SLOVENSKI STANDARD
# oSIST prEN 17140:2021

**01-november-2021**

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**Toplotnoizolacijski proizvodi za stavbe - Industrijsko izdelani vakuumski izolacijski paneli (VIP) - Specifikacija**

Thermal insulation products for buildings - Factory-made vacuum insulation panels (VIP) - Specification

Wärmedämmstoffe für Gebäude - Werksmäßig hergestellte Vakuumisolationspaneele (VIP) - Spezifikation



Produits isolants thermiques pour le bâtiment - Panneaux Isolants sous Vide produits de façon industrielle (PIV) - Spécification



**Ta slovenski standard je istoveten z: prEN 17140**

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**ICS:**

| | | |
|---|---|---|
| 91.100.60 | Materiali za toplotno in zvočno izolacijo | Thermal and sound insulating materials |

**oSIST prEN 17140:2021** **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

**DRAFT**
**prEN 17140**

August 2021

ICS 91.100.60 Will supersede EN 17140:2020

English Version

# Thermal insulation products for buildings - Factory-made vacuum insulation panels (VIP) - Specification

Produits isolants thermiques pour le bâtiment - Panneaux Isolants sous Vide produits de façon industrielle (PIV) - Spécification

Wärmedämmstoffe für Gebäude - Werksmäßig hergestellte Vakuumisolationspaneele (VIP) - Spezifikation

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 88.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. prEN 17140:2021 E

# Contents

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## European foreword

This document (prEN 17140:2021) has been prepared by Technical Committee CEN/TC 88 “Thermal insulating materials and products”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 17140:2020.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association.

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

# Introduction

This document specifies factory-made vacuum insulation panels (VIP). In the building environment, these products are used for the thermal insulation of buildings and are used in components or within systems that are applied to the building envelope. Therefore, the products in end use conditions are not directly exposed to the environment and always covered by additional layers.

# 1 Scope

This document specifies characteristics of factory-made vacuum insulation panels (VIP) intended to be used for the thermal insulation of buildings (roofs, walls, ceilings and floors).

This document is applicable for factory-made vacuum insulation panels (VIP), independent of the type of envelope (see 3.1.11), using the following core materials (see 3.1.10):

— organic fibres;

— inorganic fibres and particles (e.g. glass fibre, silica, etc.).

This document is applicable for factory-made vacuum insulation panels (VIP) with or without desiccants (see 3.1.12) and with and without evacuation valve (3.1.14).

The products covered by this document can be used in roofs, walls, ceilings and floors.

This document specifies procedures for assessment and verification of constancy of performance (AVCP) of characteristics of factory-made vacuum insulation panels (VIP).

This document does not cover products:

— intended to be used for the thermal insulation of building equipment and industrial installations;

— intended to be used for civil engineering works;

— intended to be used as perimeter or foundation;

— intended to be used for acoustic applications;

— with a thermal resistance $R_D$ lower than 0,5 $m^2 \cdot K/W$;

— that contain getters (3.1.13);

— that have protective layers (3.1.9).



# 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 822:2013, *Thermal insulating products for building applications - Determination of length and width*

EN 823:2013, *Thermal insulating products for building applications - Determination of thickness*

EN 824:2013, *Thermal insulating products for building applications - Determination of squareness*

EN 825:2013, *Thermal insulating products for building applications - Determination of flatness*

EN 826:2013, *Thermal insulating products for building applications - Determination of compression behaviour*

EN 1602:2013, *Thermal insulating products for building applications - Determination of the apparent density*

EN 1604:2013, *Thermal insulating products for building applications - Determination of dimensional stability under specified temperature and humidity conditions*

EN 1605:2013, *Thermal insulating products for building applications - Determination of deformation under specified compressive load and temperature conditions*

EN 1606:2013, *Thermal insulating products for building applications - Determination of compressive creep*

EN 1607:2013, *Thermal insulating products for building applications - Determination of tensile strength perpendicular to faces*

EN 12664:2001, *Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance*

EN 12667:2001, *Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance*

EN 13238:2010, *Reaction to fire tests for building products - Conditioning procedures and general rules for selection of substrates*

EN 13501-1:2018, *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests*

EN 13820:2003, *Thermal insulating materials for building applications - Determination of organic content*



EN 13823:2020, *Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item*



EN 16516:2017+A1:2020, *Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air*

EN 16733:2016, *Reaction to fire tests for building products - Determination of a building product's propensity to undergo continuous smouldering*

EN ISO 1182:2020, *Reaction to fire tests for products - Non-combustibility test (ISO 1182:2020)*

EN ISO 1716:2018, *Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value) (ISO 1716:2018)*

EN ISO 10211:2017, *Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations (ISO 10211:2017)*

EN ISO 10456:2007[1], *Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007)*

EN ISO 11925-2:2020, *Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test (ISO 11925-2:2020)*

ISO 16269-6:2014, *Statistical interpretation of data - Part 6: Determination of statistical tolerance intervals*

[1] As impacted by EN ISO 10456:2007/AC:2009.

# 3 Terms and definitions, symbols, units and abbreviated terms

## 3.1 Terms and definitions

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

ISO and IEC maintain terminological 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/

**3.1.1**
**vacuum insulation panel**
**VIP**
insulation product made of a sealed barrier envelope containing a core material with an open porosity structure, where the gas pressure inside the sealed barrier envelope is lowered below atmospheric pressure

**3.1.2**
**centre of panel**
**COP**
area of the VIP whose thermal performance is not affected by the edge effect

**3.1.3**
**edge effect**
form of thermal bridging along the edge due to the higher thermal conductivity of the outer envelope, both through the material of the envelope itself and the sealed folded envelope, compared to the core



**3.1.4**
**inner pressure**
total gas pressure within the VIP, measured in mbar

**3.1.5**
**pressure compensation method**
method of testing inner pressure of a VIP using a laminate-lift-off technique with a vacuum chamber or suction bell

Note 1 to entry: In some literature also called foil-lift-off technique.

**3.1.6**
**vacuum chamber**
device to remove air or other gases from a volume around a VIP to determine the inner pressure of a VIP by the pressure compensation method

**3.1.7**
**suction bell**
device to remove air or other gases from a volume connected to a part of a VIP to determine the inner pressure of a VIP by the pressure compensation method

**3.1.8**
**pressure sensor**
device to measure the inner pressure of a VIP

**3.1.9**
**protective layer**
functional surface material, e.g. paper, glass fibre textile or rubber, which is not considered as separate thermal insulation layer to be added to the thermal resistance of the product, intended to improve the handling of the product and protect it from damage

**3.1.10**
**core material**
insulation material with an open porosity structure constituting the main component inside the VIP envelope

**3.1.11**
**envelope**
airtight and water-tight outer layer of the VIP securing the vacuum inside the VIP

**3.1.12**
**desiccant**
additive material different from the core material which intends to absorb or adsorb water vapour in the sealed panel

**3.1.13**
**getter**
additive material different from the core material which intends to absorb or adsorb other gases than water vapour in the sealed panel



**3.1.14**
**evacuation valve**
device to connect the VIP to a vacuum pump



## 3.2 Symbols and abbreviated terms

For the purposes of this document, the following symbols, units and abbreviated terms apply.

| | | |
|---|---|---|
| $A$ | surface area of the VIP | m² |
| $A_m$ | metering area of the GHP or HFM apparatus used for the measurement | m² |
| $b_c$ | core width | m |
| $b_w$ | working width | m |
| *CS(Y)* | compressive stress/strength(Y=yield) | kPa |
| $d$ | thickness | m |
| $d_{ambient}$ | thickness of the ventilated VIP | m |
| $d_N$ | nominal thickness of the product | m |
| $f_{air}$ | acceleration factor for dry air of the VIP envelope | – |
| $f_v$ | acceleration factor for water vapour of the VIP envelope | – |
| $k$ | factor related to the number of test results available | – |
| $l_c$ | core length | m |

| | | |
|---|---|---|
| $l_w$ | working length | m |
| $l_\psi$ | length of the joints within the metering area | m |
| $N$ | number of test results | – |
| $P_{air}$ | air permeability of the VIP envelope | $m^3$ Pa/ ($m^2$·s) |
| $P_v$ | water intake rate of the VIP envelope | kg/($m^2$·s) |
| $p_{air}$ | pressure inside the VIP | Pa |
| $p_{lim}$ | maximum value of the inner pressure measured at least 24 h after production | Pa |
| $p_v$ | water vapour pressure inside the VIP | Pa |
| $p_0$ | initial value of the inner pressure | Pa |
| $p_{1/2}$ | inner pressure of a VIP, where λ increases by 1/2 of the thermal conductivity of still air. | Pa |
| $R_{COP,90/90aged}$ | $R_{90/90}$ at centre of panel plus ageing | $m^2$·K/W |
| $R_D$ | expressed thermal resistance including ageing, edge-effect and rounding rules | $m^2$·K/W |
| $R_{mean}$ | mean thermal resistance | $m^2$·K/W |
| $R_i$ | one test result of thermal resistance | $m^2$·K/W |
| $R_{90/90}$ | 90 % fractile with a confidence level of 90 % for the thermal resistance | $m^2$·K/W |
| $S$ | top surface area (length x width) of the VIP | $m^2$ |
| $S_b$ | deviation from squareness on width or length | mm/m |
| $S_{max}$ | deviation from flatness | mm |
| $S_N$ | nominal perimeter of the product | m |
| $s_R$ | estimate of the standard deviation of the thermal resistance | $m^2$·K/W |
| $s_\lambda$ | estimate of the standard deviation of the thermal conductivity | W/(m·K) |
| $s_{\lambda i}$ | estimate of the standard deviation of the initial thermal conductivity within 90 days of production | W/(m·K) |
| $T$ | temperature | K |
| $t$ | time | s |
| $t_{Des}$ | service life time of the desiccant | a |
| $X$ | water content inside the VIP | mass-% |
| $X'_{t,50/70}$ | change of water content with time at 50°C 70 % RH | mass-%/s |

| | | |
|---|---|---|
| $X_{ct}$ | compressive creep | mm |
| $X_t$ | total thickness reduction | mm |
| $\lambda$ | thermal conductivity | W/(m·K) |
| $\lambda_{ambient}$ | thermal conductivity of a ventilated VIP at centre of the panel | W/(m·K) |
| $\lambda_{COP}$ | thermal conductivity for centre of panel | W/(m·K) |
| $\lambda_{COP,mean}(25years)$ | average value of thermal conductivity over the first 25 years in use at centre of panel | W/(m·K) |
| $\lambda_{COP,90/90,aged}$ | $\lambda_{90/90}$ at centre of panel plus ageing | W/(m·K) |
| $\lambda_D$ | expressed thermal conductivity including ageing, edge-effect and rounding rules | W/(m·K) |
| $\lambda_{eq\ ja}$ | equivalent thermal conductivity including edge effects for the specific joint assembly | W/(m·K) |
| $\lambda_{mean}$ | mean value of thermal conductivity | W/(m·K) |
| $\lambda_i$ | one test result of thermal conductivity | W/(m·K) |
| $\lambda'_p$ | change of thermal conductivity with pressure | W/(m·K·Pa) |
| $\lambda'_t$ | change of thermal conductivity with time | W/(m·K·s) |
| $\lambda'_X$ | change of thermal conductivity with humidity | W/(m·K)/mass-% |
| $\lambda_{90/90}$ | 90 % fractile with a confidence level of 90 % for the thermal conductivity | W/(m·K) |
| $\lambda'_{t,\ 23,\ 50}$ | change of thermal conductivity with time at 23°C 50 % RH | W/(m·K·a) |
| $\lambda'_{t,\ 50,\ 70}$ | change of thermal conductivity with time at 50°C 70 % RH | W/(m·K·a) |
| $\lambda(t)$ | time-dependent thermal conductivity value | W/(m·K) |
| $\lambda(t)_{,\ 23,\ 50}$ | time dependent value of thermal conductivity at 23°C 50 % RH | W/(m·K) |
| $\lambda^*\ (t = 0)$ | interpolated initial value of thermal conductivity | W/(m·K) |
| $\sigma_c$ | compressive stress | kPa |
| $\sigma_m$ | compressive strength | kPa |
| $\sigma_{mt}$ | tensile strength perpendicular to faces | kPa |
| $\sigma_{10}$ | compressive stress at 10 % deformation | kPa |
| $\Phi$ | relative humidity inside the VIP | % |
| $\Phi'_X$ | change of relative humidity inside the VIP as function of water content | (rel. humidity-%)/(mass-%) |

| | | |
|---|---|---|
| $\Psi$ | linear thermal transmittance | W/(m·K) |
| $\psi_m$ | linear thermal transmittance for the joints in the metering area | W/(m·K) |

Abbreviated terms used in this document:

VIP vacuum insulation panel

COP centre of panel

AVCP assessment and verification of constancy of performance (previously named attestation of conformity)

DoP declaration of performance

FPC factory production control

STP standard condition for temperature and pressure

RtF reaction to fire

ThIB thermal insulation for buildings

VOC volatile organic compounds



# 4 Characteristics

## 4.1 Reaction to fire



### 4.1.1 Determination

Reaction to fire classification shall be determined according to 5.2.1.

### 4.1.2 Expression

The reaction to fire shall be classified and expressed according to EN 13501-1:2018, Clause 11.

EXAMPLE Class E.

## 4.2 Propensity to undergo continuous smouldering

### 4.2.1 Determination

Propensity to undergo continuous smouldering of the core material shall be determined according to 5.2.2.

### 4.2.2 Evaluation and expression

Propensity to undergo continuous smouldering shall be expressed according to EN 16733:2016, Clause 11. If the test according to EN 16733:2016, Clause 11 has been passed, the result shall be expressed as follows: “the product does not show propensity for continuous smouldering combustion”. If the test according to EN 16733:2016, Clause 11 has been failed, the result shall be expressed as follows: “the product shows propensity for continuous smouldering combustion”. If the assessment was not possible according to EN 16733:2016, Clause 11, the result shall be expressed as follows: “assessment of the propensity for continuous smouldering combustion is not possible”.

If a designation code is given, the following abbreviations shall be used:

— the product does not show propensity for continuous smouldering combustion: *NoS*

— the product shows propensity for continuous smouldering combustion: *S*

— the assessment of the propensity for continuous smouldering combustion is not possible: *ANP*.

EXAMPLE *NoS*.

## 4.3 Release of VOCs

### 4.3.1 Determination

The release of VOCs into indoor air shall be determined according to 5.2.3.

### 4.3.2 Expression

The release of VOCs into indoor air shall be expressed as values in accordance with EN 16516:2017+A1:2020.

## 4.4 Compressive strength

### 4.4.1 Determination

The compressive strength shall be determined according to 5.2.4.

### 4.4.2 Evaluation and expression

The compressive strength shall be expressed as a designation code *CS(Y)i* or *CS(10)i*, depending on the result of the testing of 5.2.4. The test result *i* shall be rounded downwards in steps of 10 kPa.



EXAMPLE 1 *CS(Y)120*.

EXAMPLE 2 *CS(10)120*.



## 4.5 Tensile strength perpendicular to faces

### 4.5.1 Determination

The tensile strength perpendicular to faces, $\sigma_{mt}$, shall be determined according to 5.2.5.

### 4.5.2 Expression

The tensile strength perpendicular to faces, $\sigma_{mt}$, shall be expressed as a designation code *TRi*. The value *i* of the tensile strength shall be rounded downwards in steps of 10 kPa.

EXAMPLE *TR80*.

## 4.6 Thermal resistance

### 4.6.1 Thermal resistance of the VIP

#### 4.6.1.1 Determination

The thermal resistance shall be determined according to 5.2.6.1.

#### 4.6.1.2 Expression

The thermal resistance shall be rounded downwards to the nearest 0,05 m²·K/W and be expressed as a value in m²·K/W. It shall be expressed together with thermal conductivity rounded upwards in steps of 0,000 5 W/(m·K) and expressed as a value in W/(m·K). It shall be expressed together with the thickness given as a value in mm.

EXAMPLE $R_D$= 4,60 $m^2$·K/W ($\lambda_D$= 0,0065 W/(m·K), *d*= 30 mm).

### 4.6.2 Thermal resistance of the ventilated VIP under ambient pressure due to damage

#### 4.6.2.1 Determination

The thermal resistance of the ventilated VIP under ambient pressure due to damage shall be determined according to 5.2.6.2.

#### 4.6.2.2 Expression

The thermal resistance of the ventilated VIP under ambient pressure due to damage shall be rounded downwards to the nearest 0,05 $m^2 \cdot K/W$ and be expressed as a value in $m^2 \cdot K/W$. It shall be expressed together with the thickness given as a value in mm.

EXAMPLE $R_{ambient, eff}$ = 1,00 $m^2 \cdot K/W$ ($d_{ambient}$ = 20 mm).

## 4.7 Durability aspects

### 4.7.1 Dimensional stability under specified temperature and humidity conditions

#### 4.7.1.1 Determination

Dimensional stability under specified temperature or under specified temperature and humidity conditions shall be determined according to 5.2.7.1.

#### 4.7.1.2 Expression

Dimensional stability under specified temperature or under specified temperature and humidity conditions shall be expressed as a code in the following way: If the relative changes in core length and core width do not exceed 1 % and the relative reduction in thickness does not exceed 3 %, the code shall be *DS*. Otherwise, the code shall be *NoDS*.



EXAMPLE *DS*.

### 4.7.2 Dimensional stability under specified compressive load and temperature conditions

#### 4.7.2.1 Determination

Dimensional stability under specified compressive load and temperature conditions shall be determined according to 5.2.7.2.

#### 4.7.2.2 Expression

Dimensional stability under specified compressive load and temperature conditions shall be expressed as a code in the following way: If the relative changes in thickness do not exceed 3 %, the code shall be *DSC*. Otherwise, the code shall be *NoDSC*.

EXAMPLE *DSC*.

### 4.7.3 Compressive creep

#### 4.7.3.1 Determination

The compressive creep shall be determined according to 5.2.7.3.

#### 4.7.3.2 Expression

Compressive creep, $X_{ct}$, shall be expressed as a designation code $CC(i_1/i_2/y)\sigma_c$ together with the total thickness reduction, $X_t$. The value of the total thickness reduction $i_1$ and the value of compressive creep $i_2$ after $y$ years shall be given in steps of 0,1 mm and at the expressed stress $\sigma_c$.

EXAMPLE *CC*(2,5/2/10)50.