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Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour

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INTERNATIONAL STANDARD

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CIE S 012/E

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Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour

Méthode normalisée d'évaluation de la qualité spectrale des simulateurs de lumière du jour pour le jugement visuel et la mesure des couleurs

Reference number
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CIE S 012/E:2004

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

ISO 23603 was prepared as Standard CIE S 012/E by the International Commission on Illumination, which has been recognized by the ISO Council as an international standardizing body. It was adopted by ISO under a special procedure which requires approval by at least 75 % of the member bodes casting a vote, and is published as a joint ISO/CIE edition.

The International Commission on Illumination (abbreviated as CIE from its French title) is an organization devoted to international cooperation and exchange of information among its member countries on all matters relating to the science and art of lighting.

ISO 23603 was prepared by CIE Technical Committee 1-53 *A standard method for assessing the quality of daylight simulators*.

COMMISSION INTERNATIONALE DE L'ECLAIRAGE
INTERNATIONAL COMMISSION ON ILLUMINATION
INTERNATIONALE BELEUCHTUNGSKOMMISSION

CIE S 012/E:2004

Standard

Standard Method of Assessing the Spectral Quality of Daylight Simulators for Visual Appraisal and Measurement of Colour

Méthode normalisée d'évaluation de la qualité spectrale des simulateurs de lumière du jour pour le jugement visuel et la mesure des couleurs

Standardmethoden zur Bewertung der spektralen Qualität von Tageslichtsimulatoren für visuelle Beurteilung und Farbmessung

CIE Central Bureau, Vienna
Kegelgasse 27, A-1030 Vienna, Austria

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FOREWORD

Standards produced by the Commission Internationale de l'Eclairage (CIE) are a concise documentation of data defining aspects of light and lighting, for which international harmony requires such unique definition. CIE Standards are therefore a primary source of internationally accepted and agreed data, which can be taken, essentially unaltered, into universal standard systems.

This International Standard has been prepared by CIE Technical Committee 1-53*, "A standard method for assessing the quality of daylight simulators", and was approved by the National Committees of the CIE.

Observed colours of objects depend on the illumination of the objects and the results of colour measurements may depend on the illumination used in the measurement. The CIE has standardized the spectral power distributions of several phases of daylight for use in observing and measuring colour. For practical applications in colour technology, illuminators are designed to illuminate specimens with light simulating one or more of these CIE illuminants. The accuracy of simulation has an important bearing on the accuracy of visual matches and colour measurements. CIE Technical Committee TC1.3 studied methods of assessing the spectral quality of daylight simulators and issued recommendations in the publication: CIE 51-1981 *A method for assessing the quality of daylight simulators for colorimetry*. That publication established the limits of the deviation from the ideal colour that initially qualified a simulator for consideration and established a test method to assign quality grades to simulators. The limits and test method expressed in that publication have been used throughout the world, since 1981. The historical development of the methodology is described in that publication.

This standard is based on the principles and methods described in CIE 51-1981. There are several new features, based on recent research and standardization (JIS, 2000; McCamy, 1996 and 1999). CIE 51-1981 treated CIE Illuminants D55, and D75 as well as CIE standard illuminant D65. CIE illuminant D50, which is widely used in photographic and colour printing technologies, was included in a later supplement to CIE 51-1981 (CIE 135/3-1999 Visual metamers for assessing the quality of CIE illuminant D50) and is also included in this standard. CIE 51.2-1999 includes both the original publication and the supplement. CIE 51.2-1999 specified limits on colour deviation graphically; this standard specifies the same limits numerically. CIE 51.2-1999 listed wavelength-dependent constants for visible-range assessment over the wavelength range from 400 nm to 700 nm; this standard lists those constants over the range from 380 nm to 780 nm. The constants and wavelength range for ultraviolet-range assessment in CIE 51.2-1999 are retained in this standard. For the special purpose of ultraviolet-range assessment, the wavelength range from 400 nm to 700 nm adequately represents the visible spectrum, because all of the fluorescence emission considered is within that range.

* Chairman of this TC was C. S. McCamy (US), members were: D. H. Alman (US), R. Hirschler (BR), T. Ichijo (JP), J. T. C. van Kemenade (NL), M. R. Luo (UK), M. Pointer (UK), J. Schanda (HU), and J. C. Zwinkels (CA).

INTRODUCTION

The purpose of this assessment is to quantify the suitability of the spectral irradiance distribution of a practical simulator of CIE daylight illuminant D50, D55, D75 or CIE standard daylight illuminant D65 for the visual appraisal or measurement of colours of fluorescent or non-fluorescent specimens.

The basis for the assessment is the special metamerism index for change in illuminant, using pairs of virtual (rather than real) specimens specified by their reflecting and fluorescing properties. The pairs of specimens are metameric matches under the CIE daylight illuminant, when evaluated with the CIE 1964 standard colorimetric observer. The method described in this standard quantifies the mismatch when the pairs of virtual specimens are illuminated by the simulator under test and evaluated by the same standard observer.

A visible range metamerism index is derived to quantify the suitability of the simulator for the visible wavelength range.

An ultraviolet range metamerism index is derived, using a different set of virtual metameric pairs, each pair having a fluorescent and a non-fluorescent specimen, which spectrally match for the CIE daylight illuminant and standard colorimetric observer. The non-fluorescent specimen in each pair is specified by its spectral radiance factor. The fluorescent specimen in each pair is specified by its spectral reflected radiance factor, relative spectral distribution of radiance due to fluorescence, and spectral external radiant efficiency of the fluorescent specimen. The ultraviolet range metamerism index quantifies the mismatch due to fluorescence resulting from the use of the simulator and the standard observer.

1. SCOPE

This International Standard specifies a method of assessing the spectral quality of the irradiance provided by a daylight simulator to be used for visual appraisal of colours or for colour measurements and a method of assigning a quality grade to the simulator. It specifies the maximum permissible deviation of the chromaticity of the simulator from the chromaticity of the CIE standard daylight illuminant or CIE daylight illuminant being simulated, for a simulator to be graded by this method.

2. NORMATIVE REFERENCES

The following standards and other documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All publications are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the publications indicated below. Members of CIE, the International Electrotechnical Commission (IEC) and the International Organisation for Standardization (ISO) maintain registers of currently valid international standards.

CIE 15:2004. *Colorimetry, 3rd edition*.
CIE 17.4-1987. *International Lighting Vocabulary,* ILV (joint IEC/CIE publication)..
CIE 51.2-1999. *A method for assessing the quality of daylight simulators for colorimetry*.
CIE 63-1984. *The spectroradiometric measurement of light sources*.
ISO 10526/CIE S 005-1999. *CIE standard illuminants for colorimetry*.
ISO/CIE 10527-1991. *Colorimetric observers*.

3. DEFINITIONS AND SYMBOLS

For the purposes of this standard, the following definitions and symbols apply. Definitions and symbols used in this standard, but not listed here, conform to CIE 17.4-1987 and CIE 15:2004.

3.1 simulator*

device that provides spectral irradiance approximating that of a CIE standard daylight illuminant or CIE daylight illuminant, for visual appraisal or measurement of colours

3.2 quality grade*

class of quality of simulation of the spectral irradiance of a CIE standard illuminant or CIE illuminant by a simulator, expressed as a letter symbol A, B, C, D, or E, with class A representing the highest quality

3.3 reflectance factor (at a surface element, for the part of the reflected radiation contained in a given cone with the apex at the surface element, and for incident radiation of a given spectral composition, polarization and geometrical distribution) (see ILV 845-04-64)

ratio of the radiant or luminous flux reflected in the directions delimited by the given cone to that reflected in the same directions by a perfect reflecting diffuser identically irradiated or illuminated
Symbol: R

3.4 reflected radiance factor* (at a representative element of the surface of a non-self-radiating medium, in a given direction, under specified conditions of irradiation)

ratio of the radiance due to reflection of the medium in the given direction to the radiance of a perfect reflecting diffuser identically irradiated
Symbol: β_R

3.5 fluorescent radiance factor* (at a surface element of a non-self-radiating medium, in a given direction, under specified conditions of irradiation)

ratio of the radiance due to fluorescence of the specimen to the radiance of the perfect reflecting diffuser identically irradiated and viewed
Symbol: β_F

3.6 total radiance factor* (at a representative element of the surface of a non-self-radiating medium, in a given direction, under specified conditions of irradiation)

sum of the reflected radiance factor β_R and the fluorescent radiance factor β_F
Symbol: β_T

3.7 fluorescent radiant efficiency*

ratio of the radiant power emitted by fluorescence for a given spectral excitation, to the spectral radiant excitation power irradiating the fluorescent material

3.8 spectral external radiant efficiency of the fluorescent specimen*

ratio of the total radiant power emitted by the fluorescent process for an excitation wavelength λ' to the total radiant excitation power irradiating the fluorescent material
Symbol: $Q(\lambda')$, where λ' is the excitation wavelength

3.9 total radiant excitation*

total radiant power irradiating the specimen that is capable of exciting fluorescence
Symbol: N

3.10 relative spectral distribution of radiance due to fluorescence*

ratio of the spectral distribution of radiance due to fluorescence to the sum of the tabulated values of this distribution, i.e. $\Sigma_\lambda F(\lambda) = 1{,}0$
Symbol: $F(\lambda)$

* New definition. Not in CIE 17.4-1987.

4. REQUIREMENTS

4.1 Chromaticity tolerance

The first requirement of a simulator is that the light it provides be nearly the same chromaticity as the light of the CIE daylight illuminant. For a daylight simulator to qualify for classification by this standard, the CIE 1976 u'_{10} v'_{10} chromaticity difference between the light of the simulator and that of the CIE daylight illuminant shall not exceed 0,015. (See CIE 15:2004.)

4.2 Quality grade

The chromaticity requirement described in paragraph 4.1 having been met, and a metamerism index having been determined by the method of this standard, the spectral quality of simulation shall be classified, using a letter symbol indicating a quality grade, according to Table 1.

The quality of spectral simulation is evaluated for the visible spectrum and for the ultraviolet spectrum and separate quality grades are assigned for those two spectral regions. The quality grades are reported as a two-letter symbol, the quality grade for the visible region being stated first. For example, the symbol BC means the simulator has a quality grade of B for the visible spectrum and C for the ultraviolet spectrum. (Daylight simulators having these grades have been found useful for many applications.)

5. TEST METHODS

5.1 Spectroradiometry

The relative spectral irradiance (the relative spectral power distribution of the flux incident on the specimen) of the simulator shall be measured by spectroradiometry for the near ultraviolet and visible spectrum, in the wavelength range from 300 nm to 780 nm. The radiometric quantity required is the relative spectral irradiance at the surface to be observed or measured. This procedure takes into account, not only the relative spectral radiance of the source, but also the spectral effect of any lenses, reflectors, diffusers, or filters that affect the relative spectral irradiance.

Devices providing significant spectral irradiance at wavelengths less than 300 nm are not suitable as daylight simulators. Radiant power of shorter wavelengths, coming from the sun, is absorbed in the earth's atmosphere, so it is absent in natural daylight.

The relative spectral irradiance shall be measured at 5 nm intervals and over 5 nm bands, at wavelengths from 300 nm to 780 nm. This may be accomplished by direct measurement or a combination of measurement and interpolation, depending on the nature of the spectroradiometer and whether the relative spectral irradiance includes some component of a line spectrum. When the spectral power distribution of the simulator includes spectral lines, as is the case when fluorescent lamps are used, the spectral data are treated by the method in CIE 63-1984 *The spectroradiometric measurement of light sources*.

5.2 Computations

5.2.1 Normalization

The spectral irradiance of the simulator is normalized so the assessment is independent of the absolute value of irradiance. The normalized irradiance is computed by equation (5.1):

$$S_n(\lambda) = \frac{100 \cdot S(\lambda)}{\sum_{300}^{780} S(\lambda) \cdot \bar{y}_{10}(\lambda) \cdot \Delta\lambda} \qquad (5.1)$$

where $S(\lambda)$ is the measured irradiance, the subscript n denotes the normalized quantity, $\bar{y}_{10}(\lambda)$ is one of the colour matching functions of the CIE 1964 standard colorimetric observer (see ISO/CIE 10527-1991), $\Delta\lambda$ is the wavelength interval used for the summation, and the summation is over the wavelength range from 300 nm to 780 nm.

5.2.2 Chromaticity deviation

The CIE 1976 u'_{10} v'_{10} chromaticity difference between the light from the simulator and that of the simulated CIE standard daylight illuminant or CIE daylight illuminant shall not exceed 0,015. To facilitate this computation, the chromaticity coordinates of the four CIE daylight illuminants in CIE 15:2004 *Colorimetry*, are listed in Table 2.

5.2.3 Virtual metameric pairs

5.2.3.1 Pairs for visible-range assessment

Sets of virtual metameric pairs of specimens, for visible-range assessment, are specified by their spectral radiance factors in Tables 3 and 4. Each pair has a "standard" spectrum and a "comparison" spectrum, representing virtual specimens that match for the CIE 1964 standard colorimetric observer. The five standard spectra are listed in Table 3 and the same set of five is used for all four CIE daylight illuminants. Five comparison spectra are listed for each of the four CIE daylight illuminants, in Tables 4a-4d.

5.2.3.2 Pairs for ultraviolet-range assessment

Three virtual metameric pairs of specimens, for ultraviolet-range assessment, are specified in Tables 5 and 6a-6d.

Three virtual fluorescent specimens are listed in Table 5. Their reflection and fluorescence properties are specified by tabulated values of the spectral reflected radiance factor $\beta_R(\lambda)$, the relative spectral distribution of radiance due to fluorescence $F(\lambda)$, and the spectral external radiant efficiency of the fluorescent specimen $Q(\lambda')$.

Three virtual non-fluorescent specimens are listed in Tables 6a-6d. Their reflection properties are specified by their spectral reflectance factors, for each of the CIE daylight illuminants.

5.2.4 Computing metamerism indices

Tristimulus values shall be computed by integrating the product of the colour matching functions of the CIE 1964 standard colorimetric observer, the normalized relative spectral irradiance of the simulator, and the tabulated properties of the virtual specimens, over the wavelength range and intervals specified in Table 4 (visible-range assessment) and Tables 5 and 6 (ultraviolet-range assessment). (See also CIE 15:2004.)

5.2.4.1 Indices for visible-range assessment

Using the normalized spectral irradiance of the simulator, tristimulus values shall be computed for the appropriate five metameric pairs in Tables 3 and 4a-4d. Using the CIE 1976 *L*a*b** colour-difference formula, the colour difference between the standard specimen and the corresponding comparison specimen, $\Delta E^*_{ab,10}$, shall be computed to three decimal places for each of the five pairs. The visible range metamerism index M_v is the average of the five colour differences. (See also CIE 15:2004.)

5.2.4.2 Indices for ultraviolet-range assessment

The virtual fluorescent specimens absorb radiant power in the ultraviolet region of the spectrum and emit light in the visible region of the spectrum. The emitted light affects the colour of the specimen. The three virtual specimens absorb radiant power in three different parts of the ultraviolet spectrum. Their ultraviolet excitation properties are typical of those in commonly used whitening agents.

When a simulator having both ultraviolet and visible spectral components illuminates a fluorescent specimen, the specimen reflects some light and emits light due to fluorescence. The light emanating from the specimen is the sum of these two components. The amount of light emitted depends on the fluorescent radiant efficiency of the virtual specimens and the amount of excitation, which depends on the ultraviolet spectral distribution of irradiance provided by the simulator.

The total excitation N of the fluorescent standard specimen in Table 5 is computed by equation (5.2):

$$N = \sum_{300}^{460} S_n(\lambda') \cdot Q(\lambda') \cdot \Delta\lambda' \tag{5.2}$$

where $S_n(\lambda')$ is the normalized spectral irradiance of the simulator in the spectral region from 300 nm to 460 nm, $Q(\lambda')$ is the spectral external radiant efficiency of the fluorescent specimen over the same spectral range, as shown in Table 5, and $\Delta\lambda'$ is the wavelength interval of 5 nm.

The spectral fluorescent radiance factor $\beta_F(\lambda)$ is computed by equation (5.3):

$$\beta_F(\lambda) = \frac{N \cdot F(\lambda)}{S_n(\lambda)} \tag{5.3}$$

where N is the total excitation computed by equation (5.2), $F(\lambda)$ is the relative spectral distribution of radiance due to fluorescence as shown in Table 5, and $S_n(\lambda)$ is the normalized spectral irradiance distribution of the simulator.

The total spectral radiance factor $\beta_T(\lambda)$ is computed by equation (5.4):

$$\beta_T(\lambda) = \beta_R(\lambda) + \beta_F(\lambda) \tag{5.4}$$

where $\beta_R(\lambda)$ is the spectral reflected radiance factor listed for the fluorescent specimen in Table 5, and $\beta_F(\lambda)$ is the fluorescent radiance factor computed by equation (5.3).

The tristimulus values for each pair of specimens shall be computed using the normalized spectral irradiance distribution of the simulator, $\beta_T(\lambda)$ for the spectral radiance factor for the standard specimen and the tabulated values in Tables 6a-6d for the comparison specimen. The colour difference between the specimens in each pair shall be computed to three decimal places by the CIE 1976 *L*a*b** formula.

The ultraviolet-range metamerism index M_u is the average colour difference for the three metameric pairs.

6. TABLES

Table 1. Quality classification of daylight simulators.

Quality Grade	Metamerism Index M_v or M_u
A	≤ 0,25
B	>0,25 to 0,50
C	>0,50 to 1,00
D	>1,00 to 2,00
E	> 2,00

Table 2. CIE 1976 $u'_{10}v'_{10}$ chromaticity coordinates of CIE daylight illuminants.

CIE Daylight	u'_{10}	v'_{10}
D50	0,2102	0,4889
D55	0,2051	0,4816
D65	0,1979	0,4695
D75	0,1930	0,4601

Table 3. Spectral radiance factors of standard specimens for visible range assessment.

Wave-length (nm)	Specimen					Wave-length (nm)	Specimen				
	1	2	3	4	5		1	2	3	4	5
380	0,056	0,054	0,052	0,318	0,120	585	0,369	0,035	0,093	0,206	0,135
385	0,054	0,062	0,050	0,314	0,115	590	0,401	0,037	0,090	0,204	0,156
390	0,052	0,069	0,048	0,301	0,111	595	0,431	0,041	0,089	0,202	0,183
395	0,050	0,075	0,046	0,299	0,108	600	0,459	0,046	0,089	0,203	0,214
400	0,048	0,080	0,044	0,298	0,106	605	0,482	0,053	0,089	0,209	0,250
405	0,045	0,084	0,042	0,298	0,106	610	0,501	0,061	0,090	0,220	0,285
410	0,043	0,087	0,040	0,300	0,109	615	0,516	0,071	0,091	0,236	0,313
415	0,041	0,089	0,038	0,305	0,114	620	0,528	0,082	0,092	0,256	0,333
420	0,040	0,089	0,037	0,311	0,120	625	0,537	0,095	0,092	0,277	0,340
425	0,038	0,088	0,036	0,318	0,127	630	0,544	0,109	0,092	0,298	0,342
430	0,037	0,085	0,035	0,326	0,136	635	0,551	0,121	0,093	0,317	0,341
435	0,036	0,082	0,034	0,335	0,146	640	0,557	0,133	0,096	0,337	0,345
440	0,035	0,078	0,033	0,346	0,156	645	0,562	0,145	0,101	0,361	0,362
445	0,034	0,074	0,032	0,357	0,166	650	0,567	0,156	0,109	0,391	0,391
450	0,034	0,070	0,032	0,369	0,176	655	0,573	0,166	0,120	0,430	0,434
455	0,035	0,066	0,032	0,381	0,184	660	0,579	0,177	0,134	0,476	0,487
460	0,036	0,063	0,032	0,391	0,191	665	0,585	0,188	0,154	0,531	0,547
465	0,037	0,060	0,033	0,398	0,195	670	0,592	0,201	0,177	0,589	0,609
470	0,039	0,057	0,034	0,401	0,197	675	0,598	0,217	0,202	0,647	0,667
475	0,041	0,054	0,036	0,400	0,195	680	0,605	0,236	0,228	0,702	0,721
480	0,045	0,052	0,038	0,396	0,191	685	0,613	0,257	0,252	0,749	0,766
485	0,051	0,050	0,041	0,387	0,183	690	0,621	0,279	0,275	0,787	0,803
490	0,058	0,048	0,045	0,376	0,174	695	0,629	0,302	0,296	0,816	0,830
495	0,067	0,046	0,049	0,363	0,165	700	0,637	0,326	0,316	0,835	0,849
500	0,077	0,044	0,055	0,348	0,155	705	0,645	0,350	0,336	0,847	0,859
505	0,089	0,042	0,062	0,331	0,146	710	0,653	0,374	0,355	0,855	0,866
510	0,102	0,041	0,070	0,313	0,137	715	0,661	0,398	0,373	0,861	0,871
515	0,115	0,039	0,078	0,297	0,129	720	0,669	0,422	0,390	0,865	0,875
520	0,127	0,038	0,086	0,283	0,122	725	0,677	0,446	0,406	0,867	0,878
525	0,139	0,037	0,092	0,272	0,115	730	0,685	0,470	0,421	0,868	0,880
530	0,151	0,036	0,097	0,262	0,110	735	0,693	0,494	0,435	0,868	0,881
535	0,162	0,035	0,101	0,251	0,107	740	0,701	0,518	0,448	0,868	0,881
540	0,174	0,034	0,104	0,241	0,105	745	0,709	0,542	0,460	0,868	0,881
545	0,185	0,033	0,106	0,230	0,105	750	0,717	0,566	0,471	0,868	0,881
550	0,198	0,032	0,107	0,220	0,105	755	0,725	0,590	0,481	0,868	0,881
555	0,213	0,031	0,107	0,213	0,105	760	0,733	0,614	0,490	0,868	0,881
560	0,230	0,031	0,106	0,208	0,105	765	0,741	0,638	0,498	0,868	0,881
565	0,251	0,031	0,104	0,207	0,105	770	0,749	0,662	0,505	0,868	0,881
570	0,276	0,031	0,101	0,208	0,107	775	0,757	0,686	0,511	0,868	0,881
575	0,305	0,032	0,099	0,208	0,111	780	0,765	0,710	0,516	0,868	0,881
580	0,336	0,033	0,096	0,208	0,120						

Tables 3 - 6 are attached to this publication on a disc.

Table 4a. Spectral radiance factors of comparison specimens for visible range assessment of D50 simulators.

Wave-length (nm)	Specimen					Wave-length (nm)	Specimen				
	1	2	3	4	5		1	2	3	4	5
380	0,050	0,069	0,033	0,401	0,173	585	0,309	0,049	0,097	0,234	0,131
385	0,049	0,068	0,032	0,401	0,174	590	0,345	0,055	0,097	0,234	0,149
390	0,045	0,066	0,032	0,401	0,175	595	0,384	0,063	0,100	0,235	0,174
395	0,042	0,064	0,030	0,401	0,176	600	0,427	0,072	0,102	0,238	0,200
400	0,035	0,059	0,028	0,401	0,177	605	0,473	0,077	0,103	0,240	0,228
405	0,029	0,059	0,028	0,401	0,178	610	0,515	0,083	0,104	0,241	0,258
410	0,027	0,063	0,027	0,401	0,179	615	0,552	0,085	0,104	0,240	0,286
415	0,026	0,074	0,027	0,401	0,180	620	0,582	0,086	0,104	0,237	0,316
420	0,024	0,081	0,027	0,401	0,184	625	0,608	0,087	0,103	0,234	0,342
425	0,024	0,088	0,026	0,400	0,187	630	0,630	0,087	0,103	0,229	0,366
430	0,024	0,089	0,026	0,398	0,187	635	0,646	0,087	0,104	0,228	0,387
435	0,025	0,088	0,024	0,393	0,186	640	0,659	0,087	0,104	0,228	0,405
440	0,025	0,083	0,025	0,387	0,181	645	0,671	0,088	0,106	0,236	0,424
445	0,026	0,081	0,026	0,375	0,178	650	0,683	0,088	0,108	0,245	0,440
450	0,027	0,076	0,027	0,372	0,174	655	0,695	0,088	0,113	0,264	0,454
455	0,028	0,071	0,029	0,366	0,170	660	0,708	0,088	0,119	0,287	0,469
460	0,031	0,066	0,031	0,360	0,165	665	0,723	0,088	0,128	0,320	0,485
465	0,035	0,059	0,034	0,353	0,160	670	0,736	0,088	0,141	0,358	0,506
470	0,043	0,052	0,037	0,345	0,156	675	0,750	0,088	0,158	0,403	0,526
475	0,054	0,048	0,045	0,336	0,151	680	0,755	0,088	0,174	0,455	0,548
480	0,068	0,045	0,056	0,327	0,148	685	0,762	0,088	0,195	0,505	0,567
485	0,085	0,042	0,067	0,319	0,144	690	0,770	0,088	0,213	0,560	0,591
490	0,103	0,038	0,077	0,311	0,141	695	0,778	0,088	0,234	0,610	0,616
495	0,121	0,037	0,086	0,304	0,139	700	0,782	0,088	0,257	0,660	0,641
500	0,136	0,034	0,092	0,296	0,137	705	0,785	0,089	0,281	0,710	0,659
505	0,148	0,035	0,095	0,289	0,135	710	0,787	0,089	0,308	0,755	0,676
510	0,156	0,033	0,097	0,281	0,135	715	0,788	0,089	0,332	0,795	0,692
515	0,160	0,032	0,095	0,276	0,132	720	0,789	0,089	0,354	0,825	0,705
520	0,160	0,032	0,092	0,271	0,129	725	0,790	0,089	0,374	0,850	0,715
525	0,162	0,032	0,090	0,265	0,125	730	0,791	0,089	0,389	0,870	0,725
530	0,164	0,032	0,089	0,260	0,122	735	0,791	0,089	0,400	0,885	0,734
535	0,167	0,032	0,088	0,255	0,121	740	0,791	0,089	0,410	0,895	0,744
540	0,172	0,033	0,086	0,250	0,121	745	0,792	0,089	0,417	0,900	0,754
545	0,177	0,033	0,084	0,248	0,121	750	0,792	0,089	0,424	0,900	0,764
550	0,182	0,033	0,084	0,246	0,121	755	0,792	0,089	0,429	0,900	0,774
555	0,189	0,032	0,085	0,245	0,119	760	0,792	0,089	0,431	0,900	0,784
560	0,196	0,030	0,087	0,244	0,116	765	0,792	0,089	0,432	0,900	0,794
565	0,209	0,032	0,088	0,243	0,110	770	0,792	0,089	0,432	0,900	0,804
570	0,226	0,036	0,091	0,241	0,109	775	0,792	0,089	0,432	0,900	0,814
575	0,248	0,041	0,094	0,239	0,113	780	0,792	0,089	0,432	0,900	0,824
580	0,275	0,045	0,096	0,236	0,119						

Table 4b. Spectral radiance factors of comparison specimens for visible range assessment of D55 simulators.

Wave-length (nm)	Specimen					Wave-length (nm)	Specimen				
	1	2	3	4	5		1	2	3	4	5
380	0,037	0,025	0,040	0,408	0,145	585	0,309	0,050	0,097	0,233	0,131
385	0,035	0,033	0,036	0,407	0,153	590	0,346	0,055	0,098	0,232	0,149
390	0,033	0,041	0,035	0,406	0,160	595	0,386	0,063	0,101	0,233	0,173
395	0,030	0,046	0,031	0,400	0,164	600	0,430	0,071	0,103	0,235	0,199
400	0,029	0,054	0,030	0,399	0,169	605	0,476	0,075	0,104	0,237	0,227
405	0,028	0,060	0,028	0,399	0,173	610	0,518	0,082	0,104	0,239	0,258
410	0,027	0,067	0,028	0,399	0,177	615	0,555	0,084	0,104	0,237	0,286
415	0,026	0,074	0,027	0,398	0,181	620	0,586	0,086	0,104	0,234	0,315
420	0,026	0,081	0,027	0,398	0,183	625	0,611	0,086	0,103	0,230	0,341
425	0,025	0,088	0,026	0,398	0,185	630	0,633	0,086	0,103	0,225	0,365
430	0,025	0,088	0,026	0,395	0,185	635	0,649	0,086	0,104	0,223	0,386
435	0,025	0,088	0,025	0,390	0,184	640	0,662	0,086	0,105	0,225	0,405
440	0,025	0,083	0,026	0,382	0,180	645	0,674	0,086	0,107	0,231	0,422
445	0,026	0,081	0,027	0,376	0,177	650	0,686	0,087	0,110	0,243	0,437
450	0,028	0,076	0,027	0,370	0,173	655	0,698	0,087	0,115	0,260	0,452
455	0,029	0,071	0,029	0,364	0,169	660	0,711	0,087	0,121	0,285	0,468
460	0,032	0,066	0,031	0,358	0,164	665	0,725	0,087	0,130	0,317	0,484
465	0,036	0,059	0,034	0,351	0,159	670	0,739	0,087	0,141	0,353	0,504
470	0,044	0,052	0,038	0,343	0,155	675	0,753	0,088	0,155	0,402	0,524
475	0,054	0,048	0,046	0,335	0,150	680	0,770	0,088	0,171	0,450	0,547
480	0,068	0,045	0,056	0,327	0,147	685	0,785	0,088	0,190	0,504	0,570
485	0,085	0,042	0,067	0,319	0,143	690	0,800	0,089	0,210	0,556	0,593
490	0,103	0,039	0,077	0,312	0,141	695	0,812	0,089	0,231	0,605	0,616
495	0,121	0,037	0,086	0,304	0,139	700	0,823	0,089	0,257	0,652	0,635
500	0,136	0,034	0,092	0,297	0,137	705	0,834	0,090	0,283	0,697	0,661
505	0,147	0,035	0,095	0,290	0,135	710	0,843	0,090	0,314	0,734	0,681
510	0,155	0,033	0,096	0,283	0,135	715	0,851	0,090	0,344	0,771	0,698
515	0,158	0,033	0,094	0,278	0,133	720	0,859	0,090	0,374	0,803	0,711
520	0,159	0,033	0,091	0,273	0,130	725	0,865	0,090	0,404	0,832	0,724
525	0,161	0,033	0,089	0,267	0,126	730	0,870	0,090	0,434	0,855	0,736
530	0,163	0,033	0,088	0,262	0,123	735	0,875	0,090	0,464	0,873	0,747
535	0,166	0,033	0,087	0,257	0,122	740	0,879	0,090	0,524	0,887	0,757
540	0,170	0,033	0,086	0,253	0,122	745	0,880	0,090	0,554	0,894	0,766
545	0,175	0,033	0,084	0,250	0,122	750	0,880	0,090	0,581	0,896	0,774
550	0,180	0,033	0,084	0,248	0,122	755	0,880	0,090	0,612	0,896	0,781
555	0,187	0,032	0,085	0,246	0,119	760	0,880	0,090	0,641	0,896	0,785
560	0,195	0,030	0,086	0,245	0,116	765	0,880	0,090	0,670	0,896	0,780
565	0,208	0,032	0,088	0,244	0,111	770	0,880	0,090	0,699	0,896	0,794
570	0,225	0,036	0,091	0,242	0,109	775	0,880	0,090	0,728	0,896	0,797
575	0,247	0,040	0,094	0,239	0,113	780	0,880	0,090	0,757	0,896	0,799
580	0,275	0,045	0,096	0,235	0,119						

Table 4c. Spectral radiance factors of comparison specimens for visible range assessment of D65 simulators.

Wave-length (nm)	Specimen					Wave-length (nm)	Specimen				
	1	2	3	4	5		1	2	3	4	5
380	0,036	0,051	0,043	0,389	0,075	585	0,309	0,049	0,098	0,231	0,131
385	0,035	0,052	0,042	0,389	0,094	590	0,347	0,054	0,100	0,229	0,149
390	0,034	0,054	0,040	0,389	0,111	595	0,389	0,062	0,102	0,229	0,172
395	0,034	0,056	0,037	0,389	0,128	600	0,434	0,069	0,104	0,230	0,198
400	0,033	0,055	0,031	0,391	0,150	605	0,480	0,074	0,105	0,232	0,226
405	0,030	0,057	0,028	0,393	0,169	610	0,523	0,081	0,104	0,234	0,256
410	0,028	0,063	0,028	0,394	0,176	615	0,560	0,083	0,105	0,232	0,285
415	0,026	0,073	0,027	0,395	0,180	620	0,593	0,085	0,105	0,228	0,313
420	0,026	0,080	0,027	0,396	0,182	625	0,619	0,085	0,104	0,224	0,339
425	0,026	0,088	0,026	0,395	0,183	630	0,641	0,085	0,104	0,220	0,363
430	0,026	0,089	0,026	0,392	0,183	635	0,657	0,085	0,105	0,218	0,384
435	0,026	0,088	0,026	0,387	0,182	640	0,669	0,085	0,106	0,221	0,402
440	0,026	0,083	0,027	0,379	0,179	645	0,681	0,085	0,108	0,227	0,419
445	0,027	0,081	0,028	0,373	0,175	650	0,691	0,085	0,111	0,238	0,435
450	0,029	0,076	0,028	0,367	0,171	655	0,703	0,084	0,116	0,254	0,451
455	0,030	0,071	0,029	0,361	0,167	660	0,712	0,084	0,124	0,278	0,464
460	0,033	0,066	0,031	0,355	0,162	665	0,727	0,085	0,135	0,309	0,485
465	0,037	0,059	0,034	0,348	0,157	670	0,742	0,084	0,147	0,347	0,504
470	0,044	0,052	0,039	0,340	0,153	675	0,756	0,084	0,162	0,391	0,524
475	0,054	0,048	0,047	0,333	0,149	680	0,769	0,084	0,179	0,446	0,545
480	0,068	0,045	0,057	0,326	0,146	685	0,781	0,084	0,198	0,496	0,566
485	0,085	0,043	0,067	0,319	0,143	690	0,792	0,084	0,218	0,547	0,585
490	0,104	0,040	0,077	0,312	0,141	695	0,802	0,084	0,240	0,601	0,601
495	0,121	0,037	0,086	0,305	0,139	700	0,811	0,084	0,263	0,647	0,615
500	0,136	0,034	0,092	0,300	0,138	705	0,818	0,083	0,270	0,693	0,631
505	0,146	0,035	0,095	0,292	0,137	710	0,825	0,082	0,270	0,733	0,647
510	0,153	0,033	0,095	0,286	0,136	715	0,831	0,082	0,271	0,773	0,662
515	0,156	0,033	0,093	0,281	0,134	720	0,836	0,082	0,271	0,807	0,676
520	0,157	0,034	0,090	0,276	0,131	725	0,840	0,082	0,271	0,837	0,686
525	0,159	0,034	0,088	0,270	0,127	730	0,844	0,081	0,272	0,880	0,701
530	0,161	0,034	0,087	0,265	0,124	735	0,846	0,081	0,272	0,888	0,710
535	0,164	0,034	0,086	0,260	0,123	740	0,847	0,081	0,273	0,893	0,720
540	0,167	0,034	0,085	0,257	0,123	745	0,847	0,081	0,273	0,893	0,729
545	0,172	0,033	0,083	0,253	0,122	750	0,847	0,081	0,273	0,894	0,738
550	0,177	0,033	0,083	0,251	0,122	755	0,847	0,081	0,273	0,894	0,744
555	0,184	0,031	0,083	0,249	0,120	760	0,847	0,081	0,273	0,894	0,747
560	0,193	0,031	0,084	0,248	0,117	765	0,847	0,081	0,273	0,894	0,751
565	0,206	0,033	0,088	0,246	0,113	770	0,847	0,081	0,273	0,894	0,754
570	0,223	0,036	0,091	0,243	0,111	775	0,847	0,081	0,273	0,894	0,756
575	0,246	0,041	0,094	0,238	0,113	780	0,847	0,081	0,273	0,894	0,757
580	0,275	0,045	0,096	0,234	0,119						

Table 4d. Spectral radiance factors of comparison specimens for visible range assessment of D75 simulators.

Wave-length (nm)	Specimen					Wave-length (nm)	Specimen				
	1	2	3	4	5		1	2	3	4	5
380	0,038	0,008	0,037	0,422	0,158	585	0,309	0,049	0,098	0,229	0,131
385	0,036	0,018	0,034	0,419	0,161	590	0,348	0,055	0,100	0,228	0,149
390	0,035	0,028	0,032	0,415	0,163	595	0,391	0,060	0,103	0,226	0,171
395	0,034	0,038	0,032	0,409	0,167	600	0,437	0,069	0,105	0,226	0,197
400	0,031	0,047	0,030	0,400	0,168	605	0,483	0,073	0,106	0,228	0,225
405	0,030	0,058	0,030	0,396	0,170	610	0,527	0,079	0,106	0,230	0,255
410	0,029	0,065	0,028	0,393	0,174	615	0,564	0,081	0,106	0,228	0,284
415	0,027	0,073	0,027	0,393	0,177	620	0,596	0,083	0,106	0,225	0,311
420	0,027	0,080	0,027	0,393	0,179	625	0,622	0,084	0,105	0,221	0,337
425	0,026	0,088	0,026	0,393	0,180	630	0,645	0,084	0,105	0,217	0,361
430	0,026	0,089	0,026	0,390	0,181	635	0,661	0,084	0,106	0,215	0,382
435	0,026	0,088	0,027	0,385	0,180	640	0,674	0,084	0,107	0,217	0,400
440	0,026	0,083	0,027	0,378	0,178	645	0,686	0,084	0,109	0,222	0,417
445	0,027	0,081	0,028	0,371	0,174	650	0,698	0,085	0,112	0,232	0,430
450	0,029	0,076	0,028	0,365	0,170	655	0,711	0,085	0,117	0,249	0,446
455	0,031	0,071	0,029	0,359	0,166	660	0,723	0,086	0,124	0,272	0,464
460	0,034	0,066	0,032	0,353	0,161	665	0,736	0,087	0,133	0,303	0,484
465	0,038	0,059	0,035	0,346	0,156	670	0,749	0,087	0,144	0,339	0,505
470	0,045	0,052	0,040	0,338	0,152	675	0,764	0,088	0,158	0,380	0,527
475	0,055	0,048	0,048	0,331	0,148	680	0,777	0,089	0,175	0,425	0,547
480	0,069	0,046	0,057	0,324	0,145	685	0,792	0,089	0,196	0,475	0,568
485	0,086	0,042	0,067	0,318	0,143	690	0,804	0,089	0,218	0,525	0,588
490	0,104	0,039	0,077	0,311	0,141	695	0,814	0,089	0,239	0,570	0,608
495	0,121	0,037	0,086	0,305	0,139	700	0,822	0,089	0,261	0,615	0,627
500	0,136	0,034	0,092	0,299	0,138	705	0,826	0,089	0,278	0,655	0,648
505	0,145	0,035	0,094	0,294	0,137	710	0,833	0,089	0,299	0,690	0,668
510	0,152	0,033	0,094	0,288	0,137	715	0,838	0,089	0,318	0,722	0,688
515	0,154	0,034	0,092	0,284	0,135	720	0,842	0,089	0,362	0,757	0,709
520	0,155	0,035	0,089	0,279	0,132	725	0,843	0,089	0,383	0,784	0,729
525	0,157	0,035	0,087	0,273	0,128	730	0,844	0,089	0,406	0,804	0,749
530	0,159	0,035	0,086	0,268	0,125	735	0,845	0,089	0,427	0,825	0,769
535	0,162	0,035	0,085	0,263	0,124	740	0,846	0,089	0,448	0,850	0,787
540	0,166	0,034	0,084	0,259	0,124	745	0,847	0,089	0,468	0,860	0,803
545	0,170	0,033	0,083	0,256	0,123	750	0,848	0,089	0,488	0,865	0,817
550	0,175	0,033	0,083	0,254	0,123	755	0,849	0,089	0,508	0,875	0,829
555	0,182	0,032	0,083	0,252	0,121	760	0,850	0,089	0,528	0,885	0,839
560	0,191	0,031	0,084	0,250	0,118	765	0,851	0,089	0,548	0,887	0,849
565	0,204	0,032	0,087	0,247	0,113	770	0,852	0,089	0,568	0,891	0,853
570	0,221	0,036	0,090	0,244	0,111	775	0,853	0,089	0,588	0,894	0,857
575	0,245	0,041	0,093	0,238	0,113	780	0,854	0,089	0,608	0,897	0,859
580	0,275	0,045	0,096	0,233	0,119						

Table 5. Spectral properties of fluorescent standard specimens for ultraviolet range assessment of daylight simulators.

Wave-length (nm)	Specimen 1			Specimen 2			Specimen 3		
	$Q(\lambda')\Delta\lambda'$	$\beta_S(\lambda)$	$F(\lambda)$	$Q(\lambda')\Delta\lambda'$	$\beta_S(\lambda)$	$F(\lambda)$	$Q(\lambda')\Delta\lambda'$	$\beta_S(\lambda)$	$F(\lambda)$
300	0,182								
305	0,194								
310	0,205			0,001					
315	0,214			0,001					
320	0,220			0,006					
325	0,226			0,023					
330	0,230			0,050			0,001		
335	0,232			0,075			0,001		
340	0,232			0,102			0,002		
345	0,230			0,137			0,025		
350	0,224			0,174			0,055		
355	0,216			0,204			0,082		
360	0,204			0,218			0,111		
365	0,177			0,227			0,152		
370	0,145			0,229			0,191		
375	0,117			0,228			0,218		
380	0,088			0,220			0,235		
385	0,056			0,196			0,244		
390	0,028			0,164			0,245		
395	0,016			0,134			0,245		
400	0,011	0,638	0,008	0,104	0,490	0,008	0,237	0,194	0,008
405	0,009	0,661	0,011	0,068	0,570	0,011	0,213	0,270	0,011
410	0,006	0,683	0,022	0,038	0,640	0,022	0,182	0,357	0,022
415	0,002	0,704	0,036	0,023	0,678	0,036	0,153	0,437	0,036
420		0,722	0,051	0,016	0,701	0,051	0,120	0,517	0,051
425		0,734	0,070	0,011	0,718	0,070	0,082	0,603	0,070
430		0,742	0,085	0,007	0,730	0,085	0,046	0,676	0,085
435		0,750	0,092	0,004	0,744	0,092	0,028	0,712	0,092
440		0,756	0,090	0,001	0,755	0,090	0,019	0,731	0,090
445		0,761	0,081		0,762	0,081	0,013	0,744	0,081
450		0,766	0,071		0,766	0,071	0,009	0,753	0,071
455		0,770	0,064		0,770	0,064	0,005	0,764	0,064
460		0,774	0,056		0,774	0,056	0,001	0,773	0,056
465		0,778	0,048		0,778	0,048		0,778	0,048
470		0,782	0,039		0,782	0,039		0,782	0,039
475		0,788	0,033		0,788	0,033		0,788	0,033
480		0,794	0,028		0,794	0,028		0,794	0,028
485		0,799	0,022		0,799	0,022		0,799	0,022
490		0,804	0,018		0,804	0,018		0,804	0,018
495		0,808	0,014		0,808	0,014		0,808	0,014
500		0,812	0,011		0,812	0,011		0,812	0,011

Wave-length (nm)	Specimen 1			Specimen 2			Specimen 3		
	$Q(\lambda')\Delta\lambda'$	$\beta_S(\lambda)$	$F(\lambda)$	$Q(\lambda')\Delta\lambda'$	$\beta_S(\lambda)$	$F(\lambda)$	$Q(\lambda')\Delta\lambda'$	$\beta_S(\lambda)$	$F(\lambda)$
505		0,817	0,009		0,817	0,009		0,817	0,009
510		0,822	0,008		0,822	0,008		0,822	0,008
515		0,827	0,006		0,827	0,006		0,827	0,006
520		0,830	0,005		0,830	0,005		0,830	0,005
525		0,831	0,004		0,831	0,004		0,831	0,004
530		0,831	0,004		0,831	0,004		0,831	0,004
535		0,831	0,003		0,831	0,003		0,831	0,003
540		0,832	0,003		0,832	0,003		0,832	0,003
545		0,832	0,003		0,832	0,003		0,832	0,003
550		0,833	0,001		0,833	0,001		0,833	0,001
555		0,833	0,001		0,833	0,001		0,833	0,001
560		0,834	0,001		0,834	0,001		0,834	0,001
565		0,834	0,001		0,834	0,001		0,834	0,001
570		0,835	0,001		0,835	0,001		0,835	0,001
575		0,835			0,835			0,835	
580		0,836			0,836			0,836	
585		0,837			0,837			0,837	
590		0,837			0,837			0,837	
595		0,837			0,837			0,837	
600		0,838			0,838			0,838	
605		0,839			0,839			0,839	
610		0,840			0,840			0,840	
615		0,842			0,842			0,842	
620		0,844			0,844			0,844	
625		0,846			0,846			0,846	
630		0,848			0,848			0,848	
635		0,850			0,850			0,850	
640		0,852			0,852			0,852	
645		0,854			0,854			0,854	
650		0,856			0,856			0,856	
655		0,857			0,857			0,857	
660		0,857			0,857			0,857	
665		0,857			0,857			0,857	
670		0,858			0,858			0,858	
675		0,859			0,859			0,859	
680		0,860			0,860			0,860	
685		0,861			0,861			0,861	
690		0,862			0,862			0,862	
695		0,863			0,863			0,863	
700		0,864			0,864			0,864	

Table 6a. Spectral radiance factors of comparison specimens for ultraviolet range assessment of D50 simulators.

Wave-length (nm)	Specimen			Wave-length (nm)	Specimen		
	1	2	3		1	2	3
400	0,662	0,505	0,212	555	0,835	0,834	0,834
405	0,687	0,589	0,293	560	0,835	0,834	0,835
410	0,711	0,668	0,401	565	0,835	0,834	0,835
415	0,742	0,723	0,507	570	0,836	0,835	0,836
420	0,767	0,764	0,613	575	0,836	0,835	0,835
425	0,797	0,805	0,737	580	0,836	0,836	0,836
430	0,822	0,838	0,842	585	0,837	0,837	0,837
435	0,824	0,845	0,868	590	0,837	0,837	0,837
440	0,820	0,843	0,866	595	0,837	0,837	0,837
445	0,816	0,836	0,857	600	0,838	0,838	0,838
450	0,810	0,826	0,845	605	0,839	0,839	0,839
455	0,808	0,822	0,845	610	0,840	0,840	0,840
460	0,807	0,820	0,843	615	0,842	0,842	0,842
465	0,807	0,816	0,837	620	0,844	0,844	0,844
470	0,804	0,813	0,830	625	0,846	0,846	0,846
475	0,806	0,813	0,828	630	0,848	0,848	0,848
480	0,810	0,816	0,827	635	0,850	0,850	0,850
485	0,812	0,817	0,826	640	0,851	0,852	0,852
490	0,814	0,818	0,826	645	0,851	0,854	0,854
495	0,816	0,819	0,825	650	0,852	0,856	0,856
500	0,818	0,821	0,825	655	0,852	0,856	0,857
505	0,822	0,825	0,828	660	0,852	0,856	0,857
510	0,826	0,829	0,831	665	0,853	0,856	0,857
515	0,830	0,831	0,834	670	0,853	0,856	0,858
520	0,831	0,833	0,836	675	0,853	0,858	0,859
525	0,832	0,833	0,836	680	0,853	0,858	0,860
530	0,832	0,833	0,835	685	0,853	0,858	0,861
535	0,832	0,833	0,834	690	0,853	0,858	0,862
540	0,833	0,834	0,835	695	0,853	0,858	0,863
545	0,833	0,834	0,835	700	0,853	0,859	0,864
550	0,834	0,834	0,834				

Table 6b. Spectral radiance factors of comparison specimens for ultraviolet range assessment of D55 simulators.

Wave-length (nm)	Specimen			Wave-length (nm)	Specimen		
	1	2	3		1	2	3
400	0,646	0,501	0,210	555	0,834	0,834	0,835
405	0,674	0,587	0,295	560	0,835	0,835	0,836
410	0,705	0,669	0,400	565	0,835	0,835	0,836
415	0,740	0,725	0,507	570	0,836	0,836	0,837
420	0,773	0,769	0,618	575	0,835	0,835	0,835
425	0,806	0,813	0,744	580	0,836	0,836	0,836
430	0,832	0,848	0,852	585	0,837	0,837	0,867
435	0,835	0,856	0,878	590	0,837	0,837	0,837
440	0,831	0,854	0,878	595	0,837	0,837	0,837
445	0,825	0,846	0,869	600	0,838	0,838	0,838
450	0,818	0,835	0,855	605	0,839	0,839	0,839
455	0,815	0,830	0,853	610	0,840	0,840	0,840
460	0,814	0,827	0,851	615	0,842	0,842	0,842
465	0,812	0,823	0,845	620	0,844	0,844	0,844
470	0,810	0,819	0,838	625	0,846	0,846	0,846
475	0,811	0,818	0,833	630	0,848	0,848	0,848
480	0,814	0,820	0,832	635	0,850	0,850	0,850
485	0,815	0,820	0,830	640	0,852	0,852	0,852
490	0,817	0,821	0,829	645	0,854	0,854	0,854
495	0,818	0,821	0,828	650	0,856	0,856	0,856
500	0,820	0,823	0,828	655	0,857	0,857	0,857
505	0,824	0,826	0,830	660	0,857	0,857	0,857
510	0,828	0,830	0,833	665	0,857	0,857	0,857
515	0,831	0,832	0,835	670	0,858	0,858	0,858
520	0,833	0,834	0,837	675	0,859	0,859	0,859
525	0,833	0,834	0,836	680	0,860	0,860	0,860
530	0,833	0,834	0,836	685	0,861	0,861	0,861
535	0,833	0,833	0,834	690	0,862	0,862	0,862
540	0,834	0,834	0,835	695	0,863	0,863	0,863
545	0,834	0,834	0,835	700	0,864	0,864	0,864
550	0,834	0,834	0,835				

Table 6c. Spectral radiance factors of comparison specimens for ultraviolet range assessment of D65 simulators.

Wave-length (nm)	Specimen			Wave-length (nm)	Specimen		
	1	2	3		1	2	3
400	0,648	0,502	0,211	555	0,834	0,835	0,835
405	0,676	0,589	0,296	560	0,835	0,836	0,836
410	0,709	0,672	0,402	565	0,835	0,836	0,836
415	0,748	0,731	0,511	570	0,836	0,837	0,837
420	0,785	0,778	0,625	575	0,835	0,835	0,835
425	0,824	0,828	0,755	580	0,836	0,836	0,836
430	0,855	0,868	0,868	585	0,837	0,837	0,837
435	0,860	0,878	0,898	590	0,837	0,837	0,837
440	0,855	0,876	0,899	595	0,837	0,837	0,837
445	0,846	0,866	0,888	600	0,838	0,838	0,838
450	0,836	0,852	0,872	605	0,839	0,839	0,839
455	0,832	0,846	0,869	610	0,840	0,840	0,840
460	0,829	0,841	0,866	615	0,842	0,842	0,842
465	0,825	0,836	0,859	620	0,844	0,844	0,844
470	0,822	0,831	0,850	625	0,846	0,846	0,846
475	0,821	0,828	0,843	630	0,848	0,848	0,848
480	0,822	0,828	0,841	635	0,850	0,850	0,850
485	0,822	0,827	0,838	640	0,852	0,852	0,852
490	0,823	0,827	0,836	645	0,854	0,854	0,854
495	0,823	0,826	0,833	650	0,856	0,856	0,856
500	0,824	0,827	0,833	655	0,857	0,857	0,857
505	0,827	0,829	0,834	660	0,857	0,857	0,857
510	0,831	0,833	0,837	665	0,857	0,857	0,857
515	0,833	0,835	0,838	670	0,858	0,858	0,858
520	0,835	0,836	0,839	675	0,859	0,859	0,859
525	0,835	0,836	0,837	680	0,860	0,860	0,860
530	0,835	0,836	0,837	685	0,861	0,861	0,861
535	0,834	0,834	0,835	690	0,862	0,862	0,862
540	0,835	0,835	0,836	695	0,863	0,863	0,863
545	0,835	0,835	0,836	700	0,864	0,864	0,864
550	0,834	0,835	0,835				

Table 6d. Spectral radiance factors of comparison specimens for ultraviolet range assessment of D75 simulators.

Wave-length (nm)	Specimen			Wave-length (nm)	Specimen		
	1	2	3		1	2	3
400	0,649	0,503	0,211	555	0,835	0,835	0,836
405	0,679	0,590	0,297	560	0,836	0,836	0,837
410	0,713	0,675	0,403	565	0,836	0,836	0,837
415	0,754	0,736	0,514	570	0,837	0,837	0,838
420	0,795	0,786	0,630	575	0,835	0,835	0,835
425	0,838	0,839	0,764	580	0,836	0,836	0,836
430	0,875	0,885	0,881	585	0,837	0,837	0,837
435	0,881	0,896	0,913	590	0,837	0,837	0,837
440	0,875	0,894	0,915	595	0,837	0,837	0,837
445	0,865	0,882	0,903	600	0,838	0,838	0,838
450	0,852	0,866	0,886	605	0,839	0,839	0,839
455	0,846	0,859	0,882	610	0,840	0,840	0,840
460	0,842	0,853	0,878	615	0,842	0,842	0,842
465	0,837	0,847	0,869	620	0,844	0,844	0,844
470	0,832	0,840	0,859	625	0,846	0,846	0,846
475	0,829	0,836	0,852	630	0,848	0,848	0,848
480	0,830	0,835	0,849	635	0,850	0,850	0,850
485	0,828	0,833	0,844	640	0,852	0,852	0,852
490	0,828	0,832	0,841	645	0,854	0,854	0,854
495	0,827	0,830	0,838	650	0,856	0,856	0,856
500	0,828	0,831	0,837	655	0,857	0,857	0,857
505	0,830	0,832	0,837	660	0,857	0,857	0,857
510	0,834	0,835	0,840	665	0,857	0,857	0,857
515	0,835	0,837	0,840	670	0,858	0,858	0,858
520	0,837	0,838	0,841	675	0,859	0,859	0,859
525	0,836	0,837	0,839	680	0,860	0,860	0,860
530	0,836	0,837	0,839	685	0,861	0,861	0,861
535	0,834	0,835	0,836	690	0,862	0,862	0,862
540	0,836	0,836	0,837	695	0,863	0,863	0,863
545	0,836	0,836	0,837	700	0,864	0,864	0,864
550	0,835	0,835	0,836				

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