

**DSET LABORATORIES**

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Report No.: 35782-B-0  
Order No.: AE35782-B  
Client Ref. No.: PO# 295018  
Date: February 16, 2016

**NEAR-NORMAL/HEMISPHERICAL SPECTRAL TRANSMITTANCE,  
HEMISPHERICAL SPECTRAL REFLECTANCE,  
AND TOTAL EMITTANCE REPORT**

prepared for:

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This report contains 7 pages

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**1.0 INTRODUCTION**

This report presents results of spectral reflectance, transmittance and emittance measurements on the following thirteen vinyl specimens coded:

Tufdek Almond  
Tufdek Birch  
Tufdek Carrera  
Tufdek Driftwood  
Tufdek D Sand  
Tufdek Graphite  
Tufdek Pearl  
Tufdek Rustic  
Tufdek Sanibel  
Tufdek Slate  
Tufdek TX60  
Tufdek Valencia  
Tufdek Walnut

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**2.0 TEST METHODS AND PROCEDURES**Optical Property Measurements

Hemispherical spectral transmittance and reflectance measurements were performed on the specimen in accordance with ASTM Standard Test Method E903 (2012). The measurements were performed with a PerkinElmer Lambda 950 Spectrophotometer utilizing an integrating sphere (Figure X1.3 of E903). Transmittance measurements were obtained in the solar spectrum from 2500nm to 250nm at an incident angle of 0°. The measurements are properly denoted as being 'near normal/hemispherical spectral transmittance'. Total reflectance measurements were obtained in the solar spectrum from 2500nm to 250nm at an incident angle of 8°. The measurements employ a detector-baffled, wall-mounted integrating sphere that precludes the necessity of employing a reference standard except to define the instrument's 100% line. The measurements are properly denoted as being 'hemispherical spectral reflectance'. All spectral data are submitted herewith in the original.

The spectral data were obtained by integrating the spectral data against Air Mass 1.5 direct (ASTM G159) solar spectrum utilizing 105 weighted ordinates.

The absorptance is calculated from Kirchhoff's Relationship where:

$$\rho + \alpha + \tau = 1$$



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**2.0 TEST METHODS AND PROCEDURES (cont'd)**Total Emittance Measurements

Near-Normal infrared reflectance measurements were performed in accordance with ASTM E408, Method A. A Gier Dunkle Instruments Infrared Reflectometer Model DB 100 was utilized for the measurements.

Inside the detector portion are two semi-cylindrical cavities. One of the cavities is heated by an electrical heater and the other stabilizes at approximately room temperature. Thus, the two cavities are maintained at different temperatures. As the cavities rotate, the sample is alternately irradiated at 13 Hz. A vacuum thermocouple views the sample through an optical system that focuses through slits in the ends of the cavities. The detector receives energy emitted by the sample and energy reflected by the sample. Only the reflected energy contains an alternating component as the sample is alternately irradiated by the hot and cold cavities. An amplifier is synchronized with the cavity rotation to pass only the desired alternating signal, which is then rectified and filtered. The zero and gain are set with standards of known emittance. The calibration is rechecked at several intervals during the measurement. The Gier Dunkle Infrared Reflectometer is calibrated using high and low emittance standards. The standards were calibrated at and obtained from the National Physical Laboratory in England. The emittance value for the glass standard equals 0.89. The emittance value for the mirror standard equals 0.01.

Near-Normal emittance for the client's specimens was calculated from Kirchhoff's Relationship where:

$$\rho + \alpha + \tau = 1, \alpha = \varepsilon$$

Since the specimens have no transparency in the far IR, the preceding equation reduces to

$$\rho + \varepsilon = 1 \text{ and } 1 - \rho = \varepsilon$$

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**2.0 TEST METHODS AND PROCEDURES (cont'd)****SRI**

The Solar Reflectance Index is calculated from ASTM E1980. The procedure defines a Solar Reflectance Index (SRI) that measures the relative “steady-state surface temperature” of a surface with respect to the standard white (SRI=100) and the standard black (SRI=0) under the standard solar and ambient conditions. The program used for the calculations was provided by Lawrence Berkeley Laboratory in California.

**3.0 OBSERVATIONS, DEVIATIONS, AND WAIVERS**

The measurements were performed on the uncoded side of the specimens. Emittance results are an average of four readings.

\* = Samples with transmittance may have a higher SRI with a backing.

Measurements on the unbacked samples are from test AE35782. Samples with transmittance were backed with 5/8 inch plywood.

**CAUTION:** ASTM Test Method E903 (2012), paragraph 5.4 clearly states “this test method has been found practical...except for those materials that are inhomogeneous, patterned, or corrugated”. In that the specimen exhibits inhomogeneities, the client is cautioned when utilizing the reported measurement values.

With all test methods, there typically is a level of uncertainty for the test data due to the acceptable operating tolerances of the instrumentation and variation caused by the test method. The estimated tolerances are expected to be less than plus or minus 2% for most materials tested to ASTM E903.

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**4.0 RESULTS**
Optical Property Data

Specimen Code	% Solar Transmittance	% Solar Reflectance	% Solar Absorptance	SRI
Tufdek Almond	1.5	47.3	51.2	*56
Tufdek Almond (with Backing)	0.0	47.6	52.4	57
Tufdek Birch	0.1	20.7	79.2	*21
Tufdek Birch (with Backing)	0.0	20.0	80.0	21
Tufdek Carrera	0.0	35.8	64.2	41
Tufdek Driftwood	0.0	26.8	73.2	30
Tufdek D Sand	1.2	56.8	42.0	*69
Tufdek D Sand (with Backing)	0.0	57.8	42.2	70
Tufdek Graphite	0.0	30.9	69.1	35
Tufdek Pearl	0.0	33.9	66.1	39
Tufdek Rustic	0.0	22.6	77.4	25
Tufdek Sanibel	0.0	51.7	48.3	62
Tufdek Slate	0.0	35.8	64.2	41
Tufdek TX60	0.0	83.2	16.8	105
Tufdek Valencia	1.4	45.9	52.7	*54
Tufdek Valencia (with Backing)	0.0	46.4	53.6	55
Tufdek Walnut	0.0	42.2	57.8	49



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**4.0 RESULTS (cont'd)**
Total Emittance Data

Specimen Code	Infrared Reflectance Measured	Near-Normal Emittance Calculated
Tufdek Almond	.06	.94
Tufdek Almond (with Backing)	.06	.94
Tufdek Birch	.06	.94
Tufdek Birch (with Backing)	.06	.94
Tufdek Carrera	.06	.94
Tufdek Driftwood	.06	.94
Tufdek D Sand	.06	.94
Tufdek D Sand (with Backing)	.06	.94
Tufdek Graphite	.06	.94
Tufdek Pearl	.06	.94
Tufdek Rustic	.06	.94
Tufdek Sanibel	.06	.94
Tufdek Slate	.06	.94
Tufdek TX60	.06	.94
Tufdek Valencia	.06	.94
Tufdek Valencia (with Backing)	.06	.94
Tufdek Walnut	.06	.94