



Designation: E 308 – 99

Standard Practice for Computing the Colors of Objects by Using the CIE System¹

This standard is issued under the fixed designation E 308; 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.

This standard has been approved for use by agencies of the Department of Defense.

INTRODUCTION

Standard tables (Tables 1-4) of color matching functions and illuminant spectral power distributions have since 1931 been defined by the CIE, but the CIE has eschewed the role of preparing tables of tristimulus weighting factors for the convenient calculation of tristimulus values. There have subsequently appeared numerous compilations of tristimulus weighting factors in the literature with disparity of data resulting from, for example, different selections of wavelength intervals and methods of truncating abbreviated wavelength ranges. In 1970, Foster et al. (1)² proposed conventions to standardize these two features, and Stearns (2) published a more complete set of tables. Stearns' work and later publications such as the 1985 revision of E 308 have greatly reduced the substantial variations in methods for tristimulus computation that existed several decades ago.

The disparities among earlier tables were largely caused by the introduction of computations based on 20-nm wavelength intervals. With the increasing precision of modern instruments, there is a likelihood of a need for tables for narrower wavelength intervals. Stearns' tables, based on a 10-nm interval, did not allow the derivation of consistent tables with wavelength intervals less than 10 nm. The 1-nm table must be designated the basic table if others with greater wavelength intervals are to have the same white point, and this was the reason for the 1985 revision of E308, resulting in tables that are included in the present revision as Tables 5.

The 1994 revision was made in order to introduce to the user a method of reducing the dependence of the computed tristimulus values on the bandpass of the measuring instrument, using methods that are detailed in this practice. These changes, however, lead to tables (Tables 6 in this practice) that are substantially different from the Tables 5 that have been in use since 1985. There is accordingly a danger, if the new tables are introduced but not universally adopted, that there may again be, perhaps for several decades, a significant disparity among the tables of tristimulus weighting factors commonly used. It is highly desirable that this should be avoided.

1. Scope

1.1 This practice provides the values and practical computation procedures needed to obtain CIE tristimulus values from spectral reflectance, transmittance, or radiance data for object-color specimens.

1.2 Procedures and tables of standard values are given for computing from spectral measurements the CIE tristimulus values X , Y , Z , and chromaticity coordinates x , y for the CIE 1931 standard observer and X_{10} , Y_{10} , Z_{10} and x_{10} , y_{10} for the CIE 1964 supplementary standard observer.

1.3 Standard values are included for the spectral power of

six CIE standard illuminants and three CIE recommended fluorescent illuminants.

1.4 Procedures are included for cases in which data are available only in more limited wavelength ranges than those recommended, or for a measurement interval wider than that recommended by the CIE. This practice is applicable to spectral data obtained according to Practice E 1164 with 1-, 5-, 10-, or 20-nm measurement interval.

1.5 Procedures are included for cases in which the spectral data are, and those in which they are not, corrected for bandpass dependence. For the uncorrected cases, it is assumed that the spectral bandpass of the instrument used to obtain the data was approximately equal to the measurement interval and was triangular in shape. These choices are believed to correspond to the most widely used industrial practice.

1.6 This practice includes procedures for conversion of results to color spaces that are part of the CIE system, such as CIELAB and CIELUV (3). Equations for calculating color

¹ This practice is under the jurisdiction of ASTM Committee E-12 on Color and Appearance and is the direct responsibility of Subcommittee E12.04 on Color and Appearance Analysis.

Current edition approved June 10, 1999. Published October 1999. Originally published as E 308 – 66. Last previous edition E 308 – 96.

² The boldface numbers in parentheses refer to the list of references at the end of this practice.