



King Fahd University of Petroleum & Minerals
Research Institute
Center for Engineering Research

FINAL REPORT

**TESTING OF THERMO REFLECTIVE INSULATION TO
DETERMINE THERMAL CONDUCTIVITY**

Prepared for

Al-Joaib Packing Materials Factory
Dammam, Saudi Arabia

Muharram 1427 H
February 2006 G



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SUMMARY

This report on the project titled *Testing of Thermo Reflective Insulation to Determine Thermal Conductivity* describes the results of the testing that was carried out by the Research Institute of King Fahd University of Petroleum & Minerals for the Al-Joaib Packing Materials Factory, Dammam.

Two identical samples of the thermo reflective insulation were tested for thermal conductivity using a guarded hot plate that conforms to ASTM Standard C 177-85. The samples were provided by the client.

The results show that the mean thermal conductivity of the tested thermo reflective insulation is 0.0407 W/m.K and the thermal resistance is 0.181 m².K/W.

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SECTION 1 INTRODUCTION

An analysis of the data collected at the Research Institute of King Fahd University of Petroleum & Minerals, Saudi Arabia, shows that air conditioning requires about 73% of the total electricity consumed in residential buildings [1]. In Saudi Arabia where the environment is hot and in some places also humid, knowledge of the thermal properties of building materials is essential in building design and in selecting air-conditioning systems. The load due to thermal transmission through a building envelope (wall and roof) constitutes an appreciable percent of the total thermal load. Therefore, the proper selection of building materials could reduce considerably this transmission load.

The building materials are characterized by their thermal and physical properties. The thermal characteristics of a building envelope depend on the thermal conductivity, specific heat, and density.

SECTION 2 OBJECTIVE

The objective of this work was to measure the thermal conductivity of one type of thermo reflective insulation (two identical samples) provided by Al-Joaib Packing Materials Factory, Dammam.

SECTION 3 TEST PROCEDURE

The thermal conductivity was measured under steady-state conditions using a guarded hot plate conforming to ASTM Standard C 177-85 [2, 3]. The samples of thermo reflective insulation were provided by the client.

The Dynatech guarded hot plate thermal conductance measuring system, TCFG-R4-6, shown in Figure 1, was used to determine the thermal conductivity. The type of the tested thermo reflective insulation is shown in Figure 2. The accuracy of the test equipment is about $\pm 4\%$ of the true value of the thermal conductivity for samples with a maximum thickness of 15 cm. For samples of thicknesses of 15 to 25 cm, the accuracy of the test equipment is within 15% of the true value of thermal conductivity.

During the tests, the average temperature of the samples at steady-state was kept at about $35.0 \pm 1^\circ\text{C}$. Two identical samples of thermo reflective insulation were tested.



Figure 1. Guarded hot plate thermal conductivity measuring equipment.

THERMO REFLECTIVE INSULATION SAMPLE
(Dimensions = 58 cm x 57 cm x 0.735 cm)

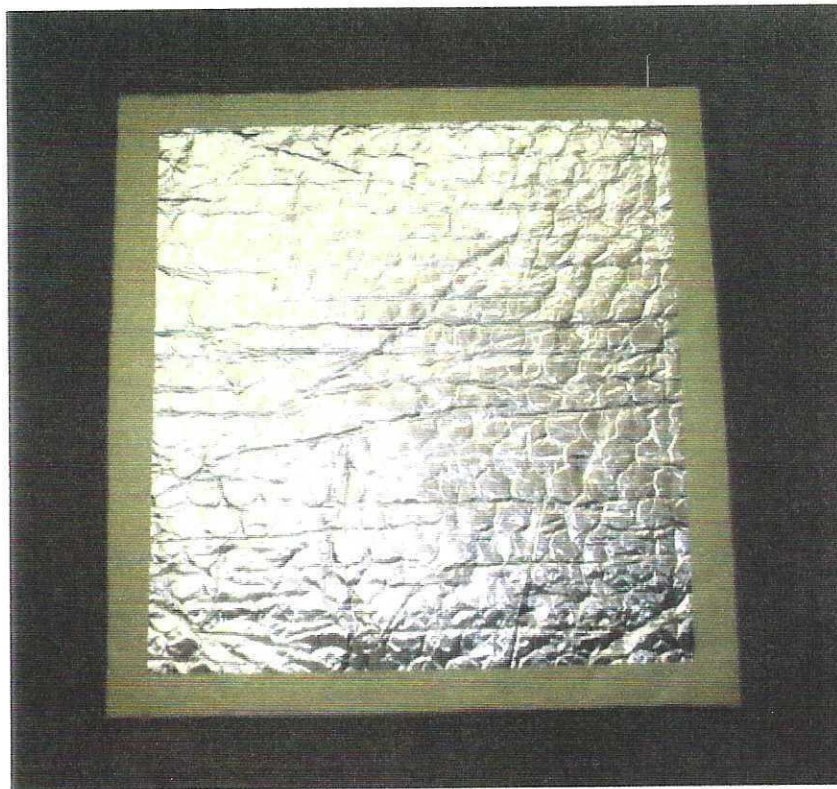


Figure 2. Type of tested thermo reflective insulation.

The average results of thermal conductivity, test temperature, and thermal resistance are reported. The thermal conductivity test data for the thermo reflective insulation are also reported.

SECTION 4 RESULTS AND DISCUSSION

The average results of thermal conductivity, test temperature, thickness, and thermal resistance for the thermo reflective insulation are reported in Table 1. The test data for thermal conductivity for the samples are reported in Table 2.

The results show that the mean thermal conductivity of the tested thermo reflective insulation is 0.0407 W/m.K and the thermal resistance is 0.181 m².K/W.

Table 1. Average test results for the thermo reflective insulation.

Description	Sample Dimension ¹ cm	Test Thickness cm	Mean Temp. °C	Mean Thermal Conductivity W/m.K	Thermal Resistance ¹ m ² .K/W
Thermo Reflective Insulation	58 x 57 x 0.735	0.735	35.2	0.0407	0.181

¹Based on test thickness.

Table 2. Test data of the thermal conductivity of the thermo reflective insulation.

Description	Number of Tests	Thermal Conductivity, W/m.K		
		Sample #1	Sample #2	Mean
Thermo Reflective Insulation	2	0.0408	0.0406	0.0407

SECTION 5 REFERENCES

1. Elhadidy, M.A., M. Ul-Haq, and A. Ahmad (2001). Electric energy consumption in selected residential buildings at KFUPM, Dhahran, Saudi Arabia. *Proc. of the Mediterranean Conference for Environment and Solar, Beirut, Lebanon*, Nov. 16-18, COMPLES 2000, IEEE, Vol. EX493.
2. Dynatech. Guarded Hot-Plate Thermal Conductance Measuring System. Dynatech Model TCFG-R4-6, Dynatech R/D Company.
3. ASTM Standard C 177-85 (1985). Standard test method for steady-state heat flux measurements and thermal transmission properties by means of the guarded hot plate apparatus. *Annual Book of ASTM Standards*, v. 4.06.