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Photography — Illumination conditions for viewing colour transparencies and their reproductions

Photographie — Conditions d'éclairement pour l'examen visuel des diapositives en couleurs et de leurs reproductions

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FOREWORD

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Australia	Germany	Sweden
Austria	Ireland	Switzerland
Belgium	Italy	Turkey
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No Member Body expressed disapproval of the document.

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Photography — Illumination conditions for viewing colour transparencies and their reproductions

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of

1) transparency illuminators (i.e. devices for uniformly and diffusely illuminating a transparency from behind so that it may be viewed directly) for use in viewing photographic colour transparencies under conditions of comparison with other reflection or transmission originals or reproductions;

2) transparency illuminators for use in direct viewing of photographic colour transparencies without reference to other originals or reproductions;

3) illumination for use in viewing reflection colour prints or reproductions when they are compared with photographic colour transparencies.

2 REFERENCES

ISO 5, *Photography — Diffuse transmission density.*

CIE Publication No. 13.2 [TC-3.2 (1974)], *Method of measuring and specifying colour rendering properties of light sources.*

CIE Publication No. 15 [E-1.3.1 (1971)], *Colorimetry.*

CIE Publication No. 17 [E-1.1 (1970)], *International lighting vocabulary.*

3 TRANSPARENCY ILLUMINATOR SPECIFICATIONS FOR COMPARISON VIEWING

3.1 Chromaticity

The chromaticity of the illuminator surface shall be approximately that of CIE Illuminant D_{50} representing a phase of natural daylight having a correlated colour temperature close to 5 000 K. The chromaticity co-ordinates of the illuminator surface shall lie on the locus of chromaticities corresponding to daylight illuminants at a co-ordinate position of $x = 0{,}345\ 7$, $y = 0{,}358\ 6$, in the CIE 1931 chromaticity diagram, or $u = 0{,}209\ 1$, $v = 0{,}325\ 4$ in the CIE 1960 USC diagram. The tolerances for variation about this co-ordinate position shall be described by a circle having radius 0,008 in the CIE 1960 USC diagram or the corresponding approximate ellipse represented in the CIE 1931 chromaticity diagram. That circle corresponds to a variation in correlated colour temperature of approximately 20 micro reciprocal degrees (mireds). For simultaneous viewing on more than one transparency illuminator, there shall, ideally, be no perceptible chromatic differences among the luminous surfaces.

3.2 Spectral power distribution

The spectral power distribution of the transparency illuminator surface shall, ideally, be the same as that of CIE Illuminant D_{50} over a spectral range from 300 nm to 830 nm computed at 10 nm intervals as tabulated in the table on page 4.

The spectral power distribution of the transparency illuminator surface is given here but no specification can be set forth for the light source (or lamp) because

a) the light from the source may be modified by the apparatus;

b) the required spectral power distribution may be obtained from a mixture of light from two or more different sources.

Tolerances for acceptable variations in the spectral power distribution of the transparency illuminator surface are set forth below in terms of the CIE general colour rendering index.

3.3 General colour rendering index

The CIE general colour rendering index of the transparency illuminator surface shall be measured as specified in CIE Publication No. 13.2 and shall have a value of 90 or higher. In addition, the separate special colour rendering indices for samples 1 to 8 shall each have a value of 80 or higher.

3.4 Luminance

The average luminance of the illuminator surface shall be $1\ 270 \pm 320\ cd \cdot m^{-2}$ as measured with a luminance meter normal to the surface. The average luminance shall be determined as the quotient of the sum of nine measurements divided by nine. These nine measurements shall be made in the centre of each of nine distinct regions each having a height and width equal to 1/3 of the height and width of the illuminated surface. Luminance are to be obtained with meters either having a spectral response function identical with the values tabulated for spectral luminous efficiency function for the CIE standard photometric observer, as given in CIE Publication No. 17,

page 51, table 1, or with a response calibrated in terms of integration with respect to that function with the light source under test. Any variations from complete uniformity of surface (viewing field) luminance shall be gradual and shall be such that the luminance in the centre of any one of the nine regions is not less than 75 % of the maximum luminance measured in any other.

3.5 Diffusion characteristics

The transparency illuminator surface shall provide diffuse light such that the luminance of the surface measured at any angle between 0 and 45° from normal shall not be less than 90 % of the luminance of the same area as measured normal (0°) to the surface.

3.6 Borders

The transparency shall be illuminated from behind by diffuse light and shall be surrounded by an illuminated area at least 50 mm in width on at least three sides. The surround shall appear to be evenly illuminated and the average illumination shall not be less than one-half of the maximum in the viewing field. The purpose of the illuminated border is to influence the appearance of a transparency so as to facilitate comparison with a reflection print. When the transparencies or transparency being viewed occupy an area less than 70 mm by 70 mm, then the illuminated surround shall not be greater in extent than four times the area of the transparencies or transparency being viewed. Any illuminated area in excess of this shall be covered with mid-grey opaque material. A transparency mounted with an opaque border may be viewed mounted if the whole occupies an area less than 70 mm by 70 mm.

4 TRANSPARENCY ILLUMINATOR SPECIFICATIONS FOR DIRECT VIEWING

The specifications for illuminators intended for use in direct viewing of transparencies without reference or comparison with other reproductions shall be the same in all respects as 3.1 to 3.6 except that in 3.6 the border area shall have superimposed upon it a neutral density mask having diffuse transmission density of 1,0 ± 0,1 as determined by the method given in ISO 5. The spectral transmittance and reflectance distribution of the mask shall be such that no change in chromaticity results beyond the chromaticity tolerance set forth in 3.1 and shall be chosen to be as spectrally non-selective as possible. This partially transparent border is preferred and specified rather than

a) the completely illuminated border of 3.6, because it is not desirable in direct viewing of transparencies to influence their appearance to facilitate comparison with reflection prints;

b) an opaque border since it is desirable to provide the observer with a fixed neutral reference, i.e. to permit the standard illuminator light flux to control visual adaptation rather than the variably chromatic flux transmitted by the transparency images.

5 ILLUMINATION SPECIFICATIONS FOR COMPARISON VIEWING OF REFLECTION PRINTS

5.1 Chromaticity

The chromaticity of the illumination incident upon the reflection sample shall be approximately that of CIE Illuminant D_{50} representing a phase of natural daylight having a correlated colour temperature close to 5 000 K. The chromaticity co-ordinates of such illumination shall lie on the locus of chromaticities corresponding to daylight illuminants at a co-ordinate position of $x = 0{,}345\,7$, $y = 0{,}358\,6$, in the CIE 1931 chromaticity diagram or $u = 0{,}209\,1$, $v = 0{,}325\,4$ in the CIE 1960 USC diagram. Tolerances for variation about this co-ordinate position shall be described by a circle having a radius of 0,008 in the CIE 1960 USC diagram or the corresponding approximate ellipse represented in the CIE 1931 chromaticity diagram.

There shall, ideally, be no perceptible chromatic difference between the luminous surface used to view transparencies and a white reference standard in place of a reflection sample. (See 6.1.)

5.2 Spectral power distribution

The spectral irradiance of the illumination shall, ideally, be the same as that of CIE Illuminant D_{50}, representing a phase of natural daylight having a correlated colour temperature close to 5 000 K, over the wavelength range of 360 nm to 830 nm computed at 10 nm intervals as tabulated in the table on page 4.

When viewing reflecting materials containing fluorescent brighteners or fluorescent colourants, the relative spectral power of the illumination shall be the same as that of CIE Illuminant D_{50}, representing a phase of natural daylight having a correlated colour temperature close to 5 000 K, over the wavelength range of 300 nm to 830 nm computed at 10 nm intervals as tabulated in the table in order to provide ultra-violet power in the spectral region of 300 nm to 360 nm for stimulation of fluorescent materials.

The spectral power distribution of the illumination incident on the reflecting sample is given here but no specification can be set forth for the light source (or lamp) because

a) the light from the source may be modified by the apparatus;

b) the required spectral power distribution may be obtained from a mixture of light from two or more different sources.

Tolerances for acceptable variations in the spectral power distribution of the incident illumination are set forth below in terms of the CIE general colour rendering index.

5.3 General colour rendering index

The CIE general colour rendering index of the illumination shall be measured as specified in CIE Publication No. 13.2 and shall have a value of 90 or higher. In addition, the separate special colour rendering indices for samples 1 to 8 shall each have a value of 80 or higher.

5.4 Illumination

The illuminance at the print-viewing plane shall be 2 000 ± 500 lx as measured with a horizontally positioned, cosine-corrected, illumination photometer located at the centre of the viewing plane. Illuminance values are to be obtained with meters either having a spectral response function identical with the values tabulated for spectral luminous efficiency function for the CIE standard photometric observer, as given in CIE Publication No. 17, page 51, table 1, or with a response calibrated in terms of integration with respect to that function with the light source under test.

The aim illuminance shall be 2 000 lx. In any event the luminous flux density measured at the centre of the transparency illuminator viewing surface shall stand in a ratio of 2 : 1 ± 0,2 to the luminous flux density of the illumination measured at the centre of the viewing plane. (See 6.2.)

The illumination over the entire viewing plane shall be uniform. (See 6.3.) Further, the light shall be so incident and the reflection reproduction so positioned that the effects of specular reflection are minimized.

5.5 Environmental conditions

The environmental conditions shall be designed to produce a minimum of interference or influence upon the viewing conditions and care should be taken that none of the environmental conditions alters the state of visual adaptation of the observer. Environmental light sources should be baffled so that they contribute essentially no light to the viewing plane and the front surface of the transparency illuminator, and are not visible to a person of average height in a position in which observations are to be made. The surfaces of environmental walls, ceilings, floors, etc., shall be baffled by an essentially neutral material in order not to reflect any undesirable quality light onto the samples.

6 NOTES

6.1 The ideal white reference standard is a Lambert reflector. In practice, materials such as smoked or pressed magnesium oxide, pressed barium sulphate powder, paint for photometric integrators, or a Munsell colour sample N 9/[1] may be used.

6.2 It is noted that the luminance of a transparency illuminator expressed in $cd \cdot m^{-2}$ (i.e. in lumens-metre^{-2} steradian^{-1}; $lm \cdot m^{-2} \cdot sr^{-1}$) should be multiplied by π in order to compute the ratio of luminous flux densities when comparison is made with illuminance expressed in lux (i.e. $lm \cdot m^{-2}$). Thus, for example:

$$\frac{(\pi \cdot sr)\ (1\ 270\ lm \cdot m^{-2} \cdot sr^{-1})}{2\ 000\ lm \cdot m^{-2}} = 1{,}994\ 9 \approx 2 \qquad \ldots (1)$$

or,

$$\frac{1\ 270\ lm \cdot m^{-2} \cdot sr^{-1}}{(\pi \cdot sr)^{-1}\ (2\ 000\ lm \cdot m^{-2})} = 1{,}994\ 9 \approx 2 \qquad \ldots (2)$$

since the total flux emitted per unit area of a Lambert surface equals π times the luminance. Hence, the form of equation (1) assumes that the illuminator surface is a Lambert emitter, and the form of equation (2) assumes that the illumination is incident upon a Lambert reflector.

6.3 The term "uniform" is used here to mean that the average level of illumination for viewing by reflection shall be of such a degree of uniformity that, if a uniform sheet of white paper of the maximum size of the original or reproduction is placed in the viewing position, it shall appear to be uniformly illuminated.

1) NEWHALL S. M., NICKERSON D., and JUDD D. B., Final report of the O.S.A. sub-committee on the spacing of the Munsell colors, *Journal of the Optical Society of America*, **33**, 385-418 (1943).

TABLE — **Relative spectral power of reference Illuminant D_{50}**

Wavelength nm	Relative power
300	0,000 2
310	0,020
320	0,078
330	0,148
340	0,179
350	0,210
360	0,239
370	0,269
380	0,245
390	0,298
400	0,493
410	0,565
420	0,600
430	0,578
440	0,748
450	0,872
460	0,906
470	0,914
480	0,952
490	0,920
500	0,957
510	0,966
520	0,971
530	1,021
540	1,008
550	1,023
560	1,000
570	0,977
580	0,989
590	0,935
600	0,977
610	0,993
620	0,990
630	0,957
640	0,988
650	0,957
660	0,982
670	1,030
680	0,991
690	0,874
700	0,916
710	0,929
720	0,768
730	0,866
740	0,926
750	0,782
760	0,577
770	0,829
780	0,783
790	0,796
800	0,734
810	0,639
820	0,708
830	0,744

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