Designation: ~~E1918 – 06~~ E1918 – 06 (Reapproved 2015)

Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field[1]

This standard is issued under the fixed designation E1918; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of solar reflectance of various horizontal and low-sloped surfaces and materials in the field, using a pyranometer. The test method is intended for use when the sun angle to the normal from a surface is less than 45°.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E722 Practice for Characterizing Neutron Fluence Spectra in Terms of an Equivalent Monoenergetic Neutron Fluence for Radiation-Hardness Testing of Electronics

E903 Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres

3. Terminology

3.1 *Definitions:*

3.1.1 *low-sloped surfaces*—surfaces with a slope smaller than 9.5°. The roofing industry has widely accepted a slope of 2:12 or less as a definition of low-sloped roofs. This corresponds to a ~~slop~~slope of approximately 9.5° (16.7 %).

3.1.2 *pyranometer*—an instrument (radiometer) used to measure the total solar radiant energy incident upon a surface per unit time and unit surface area.

3.1.3 *solar energy*—the radiant energy originating from the sun. Approximately 99 % of solar energy lies between wavelengths of 0.3 to 3.5 µm.

3.1.4 *solar flux*—for these measurements, the direct and diffuse radiation from the sun received at ground level over the solar spectrum, expressed in watts per square metre.

3.1.5 *solar reflectance*—the fraction of solar flux reflected by a surface.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *solar spectrum*—the solar spectrum at ground level extending from wavelength 0.3 to 3.5 µm.

4. Summary of Test Method

4.1 A pyranometer is used to measure incoming and reflected solar radiation for a uniform horizontal or low-sloped surface. The solar reflectance is the ratio of the reflected radiation to the incoming radiation.

5. Significance and Use

5.1 Solar reflectance is an important factor affecting surface and near-surface ambient air temperature. Surfaces with low solar reflectance (typically 30 % or lower), absorb a high fraction of the incoming solar energy which is either conducted into buildings or convected to air (leading to higher air temperatures). Use of materials with high solar reflectance may result in lower air-conditioning energy use and cooler cities and communities. The test method described here measures the solar reflectance of surfaces in the field.

[1] This test method is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.18 on Nonbituminous Organic Roof Coverings.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

6. Apparatus

6.1 *Sensor*—A precision spectral pyranometer (PSP) sensitive to radiant energy in the 0.28–2.8 µm band is recommended. A typical pyranometer yields a linear output of ±0.5 % between 0 and 1400 $W \cdot m^{-2}$ and a response time of one s. Specific characteristics can be obtained based on calibration by the manufacturer of the pyranometer. Other suitable pyranometers are discussed in Zerlaut.[3] The double-dome design of the PSP minimizes the effects of internal convection resulting from tilting the pyranometer at different angles. For this reason, the PSP is especially suitable for this test, since measurement of solar reflectivity requires the apparatus to alternatively face up and down.

6.2 *Read-Out Instrument*—The analog output from the pyranometer is converted to digital output with a readout meter (such as EPLAB Model 455 Instantaneous Solar Radiation Meter) that has an accuracy of better than ±0.5 % and a resolution of 1 $W \cdot m^{-2}$. The meter shall be scaled to the sensitivity of the specific PSP by the manufacturer of the pyranometer. Alternatively, a precision voltmeter can be used.

6.3 *Pyranometer Stand*—The pyranometer shall be mounted on an arm and a stand that places the sensor at a height of 50 cm above the surface to minimize the effect of the shadow on measured reflected radiation. The arm and stand shall be strong, cast the smallest possible shadow, and allow the pyranometer to be turned upward and downward easily as shown in Fig. 1.

7. Sampling, Test Specimens, and Test Units

7.1 The test method described here applies to large (circles with at least four metres in diameter or squares four metres on a side), homogeneous, low-sloped surfaces, such as roofs, streets, and parking lots. The measurements shall be performed on dry surfaces.

8. Calibration and Standardization

8.1 The pyranometer shall be checked to ensure its accuracy. Most pyranometers are precalibrated by manufacturers. It is a good practice to recalibrate the pyranometer as specified by the manufacturer (typically once every year or two years). Recalibration is done by the manufacturer of the pyranometer.

9. Procedure

9.1 Cloud cover and haze significantly affect the measurements. The tests shall be conducted on a clear sunny day with no cloud cover or haze during the individual measurements. See Annex A1 for guidelines on determination of the suitability of the atmospheric conditions for conducting the tests.

9.2 The test shall be done in conditions where the angle of the sun to the normal from the surface of interest is less than 45°. For flat and low-sloped surfaces, this limits the test to between the hours of 9 a.m. and 3 p.m. local standard time; this is when solar radiation is at least 70 % of the value obtained at solar noon for that day. In winter months (when solar angle is low), perform the tests between hours 10 a.m. and 2 p.m.

[3] Zerlaut, G., "Solar Radiation Instrumentation," *Solar Resources*, R.L. Hulstrom, ed., MIT Press, Cambridge, MA, 1989, pp. 173–308.

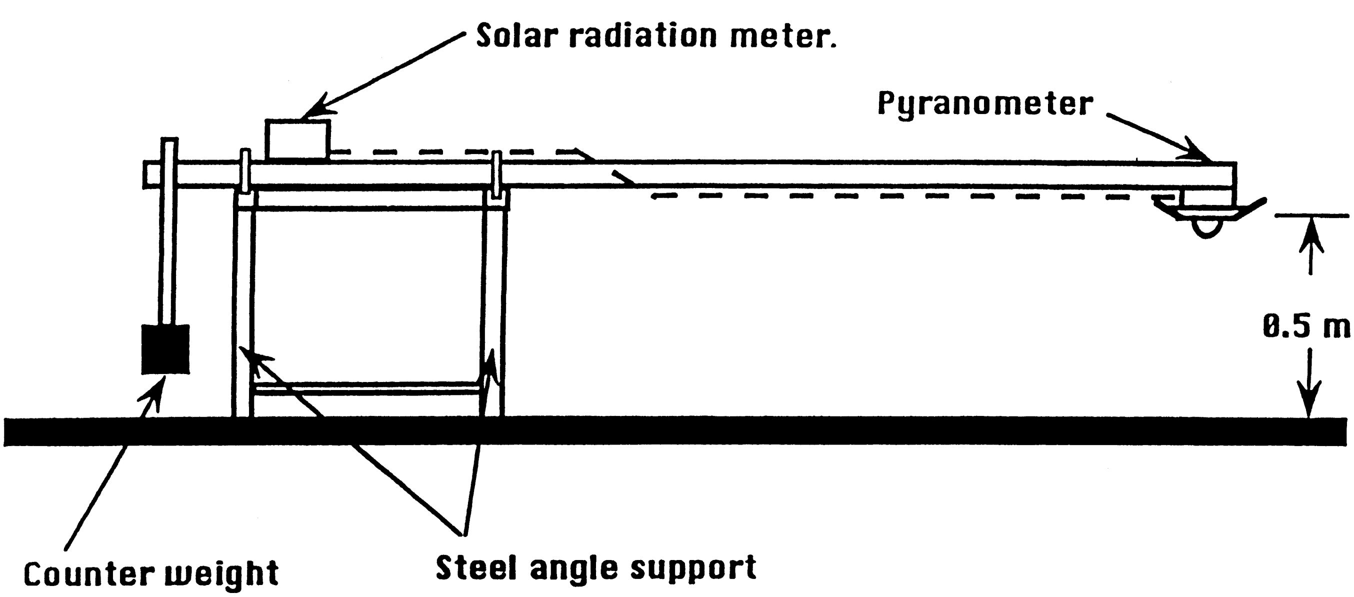

FIG. 1 Schematic of the Pyranometer and its Stand