



SLOVENSKI STANDARD
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**Metode za preskušanje hladilnih naprav za toplotno izolirana transportna sredstva
- 2. del: Eutektične hladilne naprave**

Testing methodologies for refrigerating devices for insulated means of transport - Part 2:
Eutectic cooling devices

Prüfung von Kühleinrichtungen für wärmegeämmte Transportmittel - Teil 2: Eutektische
Kühleinrichtungen

Méthodes d'essai des dispositifs de réfrigération des moyens de transport isothermes -
Partie 2 : Dispositifs de réfrigération eutectiques

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EN 16440-2:2023 (E)**European foreword**

This document (EN 16440-2:2023) has been prepared by Technical Committee CEN/TC 413 “Insulated means of transport for temperature sensitive goods with or without cooling and/or heating device”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by December 2023, and conflicting national standards shall be withdrawn at the latest by December 2023.

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1 Scope

This document is applicable to eutectic cooling devices which are intended to be used with insulated transport equipment.

The following applications are covered:

- eutectic cooling devices with or without compressor/condenser unit intended to be installed into insulated means of transport (e.g. lorries, trailers, swap bodies, other transport equipment and wagons). Charging of the eutectic elements from the liquid to the solid phase can be performed either by a compressor/condenser unit mounted onto the vehicle or by a stationary direct or indirect system. The eutectic cooling devices are equipped, if relevant, with necessary components for the charging, transmission, cooling and/or with temperature control devices. The eutectic elements can be fitted with or without fans;
- eutectic cooling devices with independent eutectic elements are not covered by this document.

This document specifies the testing methodologies.

This document is only applicable for mono-temperature eutectic cooling devices. This document does not provide any safety requirements.

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.

EN ISO 5801, *Fans — Performance testing using standardized airways (ISO 5801)*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

3.1 General terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC Guide 99 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/>

EN 16440-2:2023 (E)**3.1.1****calorimeter box**

thermally insulated room in which the eutectic unit of the eutectic cooling device is placed

Note 1 to entry: With eutectic cooling devices, usually the insulated transport equipment is used as the calorimeter box.

3.1.2**charging power**

P_{ch}

power input needed to operate all necessary eutectic cooling components during charging

3.1.3**charging energy**

E_{ch}

energy consumption for charging

3.1.4**charging time**

t_{ch}

period of time required for the freezing of the eutectic mixture inside the eutectic elements which are submitted to the charging conditions defined by the manufacturer

3.1.5**compressor/condenser unit**

part of the eutectic cooling device including compressor, condenser, condenser fans, housing, drives and the operating panel with the control devices

EXAMPLE

A drive can be an electric motor, an internal combustion motor, a hydraulic engine and similar.

3.1.6**conditioned test room**

room where the test conditions can be maintained at a constant level and in which the calorimeter box with the eutectic unit is mounted

Note 1 to entry: Eutectic unit is mounted inside the calorimeter box and its compressor condensing unit is mounted outside the calorimeter box, if applicable.

3.1.7**insulated means for transport**

insulated vans, bodyworks for trucks and trailers, swap bodies, any kind of mobile containers and railway wagons

3.1.8**cooling device**

system which lowers and/or maintains temperature

3.1.9**cooling energy efficiency ratio**

EER_C

ratio of the useful cooling energy E_C to the total energy consumption E_T of the eutectic cooling device under rated conditions

3.1.10**energy supply**

devices not forming part of the eutectic cooling device but providing or generating the form of energy required for its operation

Note 1 to entry: This includes electric generators, hydraulic pumps, electric accumulators and fuel cells, among others.

3.1.11**dependent eutectic cooling device**

direct or indirect system with eutectic unit serving as a cooling device, intended to be installed into an insulated transport equipment with a compressor/condenser unit intended to be installed stationary or mobile onto the vehicle to charge the eutectic unit

3.1.12**eutectic element**

element containing eutectic mixtures intended for cold charging, optionally having evaporation tubes or heat exchangers

EXAMPLE tubes, plates, etc.

3.1.13**eutectic mixture**

liquid mixture of two or more components which at certain ratios inhibit the crystallisation process of one another resulting in a system having a lower melting point than either component

3.1.14**eutectic unit**

part of the eutectic cooling device consisting of one or more eutectic elements with or without forced air circulation and, if applicable, including the required expansion or refrigerant control valve and refrigerant distributor

3.1.15**heat load**

P_{HL}

heating power delivered into the calorimeter box by electric heating elements during the determination of the useful cooling capacity P_C

3.1.16**heat transmission**

P_{TR}

heat flow through the insulated limiting surfaces of the calorimeter box

3.1.17**heat transmission energy**

E_{TR}

thermal energy transmitted through the insulated limiting surfaces of the calorimeter box during the determination of the maximum cooling time t_{Cmax}

EN 16440-2:2023 (E)**3.1.18****independent eutectic cooling unit**

eutectic elements or eutectic units without any connection to a refrigerant circuit

Note 1 to entry: According to the scope independent cooling eutectic units are not covered by this document.

3.1.19**inlet air temperature at the compressor/condenser unit**

$T_{\text{IN CON}}$

mean temperature of different measuring points located at air inlets of the compressor/condenser unit

3.1.20**inside temperature of the calorimeter box**

T_i

arithmetic mean temperature measured at different locations inside the calorimeter box

3.1.21**load space**

volume inside an insulated transport equipment or a compartment available for loading the goods (excluding eutectic unit)

3.1.22**maximum cooling time**

t_{cmax}

period of time in cooling operation, starting after the charging of the eutectic elements has finished and stopping once the inside temperature T_i of the calorimeter box has reached the requested temperature of the class

3.1.23**rated conditions**

constant values laid down for comparison and certification purposes

3.1.24**temperature of the conditioned test room**

T_e

mean temperature of different measurement points located outside the calorimeter box (in the conditioned test room)

3.1.25**total energy consumption**

E_T

energy consumption of all components necessary for the operation of the eutectic cooling device under rated conditions, over the total charging time and the maximum cooling time

Note 1 to entry: Example of energy: fuel or electricity.

3.1.26**total power**

P_T

arithmetic mean of the power input of all eutectic cooling device components necessary for the operation during charging and/or cooling under rated conditions, including all means for operation

3.1.27**total thermal transmittance** U

heat flow passing through the insulating limiting surfaces of the calorimeter box per degree temperature difference

3.1.28**useful cooling capacity** P_C

capacity of the eutectic unit available with a defined heat load inside the calorimeter box determined under rated conditions

3.1.29**useful cooling energy** E_C

cooling energy stored in the eutectic elements and available over the maximum cooling time at a certain heat load in the calorimeter box under rated conditions

3.2 Terms and definitions for eutectic units with fans only**3.2.1****air volume flow** V_A

volume flow delivered by the fan(s) in the eutectic unit

3.2.2**inlet air temperature at the eutectic unit** $T_{IN\ EU}$

mean temperature of different measuring points located at air inlets of the eutectic unit

3.2.3**operating time** t_{OP}

period of total run time of the eutectic unit fans during the test while cooling

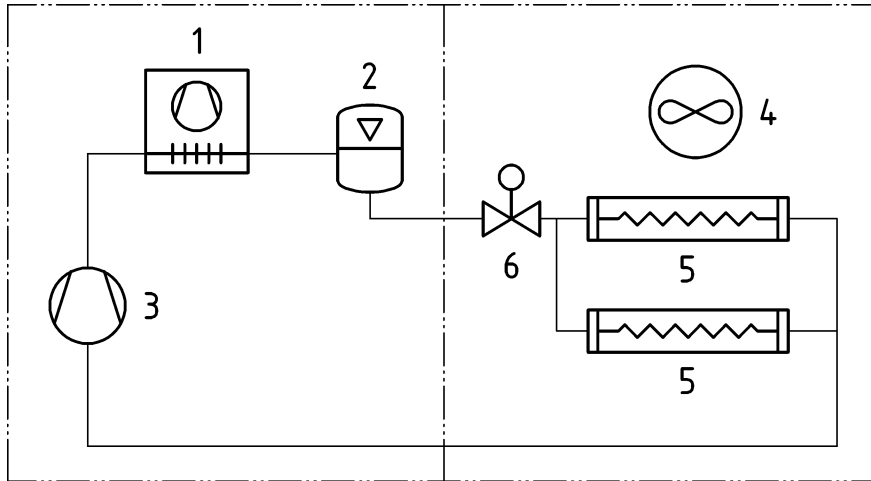
3.2.4**outlet air temperature at the eutectic unit** $T_{OUT\ EU}$

mean temperature of different measuring points located on the air outlet of the eutectic unit

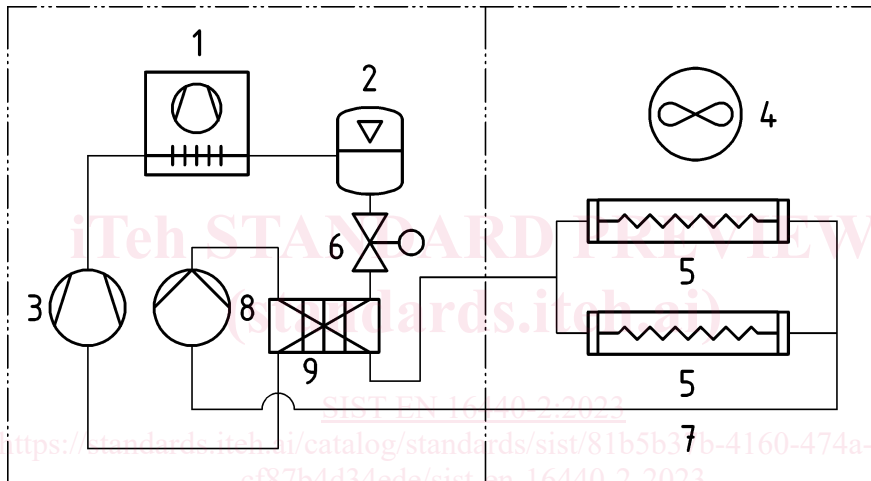
3.3 Typical setups for direct and indirect eutectic cooling devices

Figure 1 includes diagrams for direct and indirect eutectic cooling. The direct system cools the eutectic element by direct expansion. The indirect system cools a secondary fluid by heat exchanger as a transfer medium to cool the eutectic element by pump circulation.

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a) Typical setups for direct eutectic cooling devices



b) Typical setups for indirect eutectic cooling devices

Key

- 1 condenser
- 2 refrigerant receiver
- 3 compressor
- 4 optional fans/optional control devices
- 5 eutectic elements (cross section with inside heat exchanger)
- 6 expansion valve
- 7 secondary fluid
- 8 pump
- 9 heat exchanger

Figure 1 — Typical setups for direct and indirect eutectic cooling devices