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Thermal insulating products for industrial installations — Mechanical properties testing at sub-ambient temperatures

Produits isolants thermiques pour les installations industrielles — Essai des propriétés mécaniques à des températures inférieures à la température ambiante

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Foreword

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Thermal insulating products for industrial installations — Mechanical properties testing at sub-ambient temperatures

1 Scope

This document specifies the equipment and procedures for determining the mechanical properties at sub-ambient temperatures from –196 °C to 25 °C, subject to the possible temperature limitation of the test specimens. It is not applicable to products which experience dimensional changes during the test due to the loss of hydration water or which undergo other phase changes.

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 9229, *Thermal insulation — Vocabulary*

ISO 16537, *Thermal insulating products for building applications — Determination of shear behaviour*

ISO 29469, *Thermal insulating products for building applications — Determination of compression behaviour*

ISO 29765, *Thermal insulating products for building applications — Determination of tensile strength perpendicular to faces*

EN 14308:2009+A1:2003, *Thermal insulating products for building equipment and industrial installations — Factory made rigid polyurethane foam(PUR) and polyisocyanurate foam (PIR) products — Specification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9229 and the following 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
sub-ambient temperature
temperature from –196 °C to 25 °C at which the thermal insulation product is used to reduce heat flow

[SOURCE: ISO 23766:2022, 3.1]

3.2
refrigerant
fluid used for heat transfer in a refrigerating system

Note 1 to entry: A refrigerant absorbs heat at a low temperature and a low pressure of the fluid and rejects it at a higher temperature and a higher pressure of the fluid, usually involving changes of the phase of the fluid.

[SOURCE: ISO 817:2024, 3.1.37]

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3.3
thermal equilibrium
condition where the specified temperature is achieved throughout the cross section of the whole specimen

4 Principle

The mechanical properties at sub-ambient temperatures from –196 °C to 25 °C, subject to the possible temperature limitation of the test specimens, are measured at specific temperature according to the reference standards on a specimen having reached thermal equilibrium condition.

In this condition, the shear behaviour shall be determined in accordance with ISO 16537, the compression behaviour shall be determined in accordance with ISO 29469, the tensile strength perpendicular to faces shall be determined in accordance with ISO 29765. Other International Standards can be referenced.

5 Apparatus

5.1 General

The basic apparatus, including test machine, displacement measuring device, force measuring device and recording device, shall meet the requirements of reference standards in Clause 4.

The test machine shall be fit to install cooling system. The displacement measuring device, force measuring device, adhesive and recording device shall be able to work at the specific temperature. An example of the apparatus is given in the Annex A.

5.2 Cooling system

5.2.1 Cold chamber

Cold chamber in which the test pieces are exposed to low temperature, sufficient in size to contain the devices used for testing the test pieces and to permit the operation of the device to test without removal from the chamber.

The cold chamber shall be capable of maintaining the mean temperature of the test specimen to within ±3 °C of the desired test temperature.

5.2.2 Cooling medium

The cooling medium can be, for example:

— by refrigeration unit;

— by expansion of compressed gas (e.g. CO_2 or N_2);

— by immersion in a liquid maintained at its boiling point (e.g. N_2) or in a refrigerated liquid (e.g. alcohol).

Cooling medium has a significant influence on the cooling time and on the heat transfer during the test (either isothermal or adiabatic, or both) and can have a significant influence on the test result.

Liquid nitrogen has been found in practice to be the most satisfactory coolant. The cooling system can consist of pressure-controlled valve and nitrogen source (e.g. a dewar) delivering liquid nitrogen to a heat exchanger.

WARNING — The ventilation system shall be turned on at all times when nitrogen is used to avoid the risk of nitrogen asphyxiation.

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