ประกาศกระทรวงอุตสาหกรรม

ฉบับที่ ๓๑๕๕ (พ.ศ. ๒๕๔๗)

ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พ.ศ. ๒๕๑๑

เรื่อง กำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พลาสติกโฟมแข็ง-เกณฑ์กำหนดของโฟมพอลิยูรีเทน

ที่ใช้ฉีดเพื่อเป็นฉนวนความร้อนของอาคาร

อาศัยอำนาจตามความในมาตรา ๑๕ แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. ๒๕๑๑ รัฐมนตรีว่าการกระทรวงอุตสาหกรรมออกประกาศกำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม พลาสติกโฟมแข็ง-เกณฑ์กำหนดของโฟมพอลิยูรีเทนที่ใช้ฉีดเพื่อเป็นฉนวนความร้อนของอาคาร มาตรฐานเลขที่ มอก. ๑๘๙๗-๒๕๔๒ ไว้ ดังมีรายการละเอียดต่อท้ายประกาศนี้

ประกาศ ณ วันที่ ๒๐ มกราคม พ.ศ. ๒๕๔๗

พินิจ จารุสมบัติ

รัฐมนตรีว่าการกระทรวงอุตสาหกรรม

มอก. 1897-2542
ISO 8873 : 1987

มาตรฐานผลิตภัณฑ์อุตสาหกรรม
พลาสติกโฟมแข็ง - เกณฑ์กำหนดของโฟมพอลิยูรีเทนที่ใช้ฉีดเพื่อเป็นฉนวนความร้อนของอาคาร

บทนำ

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ กำหนดขึ้นโดยรับ ISO 8873 : 1987 Cellular plastics, rigid - Spray - applied polyurethane foam for thermal insulation of buildings - Specification มาใช้ในระดับเหมือนกันทุกประการ (identical) โดยใช้ ISO ฉบับภาษาอังกฤษเป็นหลัก

ขอบข่าย

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ กำหนดเกณฑ์กำหนดและวิธีทดสอบสำหรับโฟมพอลิยูรีเทนที่ใช้ฉีดเพื่อเป็นฉนวนความร้อนของอาคาร รายละเอียดให้เป็นไปตาม ISO 8873 : 1987 ข้อ 1

เอกสารอ้างอิง

ISO 291,	Plastics - Standard atmospheres for conditioning and testing.
ISO 472,	Plastics - Vocabulary.
ISO 844,	Cellullar plastics - Compression test of rigid materials.
ISO 1663,	Cellular plastics - Determination of water vapour transmission rate of rigid materials.
ISO 2581,	Plastics - Rigid cellular materials - Determination of "apparent" thermal conductivity by means of a heat-flow meter.
ISO 2796,	Cellular plastics, rigid - Test for dimensional stability.
ISO 4590,	Cellular plastics - Determination of volume percentage of open and closed cells of rigid materials.
ISO 4898,	Cellular plastics - Specification for rigid cellular materials used in the thermal insulation of buildings.
ISO 7616,	Cellular plastics - Determination of compressive creep under specified load and temperature conditions.
ISO 8301,	Thermal insulation - Determination of steady-state specific thermal resistance and related properties - Heat-flow meter.[1)]
ISO 8302,	Thermal insulation - Determination of steady-state areal thermal resistance and related properties - Guarded hot-plate method.[1)]

ИСО 1897-2542
ISO 8873 : 1987

Cellular plastics, rigid — Spray-applied polyurethane foam for thermal insulation of buildings — Specification

1 Scope and field of application

1.1 This International Standard specifies the requirements and test methods for spray-applied rigid polyurethane cellular plastics as defined in clause 3, used as thermal insulation in buildings, when applied either "on site" or in a manufacturing facility. It is not applicable to single-component moisture-cured materials.

1.2 This International Standard applies to rigid polyurethane foam, RC/PUR-SA[1], spray-applied directly to the surfaces that are to be insulated, for the following applications:

Category I — Suitable for non-loadbearing insulations, which may or may not be exposed to weather, such as wall insulations, interior roof insulations and similar applications where the insulation is only required to be self-supporting.

Category II — Suitable for limited loadbearing insulations, intended for surfaces carrying foot-traffic by maintenance personnel only, mainly exposed to weather, such as overdeck insulations or similar applications where elevated temperatures may be encountered and when compressive creep resistance is required.

1.3 The properties of spray-applied polyurethane cellular plastics may vary substantially depending on factors such as application technique, relative humidity, temperature and type of substrate, temperature of the liquid components and ambient temperature at the time of application. This International Standard therefore specifies only basic limiting values for selected properties, which may be used in quality control of the materials produced in accordance with this International Standard and for conformity control of the specified cellular material, if the samples are produced on site (*in situ*) or under the actual conditions of the site.

The limiting values are not given for the purpose of providing design data.

1.4 Additional factors not covered by this International Standard, but which prudent designers and specifiers should consider, are the following (but are not limited to them):

— vapour barriers when service temperatures are generally below ambient[2];

— fire-protective coatings to meet national or local regulations;

— weather-resistant coatings when applications require them;

— the necessity to follow the instructions of the supplier (of the raw material) and other advice or regulations pertaining to the safe use of the raw materials and their safe application, so as not to endanger the health and safety of the workers and others in the immediate area.

2 References

ISO 291, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 472, *Plastics — Vocabulary.*

ISO 844, *Cellular plastics — Compression test of rigid materials.*

ISO 1663, *Cellular plastics — Determination of water vapour transmission rate of rigid materials.*

ISO 2581, *Plastics — Rigid cellular materials — Determination of "apparent" thermal conductivity by means of a heat-flow meter.*

ISO 2796, *Cellular plastics, rigid — Test for dimensional stability.*

ISO 4590, *Cellular plastics — Determination of volume percentage of open and closed cells of rigid materials.*

1) RC denotes rigid cellular; SA denotes spray-applied.

2) The application of a suitable vapour barrier is recommended when this material is used where the service temperatures are generally below ambient. Depending upon use, other weather-resistant coatings may be necessary.

ISO 4898, *Cellular plastics — Specification for rigid cellular materials used in the thermal insulation of buildings.*

ISO 7616, *Cellular plastics — Determination of compressive creep under specified load and temperature conditions.*

ISO 8301, *Thermal insulation — Determination of steady-state specific thermal resistance and related properties — Heat-flow meter.*[1]

ISO 8302, *Thermal insulation — Determination of steady-state areal thermal resistance and related properties — Guarded hot-plate method.*[1]

3 Definition

spray-applied rigid polyurethane cellular plastic (RC/PUR-SA): Rigid cellular plastic material that is formed in-place by the catalysed reaction of polyisocyanates and polyhydroxyl compounds, expanded with a chlorofluorocarbon and producing a predominantly closed-cell product. (See also ISO 472 and ISO 4898.)

4 Property requirements

4.1 Physical properties

Physical property values are organized into two product categories as defined in 1.2.

Samples of the finished product, when prepared in accordance with clause 5, shall conform to the limiting values of the physical properties specified in the table.

4.2 Burning characteristics

The insulation material, with or without a coating or covering, shall comply with the fire regulations and codes pertaining to the locality in which they are applied.

4.3 Special requirements

Special applications may require properties other than, or in addition to, those specified in this International Standard. These properties, when agreed upon by the interested parties, may be added to the requirements of this International Standard.

5 Sample preparation

5.1 Sample panels shall be prepared by spray application under the actual conditions of the construction or manufacturing site, i.e. climate, orientation, supporting surface, etc., and in accordance with the supplier's recommendations for application of the material.

The samples shall be representative of the in-place finished material with regard to thickness (30 mm minimum) and of sufficient quantity and size to allow the tests specified to be carried out. Approximately 1,5 m^2 will usually be sufficient for one test sample series, with the thickness of the panel being determined by the individual test requirements.

5.2 The samples shall be allowed to cure for a minimum of 72 h at 23 ± 3 °C prior to cutting or testing for physical properties. Other conditions for curing may be agreed upon by the interested parties.

5.3 Core samples, when required, shall be obtained by removing both the outer skin and the boundary skin at the substrate interface. A trim cut of 3 to 5 mm is generally sufficient. Core samples may contain one or more internal skins at the successive spray-pass boundaries.

5.4 The number of sample panels and the frequency of sampling shall be agreed upon by the interested parties if they are not specified by national or international standards.

6 Test methods

6.1 Compressive strength or compressive stress at 10 % deformation

Determine the compressive properties at ultimate yield or at 10 % deformation, whichever occurs first, in accordance with ISO 844 on core specimens taken from the test sample. The loading shall be in the direction parallel to the panel thickness (foam rise).

6.2 Thermal conductivity

6.2.1 General

Determine thermal conductivity by the guarded hot-plate method (ISO 8302) or the heat-flow meter method (ISO 2581)[2], at a mean temperature of either 23 °C or 10 °C. A temperature difference of not more than 25 °C is recommended. Thermal conductivity values for one temperature may be calculated from the value for the other mean temperature where there exists a documented relationship between thermal conductivity and mean temperature. The test specimen shall be at least 25 mm in thickness. In cases of dispute, the thermal conductivity shall be tested at the mean temperature for which the value is reported.

NOTE — Thermal conductivity values thus determined are for specification purposes only.

6.2.2 Initial thermal conductivity

Initial thermal conductivity tests shall be conducted on the test panel after the 72 h curing period, but on or before the 28th day after preparation of the test panel (see clause 5).

1) At present at the stage of draft.

2) See also ISO 8301.

6.2.3 Thermal conductivity after ageing

By agreement between the interested parties, aged test panels may be tested for thermal conductivity at a period between 3 months minimum and 6 months maximum after the date of preparation.

6.3 Dimensional stability

Determine the percentage changes in length, width and thickness of core specimens (see 5.3) in accordance with ISO 2796 after 48 h exposure to the following three sets of conditions:

a) -25 ± 3 °C and ambient humidity;

b) $+100 \pm 2$ °C and ambient humidity;

c) $+70 \pm 2$ °C and (90 ± 5) % relative humidity.

6.4 Substrate adhesion

Bond a circular metal plate, approximately 50 mm diameter and equipped with a hook, with a suitable resinous or polymeric adhesive to the clean, dry surface of the foam under test. Make a circular cut around the outside of the plate through the full thickness of the foam perpendicular to the substrate. After the recommended cure time of the adhesive, apply gradually a tensile force (by hand is acceptable) through the hook perpendicular to the substrate until failure occurs. Note the mode of failure.

The adhesion of the foam shall be deemed adequate if the failure occurs by cohesive failure within the foam (see the note) rather than by delamination from the substrate, interlaminar adhesion failure or failure of the adhesive bonding of the testing device to the cellular plastic.

NOTE – "Within the foam" means not nearer to the substrate or interlaminar bonding than about 1 mm.

6.5 Closed-cell content

Determine the closed-cell content in accordance with ISO 4590 using core specimens (see 5.3).

6.6 Water vapour permeability

Determine the water vapour permeability using core specimens (see 5.3) of 25 ± 3 mm thickness, in accordance with ISO 1663 at 23 °C and a relative humidity gradient from 0 to 50 %, or at 38 °C and a relative humidity gradient from 0 to 88,5 %.

6.7 Compressive creep

Determine compressive creep in accordance with ISO 7616, but with specimens 50 ± 1 mm square and having the in-place thickness of the material. If the material thickness is greater than 50 mm, the specimen shall be trimmed to that dimension. Subject the specimens to a pressure of 20 kPa in an atmosphere conforming with ISO 291 for a period of 48 h and measure the thickness. Then place the test fixture and specimens in an oven at 80 °C under the same pressure for an additional 48 h and again measure the thickness. Report the difference in the two measured thicknesses as a percentage relative to the thickness at 23 °C.

7 Test report

The test report shall include the followng information:

a) reference to this International Standard;

b) complete identification of the materials tested;

c) description of the procedure used to prepare the test panels;

d) date of test panel preparation;

e) date of test specimen preparation;

f) date of physical property determination;

g) date(s) of testing for thermal conductivity;

h) application category for which the product is tested;

i) any deviations, exceptions or additions to the requirements of this International Standard as agreed upon by the interested parties;

j) complete listing of test results and comparison with the requirements of the relevant application category according to this International Standard.

Table – Property requirements of RC/PUR-SA for thermal insulation of buildings

Property	Unit	Requirements		Test method
		Category I	Category II	
Compressive strength or compressive stress at 10 % deformation (min.)	kPa	100	200[1]	ISO 844
Initial thermal conductivity (max.) 10 °C mean 23 °C mean	mW/(m·K)	 20 22	 20 22	ISO 2581 or absolute method. See 6.2.2.
Thermal conductivity after ageing (max.)[2] 10 °C mean/3 months min. and 6 months max. after production 10 °C mean/3 months min. and 6 months max. after production	mW/(m·K)	 24 26	 24 26	See 6.2.3.
Compressive creep (max.) after 48 h at 80 °C under 20 kPa pressure	%	–	5	ISO 7616 modified according to 6.7
Water vapour permeability 23 °C/0 to 50 % relative humidity 38 °C/0 to 88,5 % relative humidity	ng/(Pa·m·s)	4,5 to 1,5 –	4,5 to 1,5 6,0 to 2,0	ISO 1663
Dimensional stability at –25 °C +70 °C and 90 % relative humidity +100 °C	%	+0/–1,5 ±4 ±3	+0/–1,5 ±4 ±3	ISO 2796
Closed cell content (min.)	%	85	90	ISO 4590
Tensile adhesion test	–	Cohesive failure in the foam		See 6.4.

1) Higher values may be agreed upon between purchaser and supplier, depending on the performance of coatings, if any.

2) The thermal transmission properties of chlorofluorocarbon-expanded polyurethane may vary with temperature, temperature gradient, thickness and time. The apparent initial thermal conductivity requirements in the table are based on freshly sprayed samples tested under the conditions specified in 6.2. The test value obtained is to be used solely for purposes of material specification and is not intended to reflect performance under installed conditions (see annex B).

Annex A

Liquid system components for RC/PUR-SA

(This annex forms part of the standard.)

Each container of liquid components of the polyurethane spray system shall be clearly identified as either isocyanate component or polyol component. In addition, each container shall be marked with the following information:

a) name of the manufacturer;

b) manufacturer's prooduct designation;

c) lot number and/or date of manufacture;

d) net mass of contents;

e) safety information related to the safe handling and use of the material contained therein;

f) other information as required by national practice.

Annex B

Effects of ageing on the thermal conductivity of cellular materials

(This annex does not form part of the standard.)

The thermal conductivity of cellular plastic insulating materials is influenced by the composition and chemical nature of the material, its ratio of open and closed cells, its moisture content, the measurement temperature, and the composition of the gases in the cells. It is also well known that thermal conductivity may increase with time as the composition of the cell gases changes. It is possible to reduce or prevent this increase by use of thin surfacing materials that impede or stop gaseous interchange.

Because of these and other reasons, for example the method of installation in the building, the thermal conductivity values specified in the table are not to be used for design purposes but only for specifications of material between purchaser and supplier.

On the basis of more than 20 years of experience[1-3], reliable correlations between laboratory measurements on a recently manufactured product and its long-term insulation performance in the field have been established. Using these correlations, various methods have been derived by which thermal conductivity of aged cellular plastics may be calculated from the laboratory test values.

Bibliography

[1] BALL, G.W., HEALY, W.G. and PARTINGTON, J.B., *European Journal of Cellular Plastics*, Vol. 1, No. 1 (1978).

[2] BUTLER, F. and RADLINSKY, J., Paper presented at 9th International Foamed Plastics Symposium, May 17, 1979 (Düsseldorf). Published in *Kunststoffe Fortschrittsberichte*, Vol. 44, Schaumkunststoffe, 1979, Carl Hanser Verlag, Munich/Vienna.

[3] ZEHENDNER, H., *Cellular polymers*, Vol. 1, p. 211 (1982).