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Mathis Technology Application: Effusivity of Automotive Interior Overhead Panels

The Mathis Technology is an effective and simple instrument for quality control analysis, a key in manufacturing. This is especially important in the manufacture and installation of automotive interior overhead panels. Manufacturer's strive to combine layers of materials to form the final panel package that together are insulating to heat and sound, meeting the satisfaction of the customer, while remaining cost effective to the manufacturer. A series of seven extracted samples of automotive interior overhead panels were tested. Each sample was tested three times on the front face (side exposed to car interior) and three times on the back face (side exposed to interior of car roof). A 500-gram weight was placed on top of the sample to ensure good surface contact at the sample sensor interface.

The timing options used for instrument calibration and testing were: 10 second test duration, 100 Hz sampling rate, 4 second test start time and 3 minute cooling period between tests. The results are tabulated below and show excellent precision and separation between interior overhead panel packages from various automobile manufacturers with testing performed on both sample faces.

Table 1. Effusivity Results for Various Automotive Interior Overhead Panels

SAMPLE (FACE)	AVERAGE EFFUSIVITY $\sqrt{(K\rho C_P)}$	SD	RSD	PANEL COMPOSITION
Audi 5000 (front)	108.3	0.5	0.5	**Layers:** fabric, fibreboard, cardboard
(back)	169.8	2.0	1.2	
Nissan Stanza (front)	104.6	0.6	0.6	**Layers:** fabric, compressible foam, polymer, foam core and polymer
(back)	160.4	0.5	0.3	
Buick Regal (front)	96.7	0.5	0.6	**Layers:** fabric, compressible foam, polymer, foam core, compressible foam
(back)	112.1	0.7	0.6	
Oldsmobile Delta 88 (front)	95.1	0.5	0.5	**Layers:** fabric, compressible foam, fibreglass mesh, layered fibre insulation, fibreglass mesh
(back)	106.6	0.2	0.2	
Hyundai Stellar (front)	135.9	0.4	0.3	**Layers:** woven fabric, foam core, fibreboard
(back)	241.1	2.0	0.8	
Ford Taurus (front)	98.3	0.3	0.3	**Layers:** fabric, compressible foam, fibre insulation
(back)	118.6	0.2	0.1	

Where:

k	thermal conductivity (W/m·K)
ρ	density of material (kg/m^3)
c_P	specific heat capacity of the material (J/kg·K)
$\sqrt{(k\rho c_P)}$	Mathis Technology thermal effusivity (W·√s/m^2·K)
SD	standard deviation
RSD	relative standard deviation in the physical property reported (±%)