



### **The chromatic characteristic of light**

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#### Two ways of seeing

In order to describe the chromatic proprieties of a light source two measurement systems are usually used: the "colour temperature", which indicates the chromatic appearance of light itself and the "colour representation index" (RA) which suggests how an object illuminated by that light will appear in relation to the way in which it appears when it is illuminated by the reference light source. Both features can be extremely useful in evaluating and prescribing light sources, but it is important to understand their limits too.

#### Colour temperature: the appearance of light

The colour temperature of a light source is a numerical measurement of its chromatic appearance. It is based on the principle that any object, if heated to a sufficiently high temperature, emits light and the colour of that light will vary in a predictable way as the temperature increases. The system is based on the changes of colour of a theoretical "radiating blackbody", heated and brought from a condition of cold black to that of incandescent white. As the temperature increases, the blackbody goes from red to orange, to yellow, to white and finally to bluish white. The colour temperature of a light source is the temperature, expressed in Kelvin degrees (K), at which the blackbody colour will correspond exactly to that of the light source. For many light sources it is not possible to obtain a perfect correspondence. In these cases, the nearest correspondence is referred to and the colour is described as correlated colour temperature. For instance, a fluorescent tube with a temperature colour of 4000 K has a chromatic appearance similar to that of a blackbody heated to 4000 K (3727°C).

#### Heat and cold: the psychology of light

Some people get confused by the fact that light sources with low colour temperatures are defined "warm", while those with higher temperatures are defined "cold". Indeed, these descriptions have nothing to do with the temperature of the radiating blackbody, but they refer to the way in which colour groups are perceived, that is the psychological impact of illumination. Colours and light sources in the blue range of the spectrum are indicated as cold and those in the red/orange/yellow range as warm.

#### The effect of light on the colour of objects

The colour representation index (RA) is a system derived from experiments on vision aimed at evaluating the impact exerted by different light sources on the perceived colour of objects and surfaces. The first step is that of identifying the colour temperature of the given light source. The next stage is related to the illumination of eight standard sample colours, first at the light of the light source being examined, then at that of a blackbody brought to the same

colour temperature. If none of the samples changes its chromatic appearance, the light source is assigned an Ra index of 1000. Any other chromatic change is assigned a lower score. Any Ra index equal to or higher than 80 is normally considered high and it indicates that source has good colour representation proprieties.

### Colour temperature and Ra index

The colour temperature and the Ra index offer valid information on the chromatic quality of the light source, but are not perfect. Colour temperature, for instance, does not provide any indication on how a specific light source will render the colours. Let us try to imagine two light sources of the "cold" type with similar colour temperatures and chromatic appearances. Let us imagine that source B produces a similar spectrum without, however, the light in the red range. The red objects, which appears natural under source A will have, instead, a neutral, colourless aspect under source B even though both lights have the same colour temperatures. Generally speaking, a high Ra index means that a light source will render colours well. However, given the fact that Ra indexes are calculated for light sources at a specific colour temperature, it does not make any sense to compare a 2700 K light source with an Ra index of 85 to one at 4000 K with an Ra index of 85. Moreover, it is important to remember that the Ra index is the average of eight different colours. This means that a light source with a high Ra index will tend to render well a wide colour spectrum, but does not guarantee the natural appearance of a specific colour. Used together, however, these indexes constitute an excellent reference to compare light sources.

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