

Appendix I ASTM C 518 – THERMAL CONDUCTIVITY VIA HEAT FLOW METER (EXOVA)

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Testing. Advising. Assuring.

**EVALUATION OF THE THERMAL TRANSMISSION PROPERTIES OF
"SPACELIFT" BLANKET THERMAL INSULATION**

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Appendix I ASTM C 518 – THERMAL CONDUCTIVITY VIA HEAT FLOW METER (EXOVA)

Evaluation of the Thermal Transmission Properties of Spaceloft Thermal Insulation Page 2 of 6
for Aspen Aerogels Inc. Report No. 09-06-M0325-C

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1.0 INTRODUCTION

At the request of Aspen Aerogels Inc., Exova was retained to evaluate the thermal transmission properties of a sample of Spaceloft thermal insulation material to ASTM C518 – 04 using parameters provided by NFRC specification 101-2006 [E0A12].

Upon receipt, the samples were assigned the following Sample Identification No.:

Client Sample Description	Exova Sample No.
Spaceloft Sample A; Blanket-type Thermal Insulation	09-06-M0018-D
Spaceloft Sample B; Blanket-type Thermal Insulation	09-06-M0018-E
Spaceloft Sample C; Blanket-type Thermal Insulation	09-06-M0018-F

This report is based on data which was previously reported in Report No. 09-06-M0018-BRV2 to Aspen Aerogels Inc, on March 10th, 2009, modified as requested by the client.

2.0 PROCEDURE

The sample was evaluated according to the following standard test methods:

Test Description	Test Method
Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus	ASTM C 518–04

Test Conditions & Apparatus

Sample :	300 mm x 300 mm (nominal)
Thickness:	2 layers, as supplied by the client
Conditioning:	23 ± 2°C; 50 ± 5% RH > 24 hours prior to testing Environmental Controller (MII# A11354)
Test Conditions:	2°C mean temperature ΔT = 22°C
Apparatus:	LaserComp Fox 314 Heat Flow Meter (MII# A14505)
Test Date:	2009-02-06

Appendix I ASTM C 518 – THERMAL CONDUCTIVITY VIA HEAT FLOW METER (EXOVA)

Evaluation of the Thermal Transmission Properties of Spaceloft Thermal Insulation Page 3 of 6
for Aspen Aerogels Inc. Report No. 09-06-M0325-C

EXOVA

3.0 RESULTS

The apparent thermal transmission properties of the three Spaceloft materials are presented in the following three tables.

Table 1 – Thermal Transmission Properties ASTM C 518 – 04 Exova Sample No.: 09-06-M0018-D	
Description	Results
Specimen Thickness mm [in.]	21.61 [0.851]
Upper Surface Temperature °C [°F]	-8.99 [15.82]
Lower Surface Temperature °C [°F]	13.02 [55.44]
Temperature Differential °C [°F]	22.01 [39.62]
Mean Temperature °C [°F]	2.02 [35.63]
Rate of Heat Flux W/m ² [Btu/h.ft ²]	14.789 [4.688]
Thermal Conductance W/m ² ·K [Btu/h.ft ² ·°F]	0.672 [0.118]
Thermal Resistance K.m ² /W [°F.ft ² .h/Btu]	1.488 [8.451]
Thermal Conductivity W/m.K [Btu.in./h.ft ² .°F]	0.01452 [0.101]
Thermal Resistivity K.m/W [°F.ft ² .h/Btu.in.]	68.871 [9.934]

Table 2 – Physical Properties Exova Sample No.: 09-06-M0018-D					
Layer	Length, mm	Width, mm	Thickness, mm	Mass, g	Density, kg/m ³
1	304.8	304.2	10.805 ¹	132.19	131.9
2	304.6	304.6		134.33	134.0
Avg	304.7	304.4		133.26	132.9

¹ The material thickness value reported is one-half of the measured thickness determined by the heat flow meter used in the thermal conductivity test. The thickness is determined with a 0.9 psi load applied over the surface area of the 2-ply stack.

Appendix I ASTM C 518 – THERMAL CONDUCTIVITY VIA HEAT FLOW METER (EXOVA)

Evaluation of the Thermal Transmission Properties of Spaceloft Thermal Insulation for Aspen Aerogels Inc. Page 4 of 6
Report No. 09-06-M0325-C

EXOVA

Table 3 – Thermal Transmission Properties ASTM C 518 – 04 Bodycote Sample No. 09-06-M0018-E	
Description	Results
Specimen Thickness mm [in.]	21.52 [0.847]
Upper Surface Temperature °C [°F]	-8.99 [15.82]
Lower Surface Temperature °C [°F]	13.02 [55.44]
Temperature Differential °C [°F]	22.01 [39.62]
Mean Temperature °C [°F]	2.02 [35.63]
Rate of Heat Flux W/m ² [Btu/h.ft ²]	15.382 [4.876]
Thermal Conductance W/m ² K [Btu/h.ft ² .°F]	0.699 [0.123]
Thermal Resistance K.m ² /W [°F.ft ² .h/Btu]	1.431 [8.125]
Thermal Conductivity W/m.K [Btu.in./h.ft ² .°F]	0.01504 [0.104]
Thermal Resistivity K.m/W [°F.ft ² .h/Btu.in.]	66.489 [9.590]

Table 4 – Physical Properties Bodycote Sample No. 09-06-M0018-E					
Layer	Length, mm	Width, mm	Thickness, mm	Mass, g	Density, kg/m ³
1	303.9	304.2	10.805 ²	138.68	138.8
2	303.7	304.1		136.03	136.3
Avg	303.8	304.2		137.35	137.6

² The material thickness value reported is one-half of the measured thickness determined by the heat flow meter used in the thermal conductivity test. The thickness is determined with a 0.9 psi load applied over the surface area of the 2-ply stack.

Appendix I ASTM C 518 – THERMAL CONDUCTIVITY VIA HEAT FLOW METER (EXOVA)

Evaluation of the Thermal Transmission Properties of Spaceloft Thermal Insulation for Aspen Aerogels Inc. Page 5 of 6
Report No. 09-06-M0325-C

EXOVA

Table 5 – Thermal Transmission Properties ASTM C 518 – 04 Bodycote Sample No. 09-06-M0018-F	
Description	Results
Specimen Thickness mm [in.]	22.90 [0.902]
Upper Surface Temperature °C [°F]	-8.99 [15.82]
Lower Surface Temperature °C [°F]	13.02 [55.44]
Temperature Differential °C [°F]	22.01 [39.62]
Mean Temperature °C [°F]	2.02 [35.63]
Rate of Heat Flux W/m ² [Btu/h.ft ²]	14.280 [4.526]
Thermal Conductance W/m ² K [Btu/h.ft ² .°F]	0.649 [0.114]
Thermal Resistance K.m ² /W [°F.ft ² .h/Btu]	1.541 [8.753]
Thermal Conductivity W/m.K [Btu.in./h.ft ² .°F]	0.01486 [0.103]
Thermal Resistivity K.m/W [°F.ft ² .h/Btu.in.]	67.295 [9.706]

Table 6 – Physical Properties Bodycote Sample No. 09-06-M0018-F					
Layer	Length, mm	Width, mm	Thickness, mm	Mass, g	Density, kg/m ³
1	304.6	305.2	10.805 ³	140.78	140.2
2	305.1	304.8		142.23	141.6
Avg	304.8	305.0		141.50	140.9

³ The material thickness value reported is one-half of the measured thickness determined by the heat flow meter used in the thermal conductivity test. The thickness is determined with a 0.9 psi load applied over the surface area of the 2-ply stack.

Appendix I ASTM C 518 – THERMAL CONDUCTIVITY VIA HEAT FLOW METER (EXOVA)

Evaluation of the Thermal Transmission Properties of Spaceloft Thermal Insulation Page 6 of 6
for Aspen Aerogels Inc. Report No. 09-06-M0325-C

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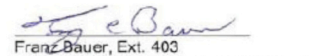
4.0 CONCLUSION

The materials provided by Aspen Aerogels Inc., labeled as Spaceloft, have an average apparent thermal conductivity 0.0148 W/m.K.

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