic pump system shall consider the size and the mass of the cold end and the piping to cool down.

4.1.3 Vertical / Submerged Inert Cryogenic Pump Systems [2)]

Vertical cryogenic pumps are typically used for cryogenic process and/or back-up applications where high flow and pressure are required. These pumps have a more complicated process diagram and piping layout as compared to horizontal pumps. These pumps can have one or several impellers or stages. The cold end of these pumps may be installed in a stainless-steel barrel usually in insulated casing or in a container installed at or below grade. The degassing piping of a vertical cryogenic pump system may be connected to the barrel and routed back to the gaseous phase of the cryogen.

The cooldown time and procedure of a vertical cryogenic pump system shall consider the size and the mass of the cold end and of the piping to cooldown. Cavitation can be more severe in multi-stage vertical cryogenic pump systems during startup or in normal operation.

4.1.4 Vertical / Submerged Liquid Oxygen Pump Systems [3)]

Cavitation can be more severe in multi-stage vertical liquid oxygen pump systems during startup or in normal operation, which can lead to ignition of internal seals of the cold end with possible escalation to combustion propagation up to burn through of the barrel and of the suction piping.

4.2 Materials

4.2.1 General

Materials of construction shall be selected taking into consideration that cryogenic pumps operate at low temperature, often in a damp environment, and at times with liquid oxygen or flammable fluids.

The minimum requirements given in 4.2.2, 4.2.3 and 4.2.4 shall apply.

4.2.2 Mechanical properties at low temperature

Metallic materials which are under stress at low temperature and which exhibit a ductile/brittle transition (such as ferritic steels) shall have minimum toughness values in accordance with ISO 21028-1 or ISO 21028-2 as appropriate.

Metallic materials which can be shown to have no ductile/brittle transition do not require impact testing.

Non-metallic materials are generally used only for seals or heat barriers. If such materials are to be used for structural parts, the stress levels and material impact values shall be shown to be acceptable for the intended use.

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1) This text is reproduced from CGA G-4.7, *Stationary, Electric-Motor-Driven, Centrifugal Liquid Oxygen Pumps*.

2) This text is reproduced from CGA G-4.7, *Stationary, Electric-Motor-Driven, Centrifugal Liquid Oxygen Pumps*.

3) This text is reproduced from CGA G-4.7, *Stationary, Electric-Motor-Driven, Centrifugal Liquid Oxygen Pumps*.

4.2.3 Corrosion resistance

Materials should be resistant to, or protected from, atmospheric corrosion. Where this is not achievable, a suitable corrosion allowance shall be considered.

4.2.4 Oxygen and oxidizing fluids compatibility

If the specified minimum service temperature is equal to or less than the boiling point of air or the pump is intended for oxygen service, the materials which are, or are likely to come, in contact with oxygen or oxygen-enriched air shall be oxygen-compatible in accordance with ISO 21010.

If the pump is employed for oxidizing cryogenic fluids, e.g. nitrous oxide, the requirements for oxygen compatibility should be taken into consideration.

In the case of nitrous oxide, the risk of decomposition shall also be considered.

Materials should be selected that minimize the potential for ignition and inhibit sustained combustion.

Suitable material properties are

— high ignition temperature,

— high thermal conductivity, and

— low heat of combustion.

Table B.1 lists materials found through testing and operating experience to be particularly suitable for centrifugal cryogenic pumps in oxygen service. Materials other than those identified in Table B.1 may be used but their selection shall be justified by specific testing or long-term experience in this application.

For (any) parts of the pump which are, or are likely to come, in contact with oxygen and which could be exposed to energy sources such as friction, aluminium or aluminium alloy including aluminium bronzes containing more than 2,5 % aluminium shall not be used. The use of aluminium or aluminium alloy for any other parts shall only be adopted after careful consideration.

Stainless steel shall not be used for exposed thin components. Exceptions allowed are seal bellows, trapped shims or gaskets and screw-locking devices of stationary parts where knowledge of past satisfactory performance is available. However, suitable alternative materials, e.g. nickel or nickel alloy, Monel®[4] and Inconel®[4], should be considered.

NOTE Tin bronze has been found to be most suitable for the main “wetted” pump components. The most common aluminium bronzes, which typically contain between 6 % and 11 % aluminium, have relatively high heats of combustion and, if combustion occurs, are practically impossible to extinguish in an oxygen environment.

4.2.5 Hydrogen compatibility

Consideration should be given to the risk of hydrogen embrittlement when selecting materials and determining stress levels for pumps for liquid hydrogen service; see ISO 21010 and ISO 11114-1, ISO 11114-2, or ISO 11114-4 for guidance.

NOTE Thermal cycling of austenitic stainless steels in the presence of hydrogen might lead to accelerated cracking.

4) Monel® and Inconel® are the trademarks of products supplied by Special Metals Corporation, New Hartford, New York, U.S.A. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.