

Test Methods

All thermal control materials are subjected to rigorous quantitative testing and 100% visual inspection for workmanship before being shipped. Our consistent use of test methods and statistical analysis of the test data assures that product quality remains at the highest standards. Multek is ISO 9001 certified.

Where possible we use test methods that are based on industry standards so that our customers can reliably reproduce our test results. The chart below shows how we test the various product types.

	Solar Absorptance (α)	Emittance (ϵ)	Surface Resistivity Ω /square	Coating Adhesion	Adhesion to steel Oz./in width	Peel Strength Oz./in width
Test method	Q000199	Q000341 (ϵ_N) Q000154 (ϵ_H)	Q000322 Q000331 Q000379 Q000725	Q000084		
Industry test method	ASTM E-490 ASTM E-903	ASTM E-408 Methods A & B	ASTM D-257 ASTM F-390	ASTM D-1000 Mil M 13508	ASTM D-1000 ASTM D-3330	ASTM D-903
Metal x substrate	X	X	X*	X		
Metal x substrate x metal	X	X	X	X		
ITO x substrate x metal	X	X	X*	X		
Substrate x adhesive					X	
Metal x substrate x adhesive	X	X	X	X	X	
Substrate x metal x adhesive	X	X	X	X	X	
Substrate x fabric laminate						X
Metal x substrate x fabric laminate	X	X	X	X		X
Substrate x fabric x metal laminate	X	X	X	X		X

* Surface resistivity not measured on aluminum or silver coating on FEP.

Note: Optical properties, resistivity, and metal adhesion of tapes are measured prior to combining with adhesive.

Optical Properties

Solar Absorptance Testing



Multek measures solar absorptance using a Perkin-Elmer Labsphere 950 UV-VIS-NIR spectrophotometer.

In this instrument the light reaches the sample at an 8° angle of incidence, enters a 150 mm diameter Labsphere integrating sphere with Spectralon™ coating, and data is recorded every 2nm from 250 nm to 2500 nm. The Labsphere has a photomultiplier tube (PMT) detector for the UV/Vis range (up to 900 nm) and a PbS detector for the NIR range (860-2500 nm). Specular samples are measured against specular reference mirrors and diffuse samples are measured against diffuse standards. The reference standards are calibrated against NIST traceable standards.

Solar absorptance (α) is computed by numerical integration of the spectral reflectance weighted by the solar spectrum as described in NASA Reference Publication 1121, NASA SP-8005, and ASTM E-490. We perform the integration by averaging the reflectivity at 25 wavelengths at the center of spectral bands representing 4% of the solar output. For terrestrial solar energy applications, air mass 1.5 can be used.

Emittance Testing

Room temperature emittance testing is currently done two different ways. A good approximation of total hemispherical emittance (ϵ_H) is obtained from a Lion Research Corporation emissometer. The instrument responds to the IR energy between 3 and 30 microns emitted from a sample through a potassium bromide window into a detector. This method conforms to ASTM E-408, Method B.

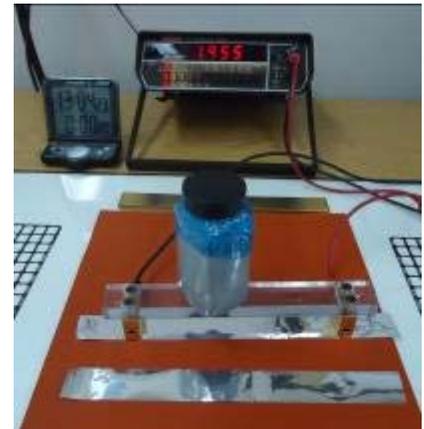




We can also test total hemispherical emittance (ϵ_H) on the AZ Technology Temp 2000A. A calculated hemispherical value can be provided by testing on the AZ Technology Temp 2000A Reflectometer in the Relative Mode. Because the ASTM-E-408 Method B specifically calls out testing on an emissometer and not a reflectometer, this alternative method will not technically meet ASTM-E408 Method B.

Electrical Properties

There are several methods for measuring surface resistivity of our products. The test methods are based on ASTM D-257 and yield similar results. The surface resistivity of roll to roll and sheet goods is most often measured using a system with two probes that are each one inch wide and are placed six inches apart. In this case, the surface resistance is one sixth of the reading on the ohm meter. The surface resistance of the material being tested in the image at the right is 0.38 Ω /square. This test approach is described in Q000331. Q000379 is similar, except that the probes are only one inch apart and the surface resistance equals the value on the meter.



When small test samples are available or we cannot cut a test sample for surface resistivity testing we use a four point probe as described in Q000322.

The surface resistivity of highly resistive products (e.g., germanium or 100XC Kapton®) may be measured on two machines. The first is a Pinion meter. This is a self-contained four point probe and it returns the order of magnitude of the surface resistivity. The second machine is an ETS 870A (shown at right) that uses a pair of concentric ring probes. The ETS 870A meter provides a resistivity readout that is accurate to several significant digits. These tests are described in our test method Q000725.



Physical Properties

We have the capability to test many of the physical characteristics of the materials we use and produce. The most common testing of physical properties are the measurements of coating adhesion, adhesion of tapes to stainless steel, and peel strength of laminates. In addition, we can measure the tensile strength and elongation of films as well as the tear resistance of films and laminates. Using an outside laboratory we can test the outgassing properties of products and raw materials.

Metal Adhesion Testing

Q000084 describes testing metal adhesion to film with a “scotch®-tape” test. The tape is selected and inspected per ASTM D-1000 to assure consistent bond strength to the metal coating. As shown in the figures below, the tape is pressed onto the coating using a calibrated force, pulled off at moderate speed at a high angle, and then examined for evidence of coating removal. The results are reported in levels of adhesion ranging from No Removal to Level 6 with more than 25% removal.



Adhesion to Stainless Steel Testing



All tapes sold by Multek are tested for bond strength. This test is done by applying the tape to a clean stainless steel substrate using a prescribed pressure and then measuring the force required to remove the tape using an Instron instrument. Our test methodology is in accordance with ASTM D-1000 and ASTM D-3330. We can also test adhesion to aluminum plates if desired.

Peel Strength

We test the peel strength of laminates in much the same way we test the adhesion of tapes to metal plates. We begin by attempting to initiate a peel of the laminate. Some laminates are bonded so well that we cannot initiate a peel, and the test stops. If we can initiate a peel, the laminate is mounted in the Instron and then pulled apart while the Instron measures and records the force required. This test follows the methodology of ASTM D-903.

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