DAMAGE WEIGHT AND FADING – Continued

Fading of interior furnishings is often attributed to ultraviolet radiation (UV) from the sun passing through windows onto interior surfaces. Historically ultraviolet (UV) light transmittance was considered to be the ultimate measure of a glazing material's ability to protect home furnishings (carpeting, drapes, furniture, etc.) from fading due to normal sunlight exposure. However, UV is not the only portion of the solar spectrum which can damage artwork or furnishings inside buildings. While it is true that exposure to UV (280 – 380nm) light is a primary contributor to the fading, visible light (380 – 780nm) is also a significant contributor to fading. Ultraviolet radiation (UV) is the single largest contributing factor in fading of fabrics, carpets and other furnishings. Although visible light, electric lighting, heating, humidity, age of fabrics and fabric dyes all play a part in the process, UV radiation is attributed to the majority of the damage. Protecting against UV is not just important in hot, sunny climates. Even in cold, cloudy climates, UV radiation can damage furnishings.

The Lawrence Berkeley National Laboratory (LBNL) Windows and Daylighting Group warns against using UV transmittance as the sole barometer for measuring potential fading damage. Scientists found that blocking all of the ultraviolet radiation portion of the solar spectrum would not eliminate fade damage for most fabrics, but will slow down the rate of fading.

New factors that quantify the overall effect of UV and visible light on fading have been developed. The most comprehensive is the ISO Damage Weighted Transmittance (Tdw-ISO), which many experts now use to more accurately assess the potential effects of various glazing materials on fading. This factor quantifies the ability of glass to reduce fading by measuring the effects of both transmitted UV and visible light.

The Tdw-ISO calculation assigns a specific Damage Weighted Transmittance to each wavelength of UV or visible light, based on its contribution to fading. It is known that the shorter wavelengths (such as UV) cause more fading damage than the longer wavelengths (such as visible). Consequently, the shorter wavelengths will have a higher weighted "damage" factor than the longer wavelengths. The sum total of these wavelength specific factors yields the Damage Weighted Transmittance for a specific glass product.

Another commonly used Tdw is the Krochmann factor. This methodology is based on the work of Jurgen Krochmann in Germany and stems from his studies of the damaging affects of radiation on paintings and other museum artifacts. The Krochmann damage weighting function was incorporated into ISO/CIE publication 89/3 "On the deterioration of exhibited museum objects by optical radiation" and is referenced by NFRC [National Fenestration Rating Council] optical properties standard NFRC 300 in computing the damage-weighted transmittance T-dw.

By comparing the Damage Weighted Transmittance of various glass types, architects, building owners, homeowners and window manufacturers can more effectively compare their ability to protect interior components from fading.

REFERENCE SOURCES: The content above can be found at the following two locations:
http://www.fsec.ucf.edu/en/consumer/buildings/basics/windows/fading.htm
http://www.ppg.com/corporate/ideascapes/resglass/window/Documents/7109FadingFactors.pdf

BATTERY REPLACEMENT

The SS24500 is powered by a 9 volt alkaline battery (included). When the battery voltage is getting too low to operate the meter, the low battery indicator will turn on. The instrument can still be used at this point, however it is recommended that the battery be replaced soon. Alkaline batteries are recommended for this product.

AUTO-POWER-OFF

The SS24500 instrument is equipped with an automatic power-off feature to extend the life of your battery. The instrument will automatically shut off after approximately 3 minutes if not used.

WARRANTY

The manufacturer warrants all models of the SS2450 to be free from defects in material and workmanship under normal use and service as specified within the operator's manual. The manufacturer shall repair or replace the unit within twelve (12) months from the original date of shipment after the unit is returned to the manufacturer's factory, prepaid by the user, and the unit is disclosed to the manufacturer's satisfaction, to be thus defective. This warranty shall not apply to any unit that has been repaired or altered other than by the manufacturer. The aforementioned provisions do not extend the original warranty period of the unit which has been repaired or replaced by the manufacturer. Batteries are not covered by warranty.

The manufacturer assumes no liability for the consequential damages of any kind through the use or misuse of the SS2450 product by the purchaser or others. No other obligations or liabilities are expressed or implied. All damage or liability claims will be limited to an amount equal to the sale price of the SS2450, as established by the manufacturer.

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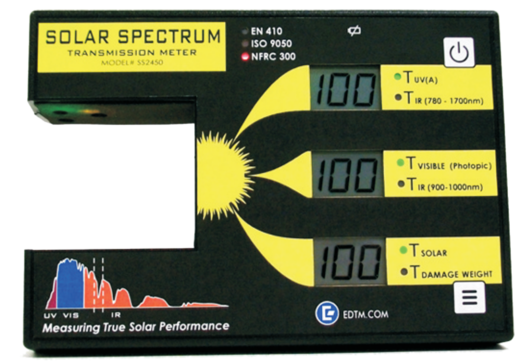
SOLAR SPECTRUM TRANSMISSION METER

MODEL# SS2450



FEATURES:

--Patented technology that effectively re-creates the solar spectrum
--Values calculated to three separate standards (user selectable)
--Two infrared ranges: narrow plus fuller spectrum to 1700nm+
--True Photopic Visible Light Transmittance (VLT)
--Full spectrum results in extremely accurate Solar Transmission & VLT values
--Damage Weight values to show protection of furnishings
--Single, double or triple glaze testing easily accomplished
--Test sample width up to 2" thick with a sash/spacer depth up to 1.10"
--No additional light sources needed
--Auto-calibration at start-up
--Battery operated: no power cord required
--Automatic power-off feature for extended battery life
--Replace Battery Indicator
--Continuous measurements
--Convenient push-on/push-off membrane style power switch

BASIC OPERATION

Place the SS2450 on a flat, stationary surface. Turn the instrument on and wait for the system to self-calibrate. After each of the displays show 100%, you can place any sample into the opening to measure the performance characteristics. Here are a few helpful reminders for conducting transmission measurements. For the most accurate transmission measurements, the glass should be held perpendicular to the sensors. Do not tilt the glass at angles. It is recommended that the samples being tested are positioned closer to the sensor side of the opening. This is the side that has 3 circular openings in a triangular pattern. See the sample image to the right. Be aware that fingerprints, dirt, and defects on the glass can affect the transmission values.

FOR MOST ACCURATE RESULTS PLACE SAMPLE AGAINST THE SENSOR SIDE (See example below)

When you slide the glass into position, move the glass all the way into the opening, resting against the stop location. Pay attention to the spacer/sash of your window. Make sure the glass is slid far enough into the opening so the spacer/sash is not blocking one of the sensors.

The instrument will continually monitor its calibration during measurements. If the instrument detects any problems with the calibration, it will reset itself in between measurements. If you mistakenly turn the instrument on with a piece of glass already in position, the displays will calibrate to read 100% with the glass in place. Simply remove the glass sample and wait a few moments. The instrument will re-calibrate itself shortly after the glass is removed. After the displays have returned to 100% after the re-calibration, you may continue with your measurements.

If the frame of your window sample is blocking one of the sensors from receiving a signal, it will result in an invalid measurement. Make sure the frame of your window sample is not blocking any of the three sensor locations or any of the 12 light sources.

If the display reads LO, please verify there is nothing between the light sources and the sensors. If there is a piece of glass present, please remove it from the slot. The unit will then re-calibrate and the displays will show 100%.

MORE ACCURATE MEASUREMENTS

Other meters on the market today do not have the capability of measuring as much of the solar spectrum range as the SS2450 instrument. These other meters give a representation of performance based upon a smaller range, which results in additional errors. For example, the representations of the IR measured by other meters use a light source with wavelengths from 900nm to 1000nm to represent the full 780nm to 2500nm Near Infrared spectrum. The SS2450 uses patented optics that are capable of replicating almost the entire solar spectrum through the Near Infrared region.

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SPECIFICATIONS

Wavelengths

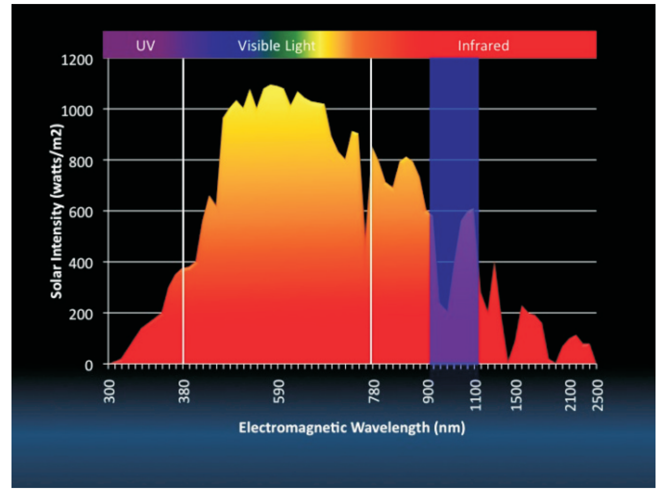
Ultra Violet	350 - 380	Nanometers
Visible	380 - 780	Nanometers
Infared (narrow spectrum)	900 - 1000	Nanometers
Infared (fuller spectrum)	780 - 1700+	Nanometers
NFRC Damage Weight	300 - 700	Nanometers
ISO Damage Weight	300 - 600	Nanometers
Krochman Damage Weight	300 - 500	Nanometers

Accuracy

Solar	+/- 3 Percentage Points
Visible	+/- 3 Percentage Points

Dimensions

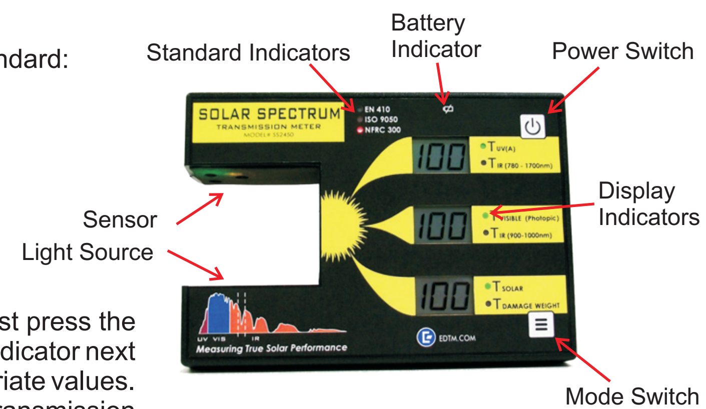
Sample Thickness	0 to 2 inches (0 to 51mm)
Sample Size	1 inch x 1 inch Minimum (25 x 25mm)
Throat depth	1.25 inches (32mm)
Unit Dimensions	6.9 x 4.9 x 2.2 inches (175x124x56mm)
Testing Time	2 seconds
Power Source	9V Battery (alkaline)
Weight	1 pound (0.5kg)



SELECTING MODES

The SS2450 is capable of displaying six unique values for each standard:

- Ultraviolet transmission percentage in the UV(A) spectrum
- Visible light (photopic) transmission percentage
- Solar transmission percentage (300 nm to 1700+ nm)
- Infrared transmission percentage (780 nm - 1700+ nm)
- Infrared transmission percentage (900 nm - 1000 nm)
- Damage Weight Factor



Because there are only 3 LCD displays on the product, the user must press the MODE switch to change between the two display sets. The display indicator next to the display will change and the displays will update with the appropriate values. Notice in the picture to the right, the ultraviolet, visible light, and solar transmission percentages are currently selected.

SELECTING STANDARDS

THE SS2450 is capable of calculating the transmission values with respect to 3 different standards: EN410(2011), ISO9050(2003), and NFRC 300(2010). The device will show results calibrated to the standard you have selected. To switch between the standard options, press and hold the MODE SWITCH first, and then press the POWER SWITCH to select the standard. The LED indicator will rotate through your selection and the displays will update with the appropriate values with each button push.

NOTICE: Not all of the standards list methods for testing all of the values we display on the SS2450 product. For instance, the standards do not specify a measurement algorithm for the Infrared transmission values specifically. In these cases, we used the solar spectrum as designated in the standard, and applied it to the band of energy being measured by our device. Since the EN410 standard does not designate a Damaged Weight factor of any kind, the instrument will display the Krochman Damage Weight Factor in its place.

STANDARDS FOR SOLAR OPTICAL MEASUREMENTS OF GLAZING MATERIALS

There are at least three standards based on the use of spectrophotometers to measure the spectral solar optical performance of glazing materials. They include ISO9050, NFRC 300, and EN 410. The test procedures in these standards often include calculation methods for measurement of single or multiple glazing layers in a given system.

The main difference between the standards is the choice of solar spectral irradiance functions. Different countries choose to follow different standards, based on their interpretation of solar spectrum measurement. Because of this, EDTM has included the 3 most popular standards used around the world. We recommend you select the standard that is most commonly used in your country. ISO 9050 currently uses the global spectrum of ISO CIE 9845 (from ASTM E892), while NFRC uses the direct spectrum of ISO/CIE 9845 (ASTM E891). This is significant because it can result in differences of a few percentage points in the measurements obtained by the SS2450 instrument. These differences will be most noticeable in glazing materials that have spectrally selective coatings applied to them.

The NFRC 300 standard has a special significance in the U.S. since it is used by the NFRC (National Fenestration Rating Council) to rate and label windows that are sold in the U.S.

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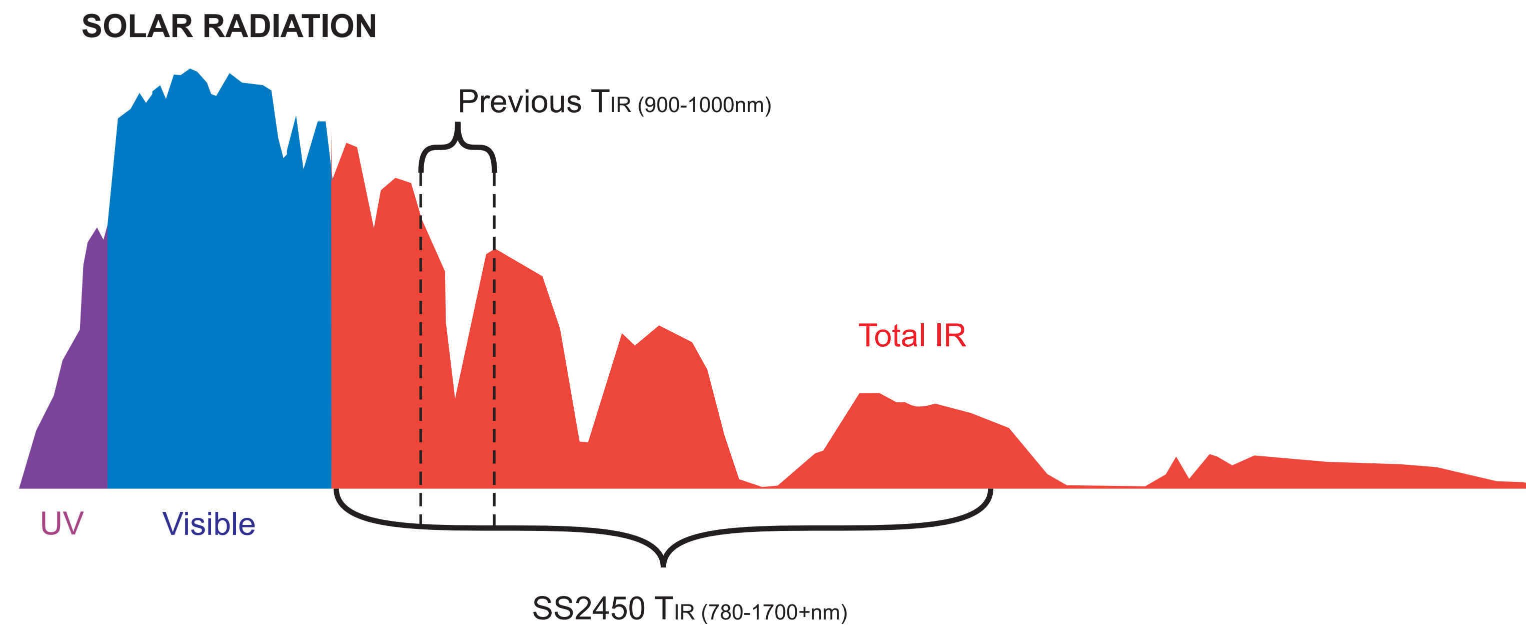
SOLAR RADIATION

The sun produces light energy called solar radiation. Solar radiation contains 3 general forms of light: Ultraviolet (UV), Visible, and Infrared(IR). Ultraviolet radiation is invisible to the human eye and has the shortest wavelengths of the three types mentioned. The UV energy of the sun is broken into categories of UV-C: (100 - 280nm), UV-B: (280 - 315nm) and UV-A: (315 - 380nm). UV-C has the shortest wavelength and is the most harmful. Thankfully it is mostly blocked by the earth's atmosphere. UV-B is the next shortest wavelength and is mostly blocked by traditional float glass that is used to make windows. UV-A energy spans 315 to 380 nm, and is the focus of the UV energy measured by the SS2450 instrument. UV-A energy is typically given the most attention in glazing systems because there is a large variance in the performance of different types of coatings and substrates used for glazing applications. Visible light includes energy from 380 to 780 nm, and as the name implies, is the energy of the sun visible to the human eye. Visible Light is often measured by the photopic spectrum of light energy, which relates to the way the human eye interprets visible light. The infrared radiation spectrum commonly includes energy from 780 to 4000 nm. The infrared spectrum is commonly broken into two spectrums: Far Infrared (2500nm and above) and Near Infrared (780nm to 2500nm). The Far infrared energy is typically referred to as long-wave radiation and is the heat that we feel from a fire or heat source. The Near Infrared energy is considered short-wave radiation and is the energy that is carried by the sun. Near Infrared energy is the focus of the SS2450 instrument because this is the energy that transmits through glass and coatings on windows. There is a LARGE variance in the amount of Near Infrared energy that is allowed to transmit through various glazing systems. Spectrally selective coatings do a much better job of rejecting this Near Infrared energy, thus resulting in lower solar gain values for those glazing systems. The expanded Near Infrared measurement capability of the SS2450 product is one of the primary features that make this instrument one of the most accurate portable devices on the market.



IR TRANSMISSION

The reason there are 2 different IR values displayed on the SS2450 instrument, is to highlight the difference between the two different methods of measuring IR. The TIR(900-1000nm) only gives a small glimpse of the IR range and does not include the fuller IR range. This has been commonly used in the industry to show a small sliver of performance in the IR region. In fact, two of EDTM's existing products that measure IR energy only show this small portion of IR energy (SD2400 & WP4500). This is commonly done because it is an extremely cost-effective method for showing some amount of IR performance. The problem with this method is some users assume that the glazing system will perform the same way throughout the rest of the Near IR region. While this is certainly a possibility, it is not an accurate measurement of the Near IR spectrum, and the assumption will result in misleading performance measurement data. Spectrally selective glazing systems will most frequently be different in the 900-1000nm range, than they are in the fuller Near Infrared spectrum measured by the SS2450 instrument.

DAMAGE WEIGHT

The Tdw (Damage Weight Transmission) values represent the transmission amount for a weighted spectral range that extends over portions of the UV and Visible spectrums. The solar radiation in this spectral range contributes to the damage of materials, through fading and general break-down of fabric structure. This value is used to give an estimation of the amount of fading-causing light that gets transmitted through a window. For example a 80% Tdw will cause more fading then a 20% Tdw. Tdw differs from the Tuv value, as Tuv is only measuring the amount of UV energy transmitting through the glazing system. Tdw includes both visible and UV energy and there is a specific weighting value applied to each wavelength of energy, as they have been determined to contribute to damage of fabrics. A more detailed explanation of Tdw and damage to fabrics can be found on the back page of this manual.

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