CIDEMCO-Tecnalia
Área Anardi, nº 5
Apartado 134 P.O. Box
E-20730 Azpeitia (Guipúzcoa) / Spain
Tel.: +34 943 81 68 00
Fax: +34 943 81 60 74

www.cidemco.es
cidemco@cidemco.es

TEST REPORT

CLIENT: **SEALED AIR PACKAGING, S.L.**

APPLICANT: **MANEL PEÑARROYA**

ADDRESS: **HOSTAL DEL PI, 16 POL. IND. BARCELONÉS**
08630 ABRERA (SPAIN)

MATERIAL TESTED: **REFLECTIVE INSULATION**
REF. "REFLECTIX®SB (SINGLE BUBBLE)"

PURPOSE OF THE REQUEST: **THERMAL RESISTANCE TEST**
(UNE-EN ISO 8990:1997)

DATE OF RECEIPT: **30.09.2010**
DATE OF TEST COMMENCEMENT: **21.10.2010**
DATE OF TEST COMPLETION: **21.10.2010**
DATE OF ISSUE OF REPORT: **03.11.2010**

The results compiled in this report refer only to the material received and submitted to testing at this Research Centre on the dates indicated.

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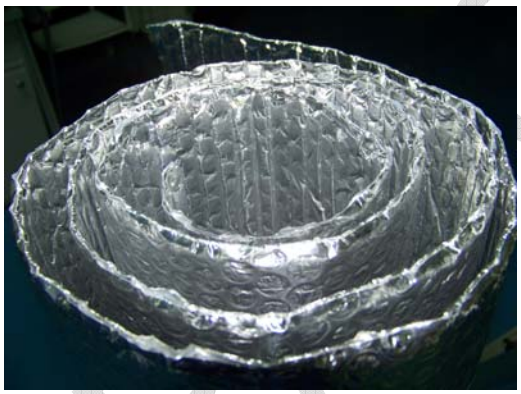
Nerea Berra
Energy Efficiency in Building Manager
Architecture and Construction Technology

Sergio Saiz
Energy Efficiency in Building Manager
Architecture and Construction Technology

SAMPLE CHARACTERISTICS

On 30 September 2010, CIDEMCO received from the company SEALED AIR PACKAGING, S.L. the material necessary to perform the test. This material is a reflective insulation consisting of foil + bubble + foil; its nominal thickness is 4mm and it comes in a rolled format, as shown in the figure. Its reference is Reflectix®SB (Single bubble) and its dimensions are 1200 x 1200 mm.

``REFLECTIX®SB (SINGLE BUBBLE)´´



TEST REQUESTED

The test requested was to determine the **Thermal Resistance (m^2K/W)** of a 15 mm air chamber, the sample *reflective insulation* and another 15 mm air chamber, based on the assembly methodology described in standard ASTM C 1224-01 Section 9.7 *"Standard Specification for Reflective Insulation for Building Applications. Test Methods: Thermal Performance" and* using the test method described in standard UNE-EN ISO 8990:1997 *"Determination of steady-state thermal transmission properties. Calibrated and guarded hot box method"*.

Standard UNE-EN ISO 8990:1997 *"Determination of steady-state thermal transmission properties – calibrated and guarded hot box methods"*, together with standard UNE 92204 of November 1995 and its Erratum of March 1997, is the official version, in Spanish, of European Standard EN ISO 8990 of August 1996, which in turn fully adopts International Standard ISO 8990:1994.

TEST PERFORMED

A specimen was prepared consisting of two plywood boards measuring (1200 x 1200) mm in whose interior the sample was placed, leaving a gap of 15 mm between the board and the sample. The sample rested on some extruded polystyrene strips measuring (15 x 40) mm placed at the edges in order to create the necessary air chamber.

Figure 2: Example of positioning of sample

Detail of a test layout below:

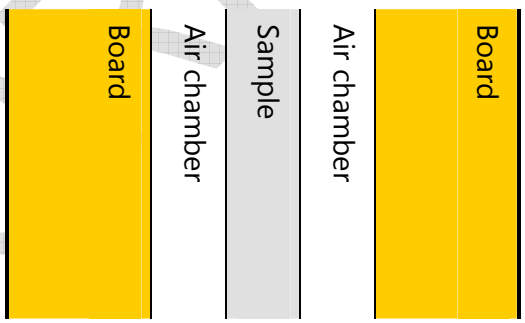


Figure 3: Detail of the assembly of the sample

Due to the lack of a specific regulation for these type of products and as agreed with the client, the test method described in standard ASTM C 1224-01 Section 9.7 and in standard UNE-EN ISO 8990:1997 was used, determining the heat flow through the specimen and the temperatures on the internal surfaces of the two plywood boards, in order to calculate with this data the Thermal Resistance of the air chamber + sample + air chamber assembly.

The figure to be determined, the Thermal Resistance "R", is defined as the difference of surface temperatures divided by the heat flow crossing the surface unit. Its unit in the International System is m^2 K/W.

The test bench consists of a 25 cm thick polystyrene wall, adapted to the size of the specimen to be tested. This wall is used to secure the specimen and separate the hot and cold chambers, also acting as a high thermal resistance element. In order to determine the Thermal Resistance "R" of the specimen, it is placed vertically in the opening made in the polystyrene wall.

Figure 4: Specimen placed in the opening

The specimen is submitted to a gradient of temperature between the two environments. These temperatures are maintained constant and controlled at ±0.5 ºC.

Using temperature probes, a heat flow probe and an electricity consumption meter, the data is gathered with regard to the surface temperature on the inside of the plywood boards, the heat flow transferred and watts consumed. These probes are connected to a data collection unit which transmits the information to a computer, which has specific software for displaying the data.

Once the steady-state heat transmission conditions have been achieved, the data is collected on the surface temperatures on the outer surface of each of the plywood boards (ºC), and on the heat flow through the specimen (W/m^2). From this data, a statistical average is obtained of the values of surface temperature and heat flow. The calculation of the value "R" ($W/m^2.K$) corresponds to average values calculated during the test.

RESULTS

The Thermal Resistance "R" has been calculated according to the perpendicular direction of the surface of the specimen.

Any edge effect was eliminated given that the surfaces of its perimeter were insulated with 25 cm thick expanded polystyrene.

Once the system had reflected stability from the thermal point of view, i.e., the fluctuation in temperature and heat flow was negligible, the average temperatures were recorded on the surfaces of the plywood boards, and the average heat flow in the perpendicular direction to the test element.

The ambient temperatures of the two climate chambers and the surface temperatures of the plywood were as follows:

	"Board + Sample + Board"
Cold ambient T:	**(4.8 ± 0.5)ºC**
Hot ambient T:	**(24.9 ± 0.5)ºC**
Cold surface T:	**(8.8 ± 0.5)ºC**
Hot surface T:	**(20.1 ± 0.5)ºC**
Thermal surface gradient:	**(11.4 ± 1.0)ºC**
Heat flow crossing the sample:	**18.5 W/m^2**

Consequently the Thermal Resistance "R" is calculated based on the 15 mm plywood board + sample + 15 mm plywood board assembly.

From this test result the theoretical Thermal Resistance "**R**" of the sample can be calculated considering that the thermal conductivity of a 600 kg/m^3 plywood board is 0.14 W/mK in accordance with standard UNE-EN 12524:2000.

Consequently, the **Thermal Resistance** "**R**" calculated for the sample is as follows:

15mm air chamber + "REFLECTIX®SB (SINGLE BUBBLE)" + 15mm air chamber:
0.6 m^{2}K/W

Equivalent to an insulator of 2.1 cm with a conductivity is 0.035 W / mK.

Surface resistance levels from EN ISO 6946:1997 are considered on the calculation of thermal transmittance:

Resistencias superficiales (en m^2 · K/W)

	Dirección del flujo de calor		
	Hacia arriba	Horizontal	Hacia abajo
R_{si}	0,10	0,13	0,17
R_{se}	0,04	0,04	0,04

NOTA – Los valores de la tabla 1 son valores de diseño. Para declarar la transmitancia térmica de los componentes y otros casos donde se requieren valores independientes de la dirección del flujo de calor, se recomienda utilizar los valores de flujo de calor horizontal.

Therefore, thermal transmittance U (W/m^{2}K) is:

	Upwards	Horizontal	Downwards
U (W/m2K)	**1,35**	**1,30**	**1,23**

ANNEXE

Sealed Air
Reflectix®
Reflective insulation

Reflectix®SB

Brand name	Reflectix®SB (Single Bubble)
Consists of	Foil + Bubble + Foil
Nominal Thickness	4,0 mm
Aluminium Thickness	8MY + 25MY PE
Aluminium Purity	99%
Aluminium Reflectivity	95%-97%
Aluminium Anticorrosion coating	NC laquer
Density	200-210 gr/m2
Bubble type	AirCap® 90gr/m2
Rolls Size	1,20m x 50m = 60m2/roll