

CIRIAF

Centro Interuniversitario
di Ricerca sull'Inquinamento
da Agenti Fisici - "Mauro Felli"

Thermotechnical laboratory
Determination of thermal resistance
according to
UNI EN ISO 8990:1999

University of Perugia
Via G. Duranti, 67 - 06125 - Perugia
tel. 075.585.3717 - fax 075.585.3697
P. IVA 00448820548

Test Report n° T047/09

**Determination of thermal resistance according to
UNI EN ISO 8990:1999**

**of an assembly made of a magnesium oxide board and an
insulating thermoreflecting material**

Client

SA.M.E. S.r.l.

Via Ferriera, 68 - 06089 Torgiano (PG)

Tel. 075-5996528 - Fax 075-5976846

www.samesrl.com

Name of the sample:
(according to the client's indications)

EXTERIOR REFLECTIVE SYSTEM SA.M.E.

Date of the test: 24/07/2009

Issue date: 05/10/2009

Place: Perugia

Operator: *Franco Aron*

Issued by: *[Signature]*

Laboratory Chief: *[Signature]*



Test report n° T047/09

This test report consists of 6 sheets

Sheet 1 of 6



CIRIAF Direzione e Amministrazione
c/o Facoltà di Ingegneria
Via G. Duranti, 67
06125 Perugia

Tel: +39 075 585 3717-3844
Fax: +39 075 585 3697
E.mail: ciriaf@unipg.it

Web Site: www.ciriaf.it

Reference standard

- **UNI EN ISO 8990:1999** – Thermal insulation - Determination of steady-state thermal transmission properties - Calibrated and guarded hot box

Product description

The test sample consists of a 12 mm magnesium oxide board, a 20 mm air space and two ISOLIVING layers with a 20 mm air space between them (Figure 1). In the thermal resistance calculation, the effect of a further (20 mm) air space after the second ISOLIVING layer has been evaluated.



Figure 1 – Picture of the sample.

Description of the measurement apparatus

The thermal resistance measures were carried out in the Calibrated Hot-Box at the CIRIAF (Inter-university Research Center on Pollution by physical agents) laboratories of the Faculty of Engineering of the University of Perugia. The apparatus was designed according to UNI EN ISO 8990:1999; Hereafter, some of the main features of the different parts constituting the equipment are reported:

- Air-conditioning chambers

The hot and cold parallelepiped chambers have an inner volume of 4.8 m³ each and the following sizes:

- external sizes 2.50 × 1.18 × 3.20 m;
- internal sizes 1.98 × 0.90 × 2.68 m.

The two chambers are composed of wood boards (19 mm thick), with an inner insulation provided by polystyrene foam (240 mm thick).

- Supporting frame

The sample is placed and clamped into the supporting frame by means of a pneumatic system applying vertical and horizontal pressure on the sample perimeter. The whole frame is composed of a wood-polystyrene foam-wood assembly.

- The heating system in the hot chamber is composed of a wire covered outside by self-extinguishing silicone with a diameter of 2.5 mm, whose inner core consists of a resistive wire of nickel-chromium. The wire is 50 m long and it has a maximum power of 500 W. The resistance is regulated by a PID system which maintains the chamber temperature at a fixed value.
- The refrigerating system, provided with a condensing unit, is a ventilated evaporator type. The system is driven by a temperature controller especially designed for stand-alone refrigerating units.
- The T (Cu-Ni) type thermocouples placed on the apparatus are 94 (47 in each chamber) and they have the following features:
 - temperature range: -200°C ÷ 350°C;
 - tolerance values: 1.5°C o 0.004×T (°C);
 - wire section and diameter: 0.03 mm²/0.2 mm;
 - insulating material of conductors: PTFE;



CIRIAF

Centro Interuniversitario
di Ricerca sull'Inquinamento
da Agenti Fisici - "Mauro Felli"



Figure 2 – Measurement apparatus

Test sample layout

The test product can be set in different ways, in order to provide the best thermo-insulating performances.

Both sides of the panel board have to be enveloped by an air space 2.0 ÷ 2.5 cm thick.

In order to evaluate the thermal resistance of the assembly and to obtain a value not depending on the material opposite to the magnesium oxide board, a series of thermal probes are placed in the inner surface of a wood board to evaluate the air space (20 mm) thermal resistance alone (Figure 3 and Figure 4).

In order to ensure a steady thickness of the air space (2.0 cm) some polystyrene wedges were placed between the wood board and the ISOLIVING layer.





CIRIAF

Centro Interuniversitario
di Ricerca sull'Inquinamento
da Agenti Fisici - "Mauro Felli"



Figure 3 – Wood board with thermal probes placed inside.

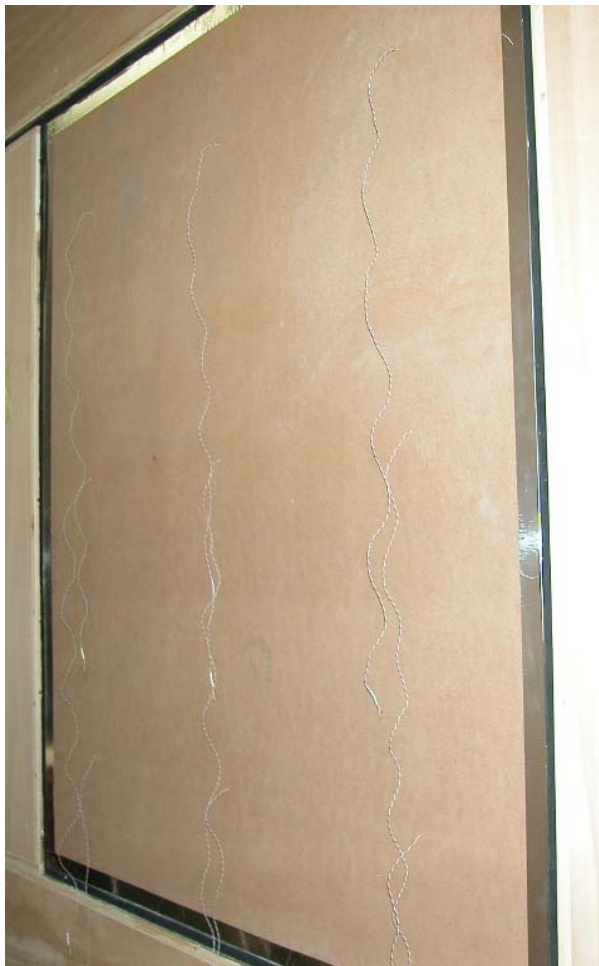
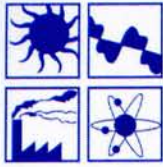


Figure 4 – Sample placed in the measurement apparatus; hot side (wood board) and cold side (magnesium oxide board).





Thermal resistance determination

The chambers are brought to a steady-state temperature, before the measurements start. The test lasted 60 minutes; table 1 shows the values of the main parameters during the test.

Table 1 – Values of main parameters registered during the test.

Test specimen sizes		
Width	123	cm
Height	148	cm
Thickness	8.80	cm
Measurement values – hot side		
Air temperature	25.72	°C
Surface temperature inside the air space	24.50	°C
Surface temperature of the baffle	25.51	°C
Power input in the hot chamber	51.35	W
Measurement values – cold side		
Air temperature	4.90	°C
Surface temperature of the magnesium oxide board	5.80	°C
Surface temperature of the baffle	5.42	°C
Calculated values		
Heat flux through the test specimen	7.62	W/m ²
Surface temperature difference of the test sample	18.70	°C
Average temperature of the test sample	15.15	°C

The thermal resistance value is:

$$R = 2.45 \text{ m}^2\text{K/W}$$

(according to UNI EN ISO 8990)

The calculated value refers to the overall thermal resistance of an assembly composed of a magnesium oxide board (12 mm) – air space (20 mm) – second ISOLIVING board (8 mm) – air space (20 mm).

The assessed overall uncertainty of the measurement expressed is $\pm 6\%$ based on a standard uncertainty multiplied by a coverage factor $k=2$, based on the level of confidence of 95%.

Test report n° T047/09

Date of test: 24/07/2009

Laboratory Operator:.....

Laboratory Chief:.....



Test report n° T047/09

This test report consists of 6 sheets

Sheet 6 of 6

