



Light sources and illuminants

The difference between the terms “light source” and “illuminant” causes a lot of confusion in everyday work in the industry. Even if the term is clear, there is a profound uncertainty when it comes to choosing the correct indices for colour evaluation.

This document shall help you selecting the correct indices for your application.

Q: Is there a difference between a light source and an illuminant?

A: Yes, there is!

By the term “light source” we describe any object that emits “light” (relative energy distribution in the visible spectrum app. 380 - 780nm). The quality and energy of this light is not described and can vary; sunlight for example will vary in its appearance during the day and time of year as well as with the weather. Thus, a “light source” is not reliably mathematically described or technically reproducible and not suited for colorimetric characterization.

To have a reliable, consisting description of a light source, the CIE (Commission Internationale de l’Eclairage) evaluated and agreed upon binding standards for different types of light sources. These reproducible light sources are named “illuminants” and represent the mathematical tables of values (relative energy versus wavelength) used for colorimetric calculations.

Among these are descriptions for types of daylight, fluorescent lamps or special light sources.

Q: Are the values of the illuminants binding or can they change from one software to another?

A: The values are industry standard and binding for each manufacturer!

Each Manufacturer of technical equipment referencing to the CIE illuminants has to refer to the technical values defined in the CIE tables for each illuminant.

As an example, you might take a look at <http://files.cie.co.at/204.xls> to receive the values for illuminants D65 and A. If you are interested in the complete list of illuminant values, please contact the CIE under www.cie.co.at in order to purchase the latest CIE tables.

Q: Which is the correct illuminant for my application or product?

A: This depends and may vary from application to application...

For example: the CIE standard and industry standard for daylight is D65, but in the printing industry and graphic arts, the commonly used daylight illuminant is D50. In other applications, e.g. in the presentation of materials under fluorescent lamps, daylight might not play the major role but TL84 is the primary illuminant to evaluate your samples with. If you are not sure, please clarify the requirements with your customer or technical department.

The following pages give you some details about the most important illuminants used.

Technical CIE illuminants reference list

General:

As a general rule, all illuminants are compared against the spectral energy distribution of the so called blackbody radiator, an artificial temperature radiator that radiates light with a specific color at defined temperatures, unit [K]. While this is supposed to be a reference for incandescent lamps, it is often used as a reference for other light sources as well.

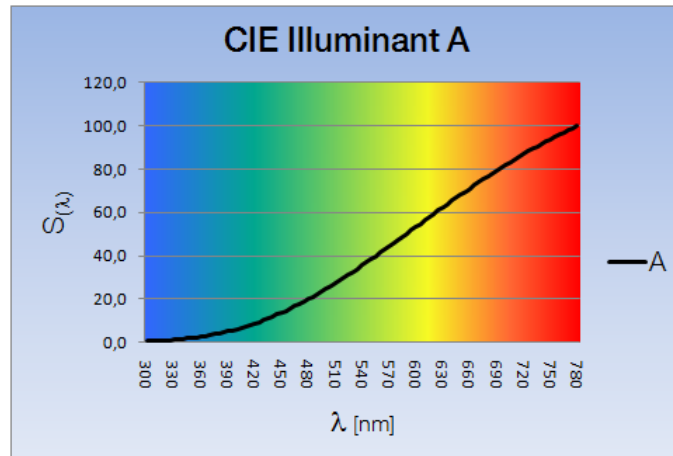
Please keep in mind that for all others (e.g. the D-illuminants) these values are relative and defined with a “correlated color temperature” (CCT).

Additional information about CIE illuminants can be found in CIE 15:2018.

CIE Standard illuminants

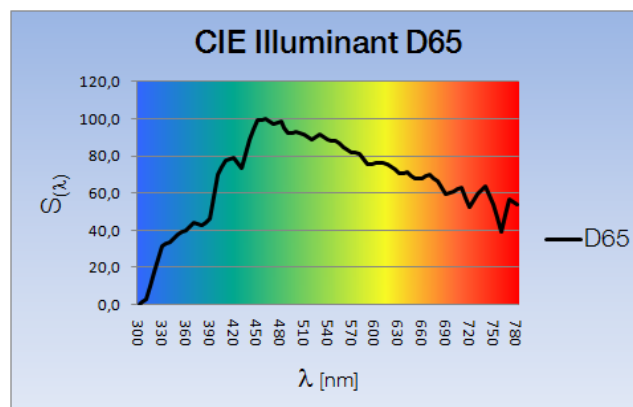
Incandescent / tungsten lamps

A: defined in 1931 as a CIE “standard illuminant”, illuminant A is intended to represent typical, domestic, tungsten-filament lighting. Its relative spectral power distribution is that of a Planckian radiator at a temperature of approximately 2856K.



CIE Standard Daylight illuminant:

D65: defined in 1964, CIE D65 has become today’s standard daylight (average noon daylight from the northern sky) reference for the industry for various applications with a CCT of 6504K; described and referenced in ISO 3668, ISO 11664-2, ASTM 1729 and DIN6173-2

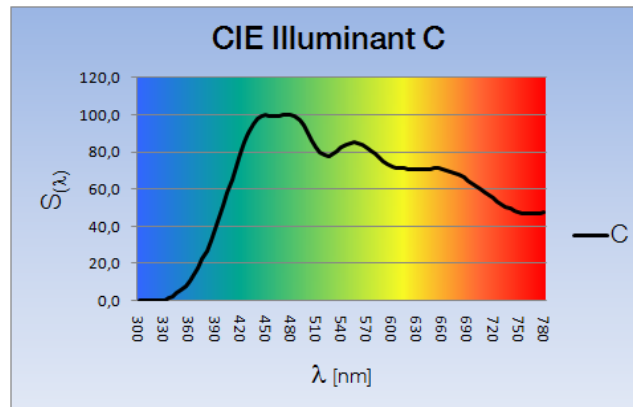


By definition, the CIE and ISO state that the “CIE standard illuminant D65 should be used in all colorimetric calculations requiring representative daylight, unless there are specific reasons for using a different illuminant.” (ISO 11664-2:2010(E)/CIE S 014-2/E:2006)

Daylight illuminants:

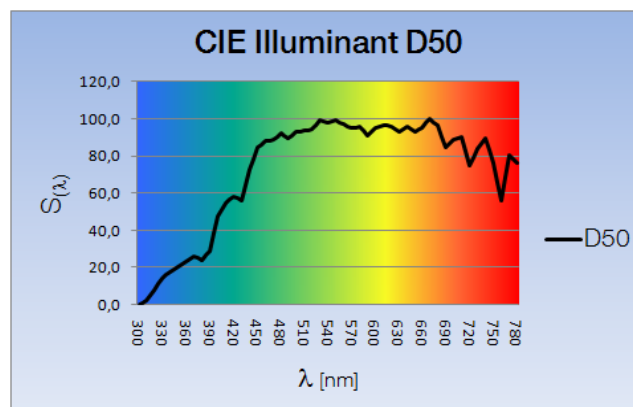
Illuminants that represent daylight conditions; the ones most widely in use today are:

- C:** old standard for average daylight from the northern sky, defined in 1931 by the CIE with a CCT of 6774K; has a significant lower UV content than the D-types; does not have CIE status of “standard illuminant” anymore



- D50:** first defined in 1974, and in 1975 certified by the ISO:3664, this daylight illuminant is the reference for the printing and graphic arts industry, CCT 5003K (ISO revised in 2009);

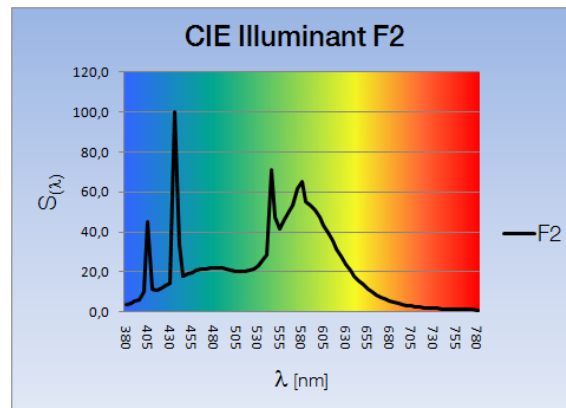
Note: CIE D50 does not have CIE status of “CIE standard illuminant”



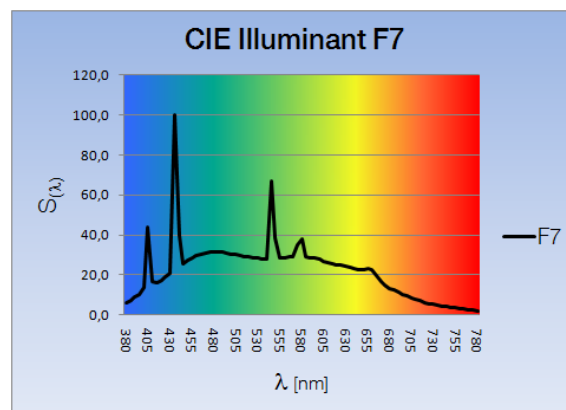
Fluorescent lamps

12 fluorescent lamp types were defined by the CIE, named F1-F12, being different in the combinations of gases used and phosphors they are covered with. Among these 12, three are most commonly used in the industry and as such, are most important for colorimetric evaluations.

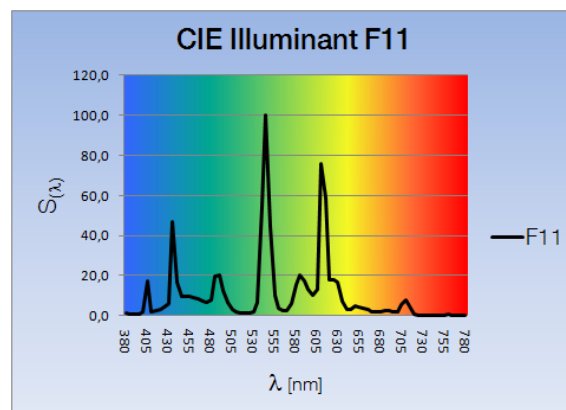
F2: also named “CWF” (cool white fluorescent), these lamp types have a CCT of 4230K and make up a majority of typical office illumination



F7: broad-band fluorescent lamp, approximation of D65 with a CCT of 6500K



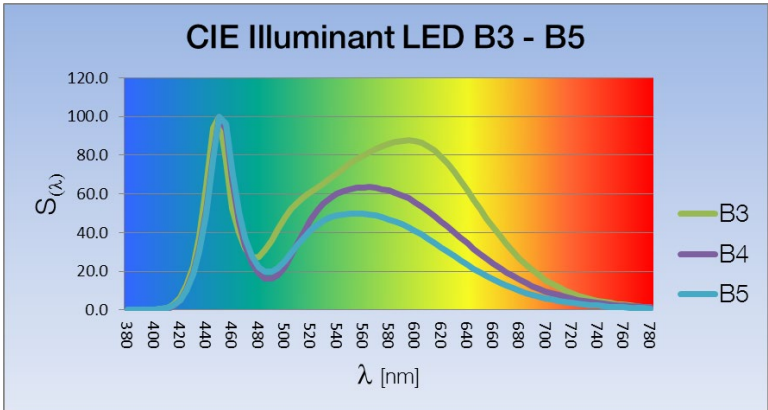
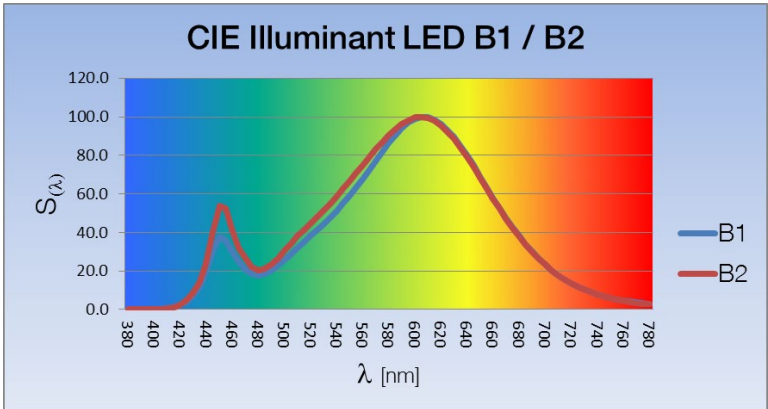
F11: also known under the name **TL84**, this fluorescent narrow tri-band type resembles or is mostly used as warehouse lighting and has a CCT of 4000K



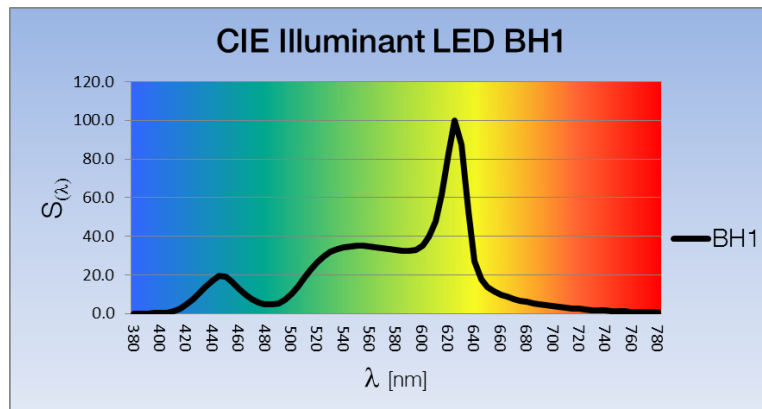
Light emitting diodes (LEDs) illuminants

In its fourth edition of CIE 15 (CIE15:2018 “Colorimetry, 4th Edition”) the CIE presents recommendations for the most commonly used white LED light sources in the market at the time of its publishing. It must be noted that these LED illuminants are averages of common white types used in the market and were created after several years of studies and clustering of CIE TC 1-85.

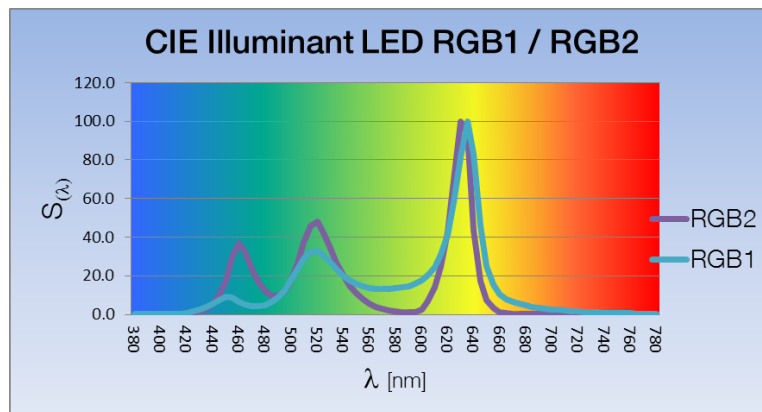
LED-B1 - B5 Illuminants LED-B1, LED-B2, LED-B3, LED-B4, and LED-B5 are the representative illuminants for phosphor-converted blue LEDs.
(CCTs: B1: 2733K / B2: 2998K / B3: 4103K / B4: 5109K / B5: 6598K)



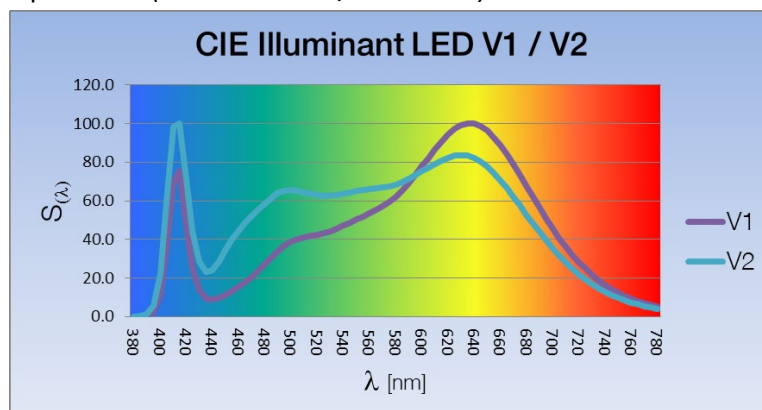
LED-BH1: LED-BH1 is the representative illuminant for white hybrid-type LEDs. Hybrid Whites consist of a mixing of phosphor converted blue LED and red LED. (*CCT: 2851K*)



LED-RGB1/2: Illuminant LED-RGB1 and LED-RGB2 represent typical spectral shapes for mixing of red, green, and blue LEDs. (*CCT RGB1: 2840K / RGB2: 4959K*)



LED-V1/V2: LED-V1 and LED-V2 represent typical spectra shapes for phosphor-converted violet-pumped LEDs. (*CCT V1: 2724K / V2: 4070K*)



Contact list

We hope this information helps you to identify your needs.

If you need additional support or information, please contact your local Konica Minolta Branch office or vendor.

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