



Standard Test Method for Calibration of Reference Pyranometers With Axis Tilted by the Shading Method¹

This standard is issued under the fixed designation E 941; 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.

INTRODUCTION

Accurate and precise measurements of the total global (hemispherical) irradiance of sunlight are required in (a) the determination of the energy available to flat plate solar collectors, (b) the assessment of irradiance and radiant exposure in the testing of solar and nonsolar-related materials technologies, and (c) the assessment of the direct solar versus diffuse sky components for energy budget analysis, geographic mapping of solar energy, and as an aid in the determination of the concentration of aerosol and particulate pollution, and water vapor effects.

The method described herein requires calibration to the World Radiation Reference Scale (also known as the Absolute Radiometric Scale); traceability to the International Pyrheliometric Scale of 1956 shall not be permitted.

The intercomparison of absolute radiometers, on which the Absolute Radiation Scale depends, is covered by procedures adopted by the World Meteorological Organization (Geneva) and by various U. S. intercomparisons, chief among which are the New River intercomparisons of absolute cavity polar pyrheliometers held on Nov. 1 to 3, 1978. These intercomparison procedures are not covered by this test method.

Although meteorological surveys require calibration of pyranometers oriented with axis vertical, applications associated with flat plate collectors and the study of the solar exposure of related materials require calibrations of instruments tilted at predetermined nonvertical orientations. These calibrations at fixed tilt angles have applications which seek state-of-the-art accuracy requiring the use of cosine, tilt, and azimuth corrections.

1. Scope

1.1 This test method covers all pyranometers having calibrations sensitive to tilt.

1.2 This test method combines measurement and calculation, yielding calibration factors derived from many measurements and identified with either a single tilt angle or at normal incidence with one or only a few specific angles of tilt.

1.3 This test method is applicable to reference pyranometers regardless of the radiation receptor employed.

1.4 Two types of calibrations are covered: Type I employs a self-calibrating pyrheliometer, and Type II calibrations employ a secondary reference pyrheliometer as the standard instrument.

1.5 This test method provides for calibration at fixed south facing tilts from the horizontal with instrument constant data obtained at various angles of incidence throughout the day at that tilt.

1.6 Calibration of reference pyranometers may be performed by a method in which the axis of the sensitive element is aligned with the sun during the shading disk test. This procedure avoids the effect of cosine errors, but emphasizes the importance of tilt corrections.

1.7 The calibration of reference pyranometers at horizontal, that is, with axis vertical, is covered in another ASTM standard (see Section 2).

1.8 This test method is applicable only to calibration procedures using light from the sun.

2. Referenced Documents

2.1 ASTM Standards:

E 44 Definition of Terms Relating to Heat Treatment of Metals²

E 772 Terminology Relating to Solar Energy Conversion³

E 816 Method for Calibration of Secondary Reference Pyrheliometers and Pyrheliometers for Field Use⁴

¹ This test method is under the jurisdiction of ASTM Committee G-3 on Durability of Nonmetallic Materials and is the direct responsibility of Subcommittee G03.09.

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² Annual Book of ASTM Standards, Vol 01.02.

³ Annual Book of ASTM Standards, Vol 12.02.

⁴ Annual Book of ASTM Standards, Vol 14.04.

