



SLOVENSKI STANDARD
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Posode za globoko podhlajene pline - Postopki ocenjevanja lastnosti toplotne izolacije

Cryogenic vessels - Methods for performance evaluation of thermal insulation

Kryo-Behälter - Verfahren zur Bewertung des Wärmedämmvermögens

Réceptifs cryogéniques - Méthodes d'évaluation de la performance de l'isolation thermique

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ICS:

23.020.40	Proti mrazu odporne posode (kriogenske posode)	Cryogenic vessels
27.200	Hladilna tehnologija	Refrigerating technology

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EUROPEAN STANDARD
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Descriptors: pressure vessels, cryogeny, definitions, tests, estimation, characteristics, thermal insulation, testing conditions

English version

Cryogenic vessels - Methods for performance evaluation of thermal insulation

Réceptifs cryogéniques - Méthodes d'évaluation de la performance de l'isolation thermique

Kryo-Behälter - Verfahren zur Bewertung des Wärmedämmvermögens

This European Standard was approved by CEN on 4 September 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 268 "Cryogenic vessels", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 1999, and conflicting national standards shall be withdrawn at the latest by May 1999.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

Traditionally in Europe, there have been different ways of defining the insulation performance. A requirement exists therefore to harmonise such methods of evaluating insulation performance for different cryogenic vessels.

To held the understanding of this standard, see the logic diagram in figure 1.

1 Scope

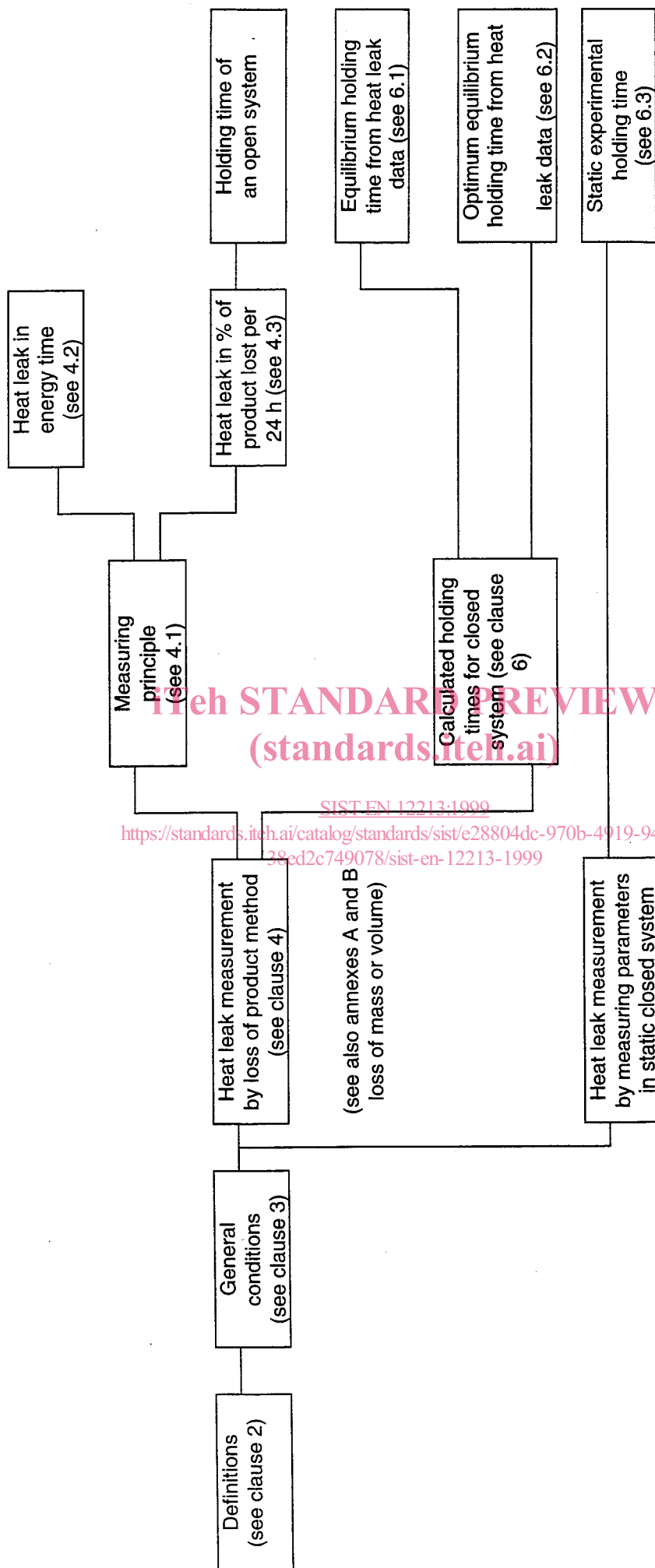
This standard defines a pratical method for determining the heat leak performance of cryogenic vessels. The methods include measurement on both open and closed systems.

This standard neither specify the requirement levels for insulation performance nor when the methodology defined is applied. These requirements may be defined in design or operational standards/regulations.

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Figure 1 : Logic diagram

2 Definitions

For the purpose of this standard, the following definitions apply :

2.1 open system

During test, a system is considered open when it is kept at a constant pressure (e.g. atmospheric pressure) and when the gas produced by the evaporation of the test fluid is continuously released to atmosphere.

2.2 closed system

During test, a system is considered closed when the mass of the contents is kept constant with no input or output of product.

2.3 heat leak performance

The quantity of heat transferred per unit time from the ambient air to the contents of the inner vessel.

NOTE : In an open system the heat leak causes a loss of product. In a closed system it causes a rise in pressure.

2.4 holding time, open system

The time expected to elapse from initial filling level until the vessel is empty (no more liquid) calculated from heat leak data.

2.5 holding time, closed system

The time elapsed from establishing the initial filling condition until the pressure has risen, due to heat leak, to the set pressure of the pressure limiting device.

NOTE : A pressure limiting device is either a safety valve or a rupture disc or a back pressure regulator or any other device installed to limit the system pressure under normal operating conditions.

2.5.1 equilibrium holding time

The holding time calculated from a specified heat leak assuming that liquid and vapour are constantly in equilibrium.

2.5.2 optimum equilibrium holding time

The equilibrium holding time calculated from heat leak data for a vessel when filled with the quantity of product giving the longest holding time.

2.5.3 static experimental holding time

a) When the critical pressure is greater than set pressure of limiting device, the holding time of a closed system measured on a stationary vessel filled with a quantity of product which is calculated to fill the tank to its gross volume without hydrostatic deformation, with saturated liquid at the set pressure of the pressure limiting device.

b) When the critical pressure is less than set pressure of limiting device, the holding time of a closed system measured on a stationary vessel initially filled with the least mass of the specified product determined as follows :

- the maximum allowable mass of filling ;

or

- the quantity of product which fills the vessel to its gross volume, without hydrostatic deformation, with liquid saturated to 99 % of its gross volume at the critical pressure.

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3 General conditions for all methods

The measurements described in this standard shall be carried out under the following conditions :

3.1 The cryogenic fluid used for testing shall be chosen by the manufacturer. Liquid nitrogen should normally be used except in cases where the vessel to be tested is designed for a specific cryogenic fluid.

3.2 The liquid and gaseous phases shall be in equilibrium at the beginning of a test. When a test is carried out at a higher pressure than one bar gauge, it is important that the liquid equilibrium pressure is not lower than this test pressure.

3.3 The test environment shall be stable and constant during the test. It shall be as close as possible to the following reference conditions :

- ambient temperature : 15 °C ;
- atmospheric pressure : 1013 mbar.

For products except carbon dioxide and nitrous oxide :

- vessel reference pressure : 1013 mbar.

For carbon dioxide and nitrous oxide :

- vessel reference pressure : 15 bar (gauge).

3.4 The vessel and its content shall have reached a stable temperature before the beginning of the measuring period. Equilibrium conditions are obtained after a period of stabilisation, the duration of which depends on the size of the vessel and the type and configuration of the insulation.

3.5 All accessories of the vessel which can have an influence on the result of the measurement shall be clearly defined and specified in the report.

3.6 All instrumentation used shall be periodically verified by calibration.

3.7 It is not necessary to use the method defined in this standard to evaluate the insulation performance resulting from small modifications (this evaluation can be obtained by simple extrapolation).

4 Measuring the heat leak by the loss of product method

4.1 General

There are two methods of measuring the heat leak :

- by direct measurement of loss of mass ;
- by indirect measurement of loss of mass by measuring the gaseous volumetric discharge rate.

The filling level shall be (50 ± 10) % of the maximum filling level at the start of measurement, unless otherwise stated.

The ambient temperature and the operating pressure at the top of the vessel shall be recorded throughout the test so as to be used for correction purposes. The temperature sensor(s) shall be placed in the immediate proximity of the test object, but sited such that they are unaffected directly by cold gas discharged from the vents.

The minimum measurement duration shall be 24 h after stable conditions have been reached.

During the test precautions shall be taken to avoid agitation of the liquid.

When measuring the rate of discharge of gas escaping from the vessel by a flow meter, it is essential that the entire gas flow passes through the meter. The gas flow rate shall be determined as a mass flow rate either by :

- using a mass flow meter ;

or

- using a volumetric flow meter. An appropriate method is shown in annex A.

4.2 Test procedure

The test procedure shall be as follows :

- step 1 : vessel precooling ;
- step 2 : stabilisation ;
- step 3 : adjustment of the filling to the intended starting level (e.g. 50 % \pm 10 %) ;
- step 4 : connection of instrumentation (e.g. gas flow meter) ;
- step 5 : second stabilisation period ;
- step 6 : determination of mass of contents of vessel at start of measuring period ;
- step 7 : a sufficient number of readings shall be taken to establish an acceptable thermal equilibrium before the start of the measuring period ;
- step 8 : measuring period shall be at least 24 hours ;
- step 9 : determination of the loss of product in mass units (when gaseous flow is measured) in accordance with annex A ;
- step 10 : reduction to reference conditions in accordance with annex B.

4.3 Determination of the heat leak in units of energy per unit time

The rate of product loss (kg/s) during the measurement period, corrected to the reference conditions in accordance with annexes A and B, shall be converted to an equivalent heat leak, Q , by multiplying it by the latent heat of evaporation (J/kg) of the product at the reference conditions.

To calculate the heat leak with a product other than the test product, compensation using linear extrapolation in accordance with annex C may be applied but only if the difference between the boiling temperature of these products at the reference conditions does not exceed 20 °C.