20 lumens / watt from tungsten lamps.

BBC ETD
INFORMATION SHEET

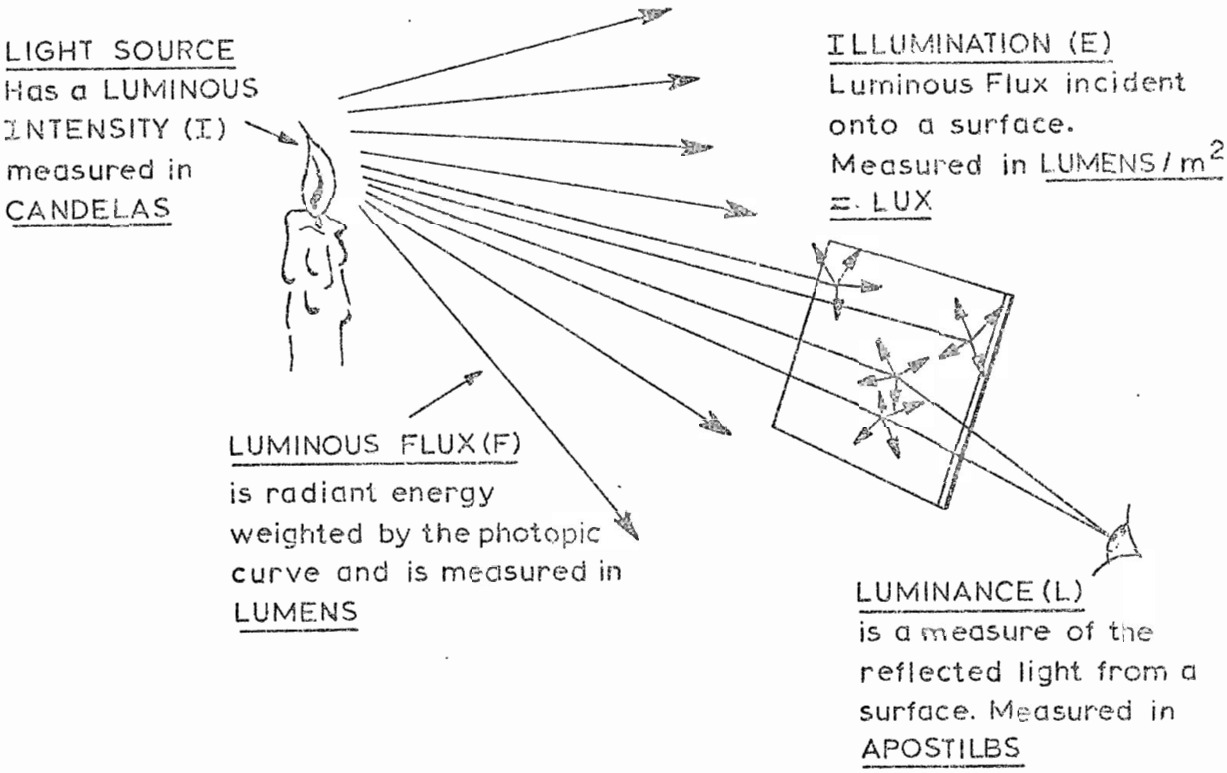
LIGHTING FOR TELEVISION

MEASUREMENT OF LIGHT

In colour television the two light measurements taken are i) Quantity and ii) Quality.

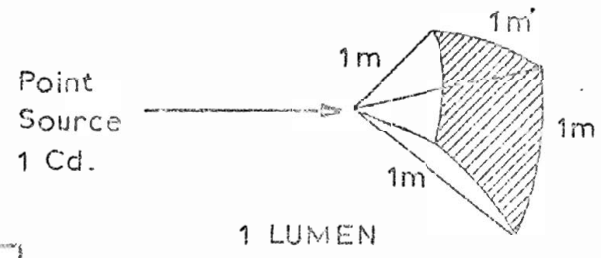
(i) QUANTITY

The original light units were derived by making a visual comparison to a standard light source. All light measurements should therefore be made with meters which have a photopic response. The various light units used may be summarised as:-



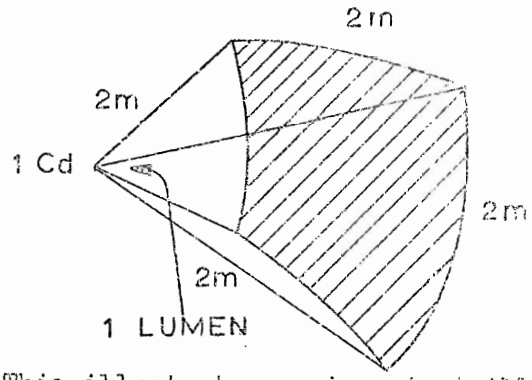
The Candela has a luminous intensity approximately equal to the original standard candle.

The Lumen is the luminous flux emitted into unit solid angle from a point source of 1 Candela.



The illumination of the shaded surface is 1 lumen/m^2 = 1 LUX

If the distance is doubled:-



The illumination of the shaded area surface is 1 lumen per 4 sq. meters or .25 lumen/m^2 = .25 LUX

This illustrates an important illumination law:-

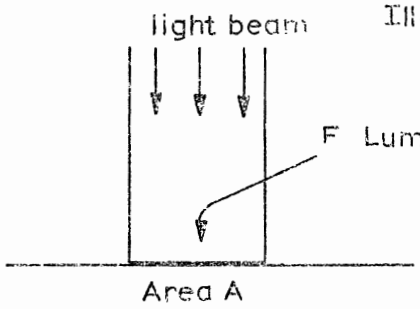
Illumination $E \propto \frac{1}{(\text{distance from the source})^2} \propto \frac{1}{d^2}$

or $E = \frac{1}{d^2}$

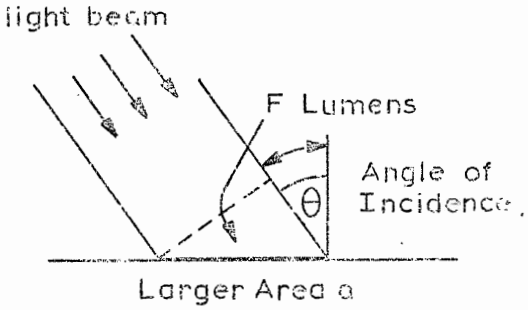
also $E = \frac{\text{Total Incident Flux}}{\text{Area}} = \frac{F}{A}$

These formulae are further modified by the Cosine Law of Illumination.

Illumination $\propto$ Cos (angle of incidence)



Illumination $= \frac{F}{A}$ lux



Illumination $= \frac{F}{a}$ Lux

But $\frac{A}{a} = \text{Cos}\,\theta$

Illumination $= \frac{F}{A}\,\text{Cos}\,\theta$ Lux

$= \frac{I}{d^2}\,\text{Cos}\,\theta$ Lux

The unit of LUMINANCE is the APOSTILB. It is a measure of the light reflected from a surface. A surface which reflects a total flux of 1 lumen/m^2 has a LUMINANCE of 1 APOSTILB.

If ρ = coefficient of reflection for a surface.

Then LUMINANCE (L) = ρE. APOSTILBS.

(ii) QUALITY

The quality i.e. colour, of a light source is determined by the distribution of radiant flux within the visible spectrum.

This can be defined either by a spectral distribution curve (graph of relative energy v. wavelength) or by comparing the colour of the source to the colour of an ideal incandescent body (black body). The temperature of the ideal incandescent body that gives a matching colour to that of the source is called the colour temperature of the source. Colour temperature is measured in degrees Kelvin (C^{o} + 273) and some typical values are:-

Standard candle	1930°K
Gas filled tungsten lamp	2760°K
Photographic lamp	3200°K
Projection bulb	3200°K
Photoflood	3400°K
Warm fluorescent tube	3500°K
Flash-bulb	3800°K
Plain carbon arc	3800°K
Blue-coated flashbulb	6000°K
H.I. Carbon arc (Sun arc)	6000°K
Electronic flash tube	6000°K
Xenon lamp	6000°K
Average daylight	6500°K
Blue sky	12000 - 18000°K

If the source is incandescent, e.g. a tungsten lamp, then the colour temperature will also give a fairly accurate indication of the spectral distribution curve for the source. With other types of light source, e.g. fluorescent lamp, the colour temperature is an indication of appearance only and gives no information about the spectral distribution curve of the source.

Fig. 1 shows spectral distribution curves for some typical light sources and Fig. 2 spectral distribution curves of incandescent sources for a range of colour temperatures.

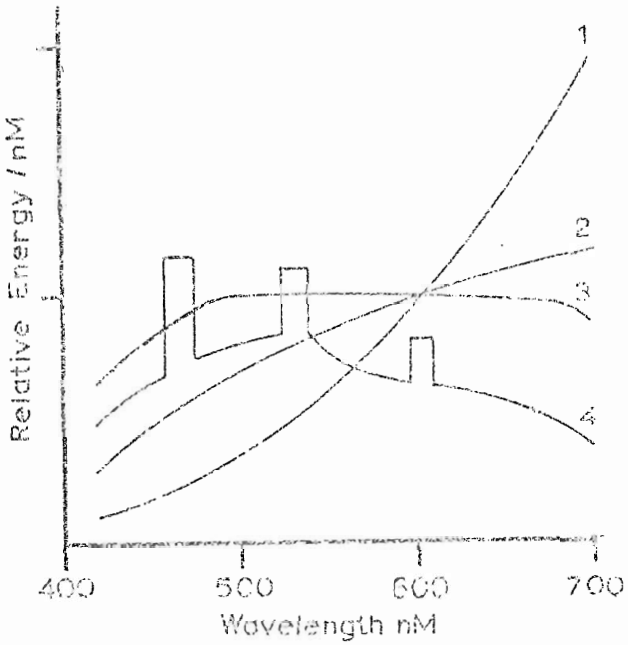


Fig 1 Energy distribution of typical light sources

1. TUNGSTEN LAMP
2. ARC LAMP
3. SUNLIGHT
4. FLUORESCENT LAMP

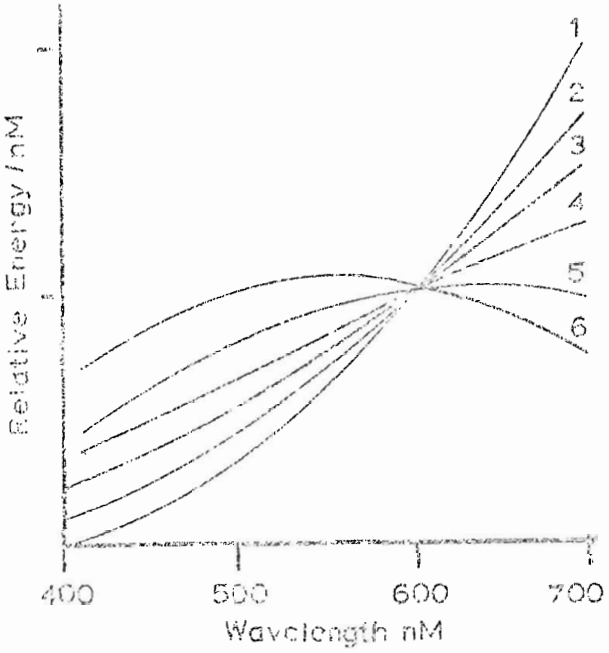


Fig 6 Relative energy distribution of "black body" at various temperatures

1. 2500°K
2. 3000°K
3. 3500°K
4. 4000°K
5. 5000°K
6. 5500°K

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