SLOVENSKI STANDARD
oSIST prEN ISO 24490:2015

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Kriogene posode - Črpalke za kriogeno področje (ISO/DIS 24490:2015)

Cryogenic vessels - Pumps for cryogenic service (ISO/DIS 24490:2015)

Kryo-Behälter - Pumpen für den Kryo-Betrieb (ISO/DIS 24490:2015)

Récipients cryogéniques - Pompes pour service cryogénique (ISO/DIS 24490:2015)

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23.020.40	Proti mrazu odporne posode (kriogenske posode)	Cryogenic vessels
23.080	Črpalke	Pumps

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Cryogenic vessels — Pumps for cryogenic service

Récipients cryogéniques — Pompes pour service cryogénique

ICS: 23.020.40

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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Contents

Page

Foreword

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

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 24490 was prepared by Technical Committee ISO/TC 220, *Cryogenic vessels*.

This second cancels and replaces the first edition (ISO 24490:2005), which has been technically revised.

Cryogenic vessels — Pumps for cryogenic service

1 Scope

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

This International Standard is applicable to centrifugal pumps. However it may be applied to other types of cryogenic pumps (e.g. reciprocating pumps), where applicable.

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 cryogenic fluids, see ISO 21029-1, ISO 20421-1 and/or ISO 21009-1.

2 Normative references

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

ISO 5198:1987, *Centrifugal, mixed flow and axial pumps — Code for hydraulic performance tests — Precision grade*

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*

3 Terms and definitions

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

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 should not 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 should be given, e.g. DN/OD or DN/ID.

[SOURCE: ISO 6708:1995, modified — Adapted to new ISO rules of presentation]

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 (97/23/EC)

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 5198:1997, Table 1.

4 Requirements for pumps

4.1 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.

4.2 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.

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 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 oxidising cryogenic fluids, e.g. nitrous oxide, the requirements for oxygen compatibility should be taken into consideration.

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

Suitable material properties are

— high ignition temperature,

— high thermal conductivity,

— 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® [1)] and Inconel® [1)], 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.

[1)] 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.

4.3 Design

4.3.1 Pressure-containing parts

The high-pressure side of the pump shall be designed to withstand at least the nominal outlet pressure. The low-pressure side shall be designed to withstand at least the nominal inlet pressure.

The material stress level from pressure might not be the dominant factor in pump design. The allowable stress level may be calculated at the pressure rating, using ISO 21009-1 for guidance.

4.3.2 Performance

The pump design and installation shall meet the performance requirements specified on the data sheet (or similar document). Examples of a data sheet can be found in ISO 5199 and ISO 9908.

4.3.3 Clearances

Clearances between moving and stationary parts within the pump shall be as large as practical, consistent with good hydraulic performance and sealing. Material selection for components should take into account the often large differences in expansion coefficients to ensure satisfactory clearances and interferences at the operating temperatures and during cool-down.

4.3.4 Prevention of rubbing

The consequences of bearing failure or the consumption of parts by wear shall be considered, particularly in pumps designed for liquid oxygen duty.

4.3.5 Fastenings

All internal fasteners shall be secured to prevent them loosening in service (e.g. friction nuts, tab washers).

Consideration shall be given to more adequately securing items which might normally be held in place by an interference fit only (e.g. wear rings). These components can cool down more quickly than others and become temporarily loose.

4.3.6 Warm bearings

Rolling-element bearings designed to run warm shall be located or protected such that freezing of the lubricating grease or oil is avoided. The effect of ice build-up over a period shall be considered. This can result in overcooling of the bearing and can allow shaft-seal leakage to be forced directly into the driver bearing. Motor-bearing heaters may be considered for cold standby pumps.

4.3.7 Cold bearings

For bearings designed to run cold, lubricated by the cryogenic fluid, the use of materials and design arrangements that can safely withstand short-term dry running shall be considered.

4.3.8 Bearing lubrication

For direct-coupled cryogenic pumps, grease and oils shall be suitable for all oxidising and predictable offset conditions. The lubricants should typically be suitable down to −40 °C.

Sealed bearings are preferred. Where bearing re-greasing *in situ* is required, grease drain plugs should be provided to reduce the risk of accumulations of grease within the motor housing.

Liquid oxygen pumps shall be constructed so that possible oxygen leakage cannot contact any hydrocarbon lubricant. If this cannot be prevented with certainty, the use of oxygen-compatible lubricants meeting the requirement of ISO 21010 shall be considered. It should be noted, however, that such oxygen-compatible