



Standard Tables for References Solar Spectral Irradiance at Air Mass 1.5: Direct Normal and Hemispherical for a 37° Tilted Surface¹

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INTRODUCTION

These tables use the revised (1)² extraterrestrial spectrum of Neckel and Labs (2). In addition, refinements were made to the calculation of atmospheric absorption and scattering in the computer code (3, 4) used to calculate the spectrum. These refinements consist of a change in the depolarization factor in the Rayleigh scattering calculation, a more accurate sampling technique for calculating scattered irradiance, and a better choice of wavelengths to perform the calculations.

1. Scope

1.1 These tables cover an air mass 1.5 solar spectral irradiance distribution for use in all terrestrial applications in which a standard reference spectral irradiance is required for the direct component of solar irradiance and hemispherical solar irradiance, consisting of both the diffuse and direct components, that is incident on a sun-facing, 37°-tilted surface.

1.2 An air mass of 1.5, a turbidity of 0.27, and a tilt of 37° (for the hemispherical spectral irradiance tables) were chosen for this standard because they are representative of average conditions in the 48 contiguous states of the United States. In real life, a large range of atmospheric conditions can be encountered, resulting in more or less important variations in atmospheric extinction. Thus, considerable departure from the present reference spectra might be observed depending on time of the day, geographical location, and other fluctuating conditions in the atmosphere.

1.3 These tables are an editorial revision of Tables E 891 and Tables E 892, that have been combined. This action has been taken to make the reference solar spectral energy standards harmonious with ISO 9845-1:1992, that was itself based wholly on Tables E 891 and Tables E 892 with respect to the tables of spectral irradiance values. The tables contained here are identical to those contained in Tables E 891 and E 892.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

E 490 Solar Constant and Air Mass Zero Solar Spectral Irradiance Tables³

E 772 Terminology Relating to Solar Energy Conversion⁴

E 891 Tables for Terrestrial Direct Normal Solar Spectral Irradiance for Air Mass 1.5⁵

E 892 Tables for Terrestrial Solar Spectral Irradiance at Air Mass 1.5 for a 37° Tilted Surface⁵

2.2 ISO Standard:

ISO 9845-1:1992(E) Solar Energy - Reference Solar Spectral Irradiance at the Ground at Different Receiving Conditions - Part 1: Direct Normal and Hemispherical Solar Irradiance for Air Mass 1.5⁶

3. Terminology

3.1 Definitions (from Terminology E 772):

3.1.1 *air mass (AM)*—ratio of the mass of atmosphere in the actual observer-sun path to the mass that would exist if the observer were at sea level, at standard barometric pressure, and the sun were directly overhead.

3.1.1.1 *Discussion*—(Sometimes called air mass ratio.) Air mass varies with the zenith angle of the sun and the local barometric pressure, that changes with altitude. For sun zenith Z , of 62° or less, and local atmospheric pressure, P , where P_O is standard atmospheric pressure, $AM \cong (P/P_O)\sec Z$.

3.1.2 *solar irradiance, diffuse, $E_{s,d}$* —downward scattered solar flux is received on a horizontal surface from a solid angle of 2π -steradian (hemisphere) with the exception of a conical solid angle with a 100 mrad (approximately 6°) included plane angle centered upon the sun's disk.

¹ These tables are under the jurisdiction of ASTM Committee G-03 on Weathering and Durability and is the direct responsibility of Subcommittee G03.09 on Radiometry.

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² The boldface numbers given in parentheses refer to the list of references at the end of the text.

³ *Annual Book of ASTM Standards*, Vol 15.03.

⁴ *Annual Book of ASTM Standards*, Vol 12.02.

⁵ *Annual Book of ASTM Standards*, Vol 14.04.

⁶ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.