



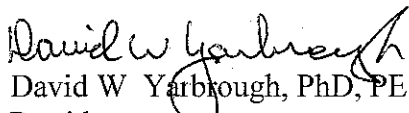
December 26, 2007

Levelton Consultants LTD.  
Building Science Division  
760 Enterprise Crescent  
Victoria, BC, Canada V87 6R4  
Attention: Alex McGowan

Dear Mr. McGowan,

A set of thermal data for three types of cellulosic insulation is enclosed. The data set contains measurements of the design density and thermal resistivity of cellulose insulation in density ranges characteristic of attic applications, wall applications, and a low-density product. The project to collect available cellulosic insulations and measure physical properties was sponsored by the Cellulose Insulation Manufacturers Association. These data are proposed for inclusion in the table with title "*Typical Thermal Properties of Common Building and Insulating Materials-Design Values*" in the *ASHRAE Handbook of Fundamentals*

Sincerely,

  
David W. Yarbrough, PhD, PE  
President

**R&D Services, Inc.**

PO Box 2400, Cookeville Tennessee, 38502-2400

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## Technical Report

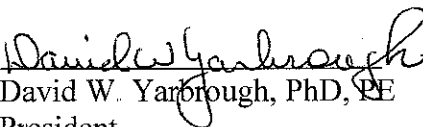
### Measured Thermal Resistivities for Cellulose Insulation Products Commercially Available in 2007

Prepared For: Cellulose Insulation Manufacturers Association

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President

December 26, 2007

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## **Measured Thermal Resistivities for Cellulose Insulation Products Commercially Available in 2007**

### Introduction

Apparent thermal conductivity measurements have been completed for ten cellulose insulation products commercially available in 2007. The thermal measurements result in values for the thermal resistivity (R-per-inch of thickness) obtained for test specimens that were four inches thick. This thickness meets or exceeds the “representative thickness requirement” for thermal insulations. This project was undertaken for the Cellulose Insulation Manufacturers Association for submission to the American Society of Heating, Refrigerating and Air Conditioning Engineers.

### Experimental Results

Thermal performance of the cellulose insulations were determined at design density as outlined in ASTM C 739 for loose-fill insulations intended for attic applications. Three thermal tests were completed for insulations at densities representative of wall-cavity applications. All thermal tests were done in accordance with ASTM C 518. A set of test reports for the materials in the study is attached.

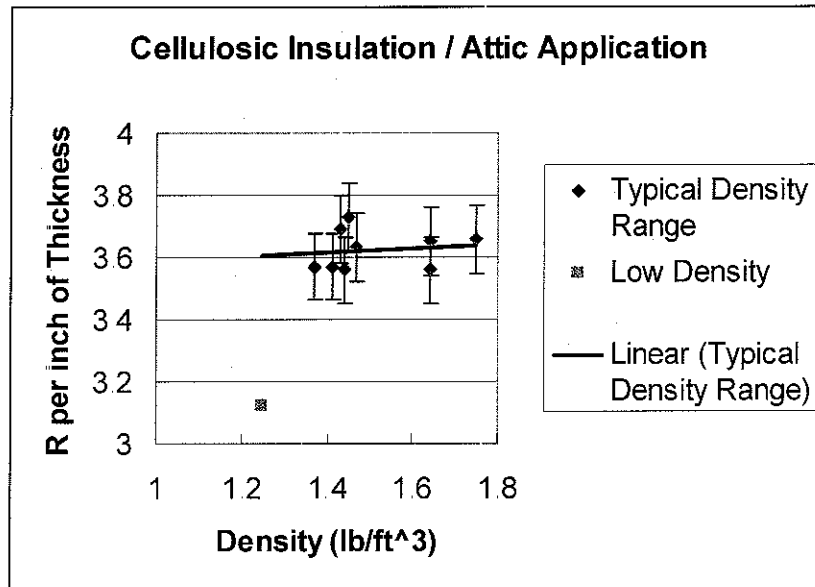
Table 1 contains a listing of the results that were obtained for the cellulose products that were included in this project. The results are also shown in Figures 1 and 2. The vertical bars in Figure 1 indicate +/- 3% variation about the data points and show overlap with the trend line in the figure. The data in Figure 2 show the distinct difference between the insulations tested at densities characteristic of attic applications (1.4 to 1.6 lb/ft<sup>3</sup>) and cellulose insulation installed at densities characteristic of wall applications (2 to 3 lb/ft<sup>3</sup>). The variation of thermal resistivity within the two groups is small.

**Table 1. Thermal Resistivity Data for Commercially Available Cellulose Insulation**

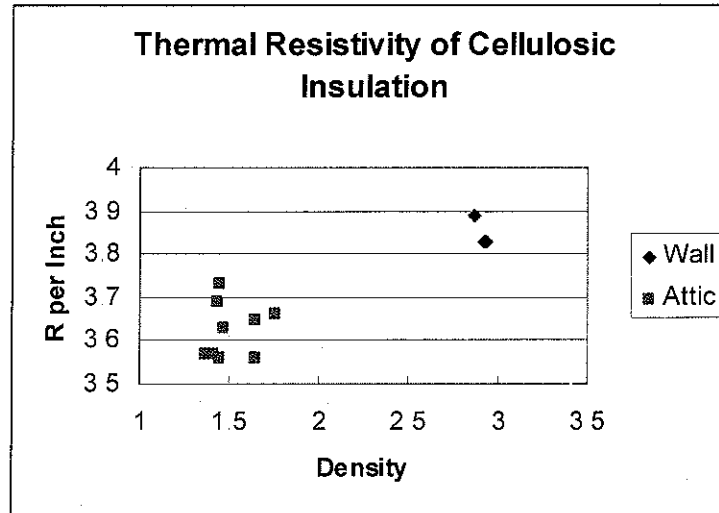
<u>Test</u>	<u>Test Density<sup>1</sup></u>	<u>Application</u>	<u>Thermal Resistivity<sup>2</sup></u>
1	2.92	Wall Cavity	3.83
2	2.87	Wall Cavity	3.89
3	2.93	Wall Cavity	3.83
4	1.43	Attic Floor	3.69
5	1.45	Attic Floor	3.73
6	1.64	Attic Floor	3.65
7	1.64	Attic Floor	3.56
8	1.41	Attic Floor	3.57
9	1.37	Attic Floor	3.57
10	1.44	Attic Floor	3.56
11	1.47	Attic Floor	3.63
12	1.25	Attic Floor	3.12
13	1.75	Attic Floor	3.66

<sup>1</sup> lb<sub>m</sub>/ft<sup>3</sup>

<sup>2</sup> ft<sup>2</sup> h<sup>o</sup>F/Btu-in (R-value per inch of thickness)



**Figure 1. R-per-Inch for Attic Applications**



**Figure 2. Cellulose Insulation in Walls and Attics**

Discussion

The measured thermal resistivities in Figure 1 indicate that the products surveyed can be characterized as having a thermal resistivity of 3.6 ft<sup>2</sup>·h·°F/Btu in. in the density range from 1.35 to 1.65 lb<sub>m</sub>/ft<sup>3</sup>. The trend line in Figure 1 indicates that the thermal resistivity is not sensitive to small changes in density in this range. The single data point at very low density (Test 12) is unusual. The data in Table 2 show a distinct set of thermal resistivities for densities in the range from 2.5 to 3.0 lb<sub>m</sub>/ft<sup>3</sup>. Since thermal resistivities are conventionally rounded to the nearest 0.1, the attic products can be characterized as being 3.6 to 3.7 R-per-inch of thickness while the wall cavity products can be characterized as being 3.8 to 3.9 R-per-inch products.

Specific products must be tested and labeled in accordance with existing federal regulations. The results in this report illustrate the range of values to be expected for the R-per-inch of thickness for cellulose insulation currently available.

David W. Yarbrough, PhD, PE  
December 22, 2007