

SMPTE STANDARD

Academy Color Encoding Specification (ACES)



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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Standards and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE ST 2065-1 was prepared by Technology Committee 10E.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

The Academy Color Encoding Specification (ACES) defines a digital color image encoding appropriate for both photographed and computer-generated images. It is the common color encoding for the Academy Image Interchange Framework. In the flow of image data from scene capture to theatrical presentation, ACES data encode imagery in a form suitable for creative manipulation. Later points in the workflow provide forms suitable for critical viewing.

Based on the definition of the ACES virtual RGB primaries, and on the color matching functions of the CIE 1931 Standard Colorimetric Observer, ACES derives an ideal recording device against which actual recording devices' behavior can be compared: the Reference Input Capture Device (RICD). As an ideal device, the RICD would be capable of distinguishing and recording all visible colors, and of capturing a luminance range exceeding that of any contemporary or anticipated physical camera. The RICD's purpose is to provide a documented, unambiguous, fixed relationship between scene colors and encoded RGB values. When a real camera records a physical scene, or a virtual camera (i.e. a CGI rendering program) creates an image of a virtual scene, an Input Device Transform (IDT) converts the resulting image data into the ACES RGB relative exposure values the RICD would have recorded of that same subject matter. Figure 1 illustrates the pipeline for creating ACES images from various image capture devices.

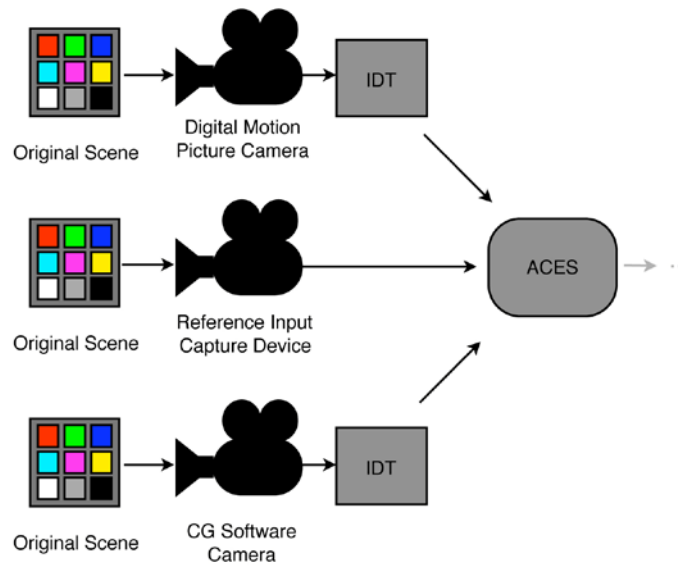


Figure 1 – Creation of ACES images from various image capture devices

ACES images are not directly viewable for final image evaluation, much as film negative or files containing images encoded as printing density are not directly viewable as final images. As an intermediate image representation, ACES images can be examined directly for identification of image orientation, cropping region or sequencing; or examination of the amount of shadow or highlight detail captured; or comparison with other directly viewed ACES images. Such direct viewing cannot be used for final color evaluation. Instead, a Reference Rendering Transform (RRT) and a selected Output Device Transform (ODT) are used to produce a viewable image when that image is presented on the selected output device. Figure 2 illustrates the ACES image capture and reproduction pipeline using the RICD.

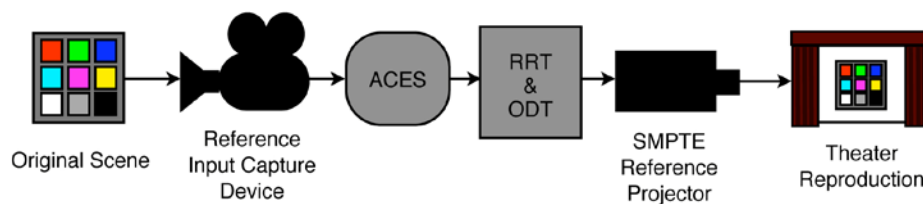


Figure 2 – ACES Capture and Reproduction using the RICD

Practical conversion of photographic or synthetic exposures to ACES RGB relative exposure values requires procedures for characterizing the color response of a real or virtual image capture system. These procedures are outside the scope of this standard.

The Image Interchange Framework of which ACES is a part provides theoretical and practical structure for color correction and artistic adjustment. Encoding in ACES does not obsolete creative judgment; rather, it facilitates it.

1 Scope

The specification defines the Academy Color Encoding Specification (ACES).

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:".

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ISO 22028-1:2004, Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 1: Architecture and requirements

SMPTE RP 177:1993, Derivation of Basic Television Color Equations

IEEE Standard for Floating-Point Arithmetic P754-2008

4 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

4.1 Academy Color Encoding Specification (ACES): An RGB color encoding for exchange of image data that have not been color rendered, between and throughout production and postproduction, within the Academy's Image Interchange Framework.

4.2 camera flare: unwanted irradiation in the image plane of an optical system, caused by the scattering and reflection of a proportion of the radiation which enters the system.

4.3 capture system noise: positive or negative signal value fluctuations, unmodulated by scene image content, introduced into an image by the image capture system.

4.4 color component transfer function: single variable, monotonic mathematical function relating to intensity applied individually to one or more color channels of a color space.

4.5 color encoding: generic term for a quantized digital encoding of a color space, encompassing both color space encodings and color image encodings.

4.6 color image encoding: digital encoding of the color values for a digital image, including the specification of a color space encoding, together with any information necessary to properly interpret the color values such as the image state and the intended image viewing environment.

4.7 color space: geometric representation of colors in space, usually of three dimensions.

4.8 color space encoding: digital encoding of a color space, including the specification of a digital encoding method, and a color space data metric.

4.9 image state: attribute of a color image encoding indicating the color rendering state of the image data.

4.10 observer adaptive white: color stimulus that an observer, adapted to a set of viewing conditions, would judge to be perfectly achromatic and to have a luminance factor of unity.

4.11 perfect reflecting diffuser: ideal isotropic, nonfluorescent diffuser with a spectral radiance factor equal to unity at each wavelength of interest.

4.12 Reference Input Capture Device (RICD): RICD hypothetical camera which records an image of a scene directly as ACES RGB relative exposure values.

4.13 relative exposure values: relative responses to light of an image capture system determined by the integrated spectral responsivities of its color channels and the spectral radiances of scene stimuli.

4.14 scaled XYZ color space: color space based upon the CIE 1931 Standard Colorimetric Observer, with X, Y and Z uniformly scaled such that the Y value of a perfect reflecting diffuser is 1.0.

4.15 surround: area adjacent to the border of an image, which, upon viewing the image, can affect the local state of adaptation of the eye. In the context of a scene capture, a 'normal' surround is one where the nature of the scene surrounding the view captured does not significantly alter the state of viewer adaptation from that when viewing exclusively the view captured.

4.16 tristimulus value: amounts of the three reference color stimuli, in a given trichromatic system, required to match the color of the stimulus considered.

4.17 viewing environment: context in which a color stimulus is viewed, producing a color appearance. Typical viewing environment components include viewing flare, surround, absolute luminance and observer adaptive white.

5 Academy Color Encoding Specification (ACES)

5.1 General

The Academy Color Encoding Specification shall be defined as specified in this section. ACES is specified in three successive layers: a color space, a color space encoding, and a color image encoding. This structure meets the requirements for extended-gamut color encodings as given in ISO 22028-1.

5.2 ACES Color Space

5.2.1 Color space type

The color space type shall be colorimetric: additive RGB.

Note: The ACES color space type can also be considered to be of the type input-device-dependent and as such has an associated reference image capture device known as the ACES reference image captured device (RICD).

5.2.2 Colorimetric specification

ACES RGB values shall represent scene colors as measured at the focal plane of the ACES Reference Image Capture Device.

The ACES RICD shall have the spectral sensitivities, which are linear combinations of the CIE 1931 color-matching functions, tabulated in Annex A, shall be free of capture system noise, and shall introduce camera flare amounting to 0.5% of the captured values of a perfect reflecting diffuser. The captured values shall thus be augmented by flare and then scaled by a factor S, calculated as follows:

$$S = \frac{0.18000}{0.18000 + 0.00500}$$

Note 1: In practice, ACES RGB values represent scene colors as measured by a real or virtual capture device. As such, captured values from real devices include both capture system noise and camera flare.

Note 2: If an image captured with any real or virtual capture device contains camera flare of an amount different than the amount specified, that difference can be reconciled in the transformation of the camera data to ACES RGB or preserved as an expression of creative intent.

Note 3: For the ACES RICD camera flare ought to be considered equivalent to veiling glare.

5.2.3 RGB primaries chromaticity values

The RGB primaries chromaticity values shall be those found in Table 1.

Table 1 – ACES RGB primaries chromaticity values

	R	G	B	CIE x	CIE y
Red	1.00000	0.00000	0.00000	0.73470	0.26530
Green	0.00000	1.00000	0.00000	0.00000	1.00000
Blue	0.00000	0.00000	1.00000	0.00010	-0.07700

5.2.4 Color space white point

The color space white point shall be that found in Table 2.

Table 2 — ACES RGB white point chromaticity values

	R	G	B	CIE x	CIE y
White	1.00000	1.00000	1.00000	0.32168	0.33767

Note: The total absence of light is represented by CIE $X = 0.00000$, $Y = 0.00000$, $Z = 0.00000$

5.2.5 Converting ACES RGB values to CIE XYZ values

ACES R , G , and B values shall be converted to scaled CIE XYZ tristimulus values using the normalized primary matrix (NPM) calculated and applied using the methods provided in Section 3.3 of SMPTE RP 177.

Note: Equation 1 shows the relationship between ACES R , G , and B values and scaled CIE XYZ tristimulus values. NPM , rounded to 10 significant digits, is derived using the color space chromaticity coordinates specified in sections 5.2.3 and 5.2.4 and the methods provided in Section 3.3 of SMPTE RP 177.

$$NPM = \begin{bmatrix} 0.9525523959 & 0.0000000000 & 0.0000936786 \\ 0.3439664498 & 0.7281660966 & -0.0721325464 \\ 0.0000000000 & 0.0000000000 & 1.0088251844 \end{bmatrix}$$

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = NPM \bullet \begin{bmatrix} R_{ACES} \\ G_{ACES} \\ B_{ACES} \end{bmatrix}$$

Equation 1 – ACES RGB to CIE XYZ Conversion

5.2.6 Converting CIE XYZ values to ACES RGB values

CIE XYZ tristimulus values shall be converted to ACES R , G , and B values using the matrix inverse of the normalized primary matrix calculated and applied using the methods provided in Section 3.3 of SMPTE RP 177.

Note: Equation 2 shows the relationship between scaled CIE XYZ tristimulus values and ACES R , G , and B values. NPM^{-1} is the matrix inversion of NPM .

$$\begin{bmatrix} R_{ACES} \\ G_{ACES} \\ B_{ACES} \end{bmatrix} = NPM^{-1} \bullet \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$$

Equation 2 – CIE XYZ to ACES RGB Conversion

5.2.7 Color component transfer function

The color component transfer function shall directly encode relative exposure values that would be captured from the scene by the RICD as ACES color component values, and shall be defined as

$$R = E_r, G = E_g, B = E_b$$

where E_r , E_g and E_b shall represent relative exposure values that would be captured from the scene by the RICD and R , G and B shall be the resulting ACES color component values. (i.e. the color component transfer function shall be linear.)

5.3 ACES Color Space Encoding

5.3.1 Color space

The color space shall be the ACES color space specified in Section 5.2.

5.3.2 Digital encoding method

5.3.2.1 Floating-point digital encoding

ACES values shall be encoded as 16-bit floating-point numbers using binary16, as described in IEEE P754.

Note 1: Binary16 is also known as half precision.

Note 2: Higher-precision floating point values can be used in calculations but the output of the calculation ought to remain congruent with the above 16-bit half-float representation.

5.3.2.2 Color component value range

The valid color component value range shall be [-65504.0, +65504.0].

Image processing software and hardware should handle the full range of valid color component values. The full range of valid color component values should not be clamped except as needed to produce a desired artistic intent.

Note 1: The set of valid ACES RGB values also includes members whose projection onto the CIE chromaticity diagram falls outside the region representing visible colors. These ACES RGB values include those with one or more negative ACES color component values and also include those whose color component values are all positive and whose projection onto the chromaticity diagram is outside the spectral locus.

Note 2: ACES is scaled such that a perfect reflecting diffuser under a particular illuminant produce ACES values of 1.0 (prior to the flare addition and the scaling operation specified in Section 5.2.2). Many scenes include objects with radiance values greater than that of a perfect reflecting diffuser hence ACES values well above 1.0 are expected.

5.4 ACES Color Image Encoding

5.4.1 Color space encoding

The color space encoding shall be the ACES Color space encoding specified in Section 5.3.

5.4.2 Image State

The image state shall be scene-referred.

5.4.3 Reference image viewing environment

5.4.3.1 Image surround

Scene objects shall be considered to be surrounded by other similarly illuminated scene objects. The ACES reference viewing environment therefore shall have a 'normal' surround.

Note: Some other publications use the term 'average surround' where ACES uses 'normal surround'. These terms can be considered equivalent for this document.

5.4.3.2 Assumed observer adapted white point

The reference viewing environment specified shall have an assumed observer adaptive white whose chromaticity coordinates are equal to those of the ACES color space white point.

If the observer adaptive white of the actual scene being photographed differs from the ACES reference viewing environment observer adaptive white specified here, that difference should be preserved as an expression of creative intent. An encoding of the colors of a coldly lit, blue-toned factory interior, for example, should be converted to an ACES encoding of the colors of a coldly lit, blue-toned factory interior, not to an ACES encoding of the colors in a daylight-illuminated outdoor scene. Any creative modifications to the scene color balance would be made by post-processing the converted data in ACES, not as a part of the conversion to ACES.

5.4.3.3 Luminance of adapting field

The luminance level of the reference viewing environment shall be that of a daylight-illuminated outdoor scene, in which a perfect reflecting diffuser would have a luminance level of at least 1,600 candelas per square meter.

If the luminance level of the actual scene being photographed differs from the ACES reference viewing environment luminance level specified here, that difference should be preserved as an expression of creative intent.

5.4.3.4 Viewing flare

The reference viewing environment shall have 0% viewing flare.

Note: Viewing flare is unrelated to camera flare. Camera flare is specified in Section 5.2.2.

Annex A ACES Reference Input Capture Device Spectral Sensitivities (Normative)

The ACES RICD spectral sensitivities are linear combinations of the color matching functions of the CIE 1931 Standard Colorimetric Observer. These spectral sensitivities were chosen such that the RICD captures color exactly as a colorimeter would, but expressed in terms of the ACES RGB primaries instead of the CIE XYZ primaries. The tabulated values of the ACES RICD spectral sensitivities are listed in Table A.1 and illustrated in Figure A.1.

The RICD spectral sensitivities listed below are area normalized. When calculating the values the RICD would capture for a particular illuminant, separate scaling factors shall be applied to each of the red, green and blue sensitivities, such that the scalar product of each scaled spectral sensitivity with the captured spectrum of a perfect reflecting diffuser under that particular illuminant shall produce values of 1.0 (prior to the flare addition and the scaling operation specified in Section 5.2.2). A comparable capture of an 'ideal' 18% gray card (isotropic, non-fluorescing and spectrally nonselective) shall produce values of 0.18000 for each scalar product (after the flare addition and the scaling operations specified in Section 5.2.2).

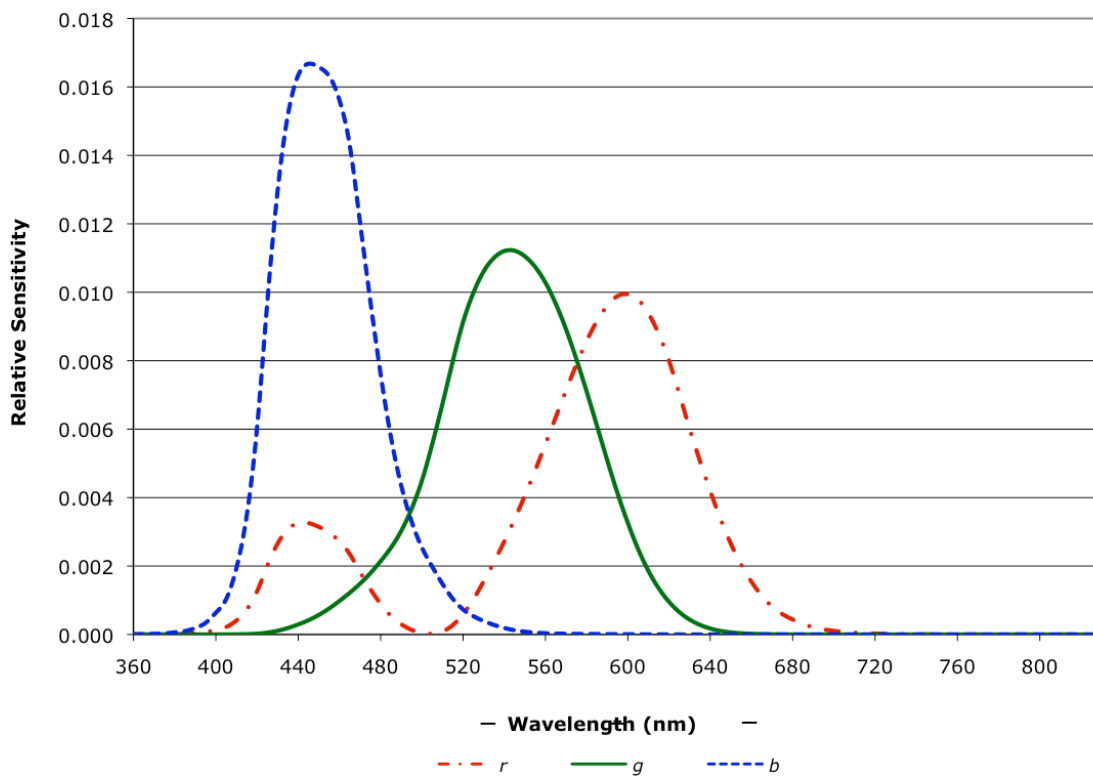


Figure A.1 — ACES RICD Spectral Sensitivities

Table A.1 — ACES RICD Spectral Sensitivities

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}	wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
360	0.000012	0.000000	0.0000057	596	0.0099180	0.0039465	0.0000091
361	0.000014	0.000000	0.0000064	597	0.0099368	0.0037690	0.0000087
362	0.000015	0.000000	0.0000072	598	0.0099462	0.0035956	0.0000083
363	0.000017	0.000000	0.0000080	599	0.0099472	0.0034261	0.0000079
364	0.000019	0.000000	0.0000090	600	0.0099405	0.0032602	0.0000075
365	0.000022	0.000000	0.0000102	601	0.0099268	0.0030979	0.0000071
366	0.000024	0.000000	0.0000114	602	0.0099054	0.0029397	0.0000068
367	0.000027	0.000000	0.0000128	603	0.0098752	0.0027858	0.0000064
368	0.000031	0.000000	0.0000144	604	0.0098355	0.0026369	0.0000060
369	0.000035	0.000000	0.0000162	605	0.0097852	0.0024933	0.0000056
370	0.000039	0.000000	0.0000182	606	0.0097238	0.0023553	0.0000051
371	0.000043	0.000000	0.0000204	607	0.0096519	0.0022229	0.0000046
372	0.000049	0.000000	0.0000228	608	0.0095705	0.0020958	0.0000041
373	0.000054	0.000000	0.0000256	609	0.0094805	0.0019739	0.0000036
374	0.000061	0.000000	0.0000288	610	0.0093828	0.0018572	0.0000032
375	0.000069	0.000000	0.0000326	611	0.0092776	0.0017455	0.0000029
376	0.000079	0.0000001	0.0000372	612	0.0091650	0.0016389	0.0000026
377	0.000090	0.0000001	0.0000425	613	0.0090448	0.0015372	0.0000025
378	0.000102	0.0000001	0.0000483	614	0.0089172	0.0014404	0.0000024
379	0.000115	0.0000001	0.0000543	615	0.0087819	0.0013484	0.0000022
380	0.000128	0.0000001	0.0000603	616	0.0086396	0.0012610	0.0000021
381	0.000141	0.0000001	0.0000663	617	0.0084904	0.0011783	0.0000021
382	0.000154	0.0000001	0.0000725	618	0.0083337	0.0010998	0.0000020
383	0.000169	0.0000001	0.0000795	619	0.0081692	0.0010253	0.0000019
384	0.000187	0.0000001	0.0000881	620	0.0079963	0.0009547	0.0000018
385	0.000209	0.0000001	0.0000987	621	0.0078151	0.0008876	0.0000016
386	0.000237	0.0000002	0.0001119	622	0.0076266	0.0008241	0.0000015
387	0.000271	0.0000002	0.0001278	623	0.0074323	0.0007641	0.0000013
388	0.000309	0.0000002	0.0001458	624	0.0072336	0.0007075	0.0000011
389	0.000351	0.0000003	0.0001659	625	0.0070319	0.0006544	0.0000009
390	0.000397	0.0000003	0.0001876	626	0.0068278	0.0006045	0.0000008
391	0.000445	0.0000003	0.0002106	627	0.0066219	0.0005578	0.0000007
392	0.000499	0.0000004	0.0002358	628	0.0064162	0.0005141	0.0000006
393	0.000559	0.0000005	0.0002646	629	0.0062122	0.0004733	0.0000005
394	0.000631	0.0000005	0.0002984	630	0.0060119	0.0004351	0.0000005
395	0.000716	0.0000006	0.0003388	631	0.0058164	0.0003996	0.0000004
396	0.000819	0.0000007	0.0003877	632	0.0056255	0.0003666	0.0000004
397	0.000938	0.0000008	0.0004444	633	0.0054382	0.0003359	0.0000003
398	0.001068	0.0000009	0.0005063	634	0.0052538	0.0003074	0.0000003
399	0.001204	0.0000010	0.0005706	635	0.0050713	0.0002809	0.0000003
400	0.001339	0.0000011	0.0006348	636	0.0048907	0.0002562	0.0000003
401	0.001469	0.0000012	0.0006968	637	0.0047124	0.0002334	0.0000002
402	0.001604	0.0000013	0.0007612	638	0.0045364	0.0002123	0.0000002

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
403	0.0001757	0.0000015	0.0008341
404	0.0001941	0.0000017	0.0009219
405	0.0002169	0.0000020	0.0010309
406	0.0002452	0.0000023	0.0011658
407	0.0002786	0.0000027	0.0013256
408	0.0003169	0.0000032	0.0015090
409	0.0003598	0.0000038	0.0017144
410	0.0004070	0.0000044	0.0019403
411	0.0004583	0.0000051	0.0021862
412	0.0005147	0.0000059	0.0024568
413	0.0005773	0.0000069	0.0027577
414	0.0006474	0.0000080	0.0030947
415	0.0007262	0.0000093	0.0034736
416	0.0008134	0.0000109	0.0038937
417	0.0009090	0.0000128	0.0043545
418	0.0010141	0.0000151	0.0048619
419	0.0011297	0.0000181	0.0054216
420	0.0012570	0.0000218	0.0060397
421	0.0013971	0.0000265	0.0067216
422	0.0015472	0.0000320	0.0074534
423	0.0017023	0.0000384	0.0082124
424	0.0018579	0.0000456	0.0089758
425	0.0020090	0.0000537	0.0097205
426	0.0021532	0.0000626	0.0104345
427	0.0022907	0.0000725	0.0111186
428	0.0024207	0.0000833	0.0117700
429	0.0025425	0.0000951	0.0123856
430	0.0026557	0.0001081	0.0129626
431	0.0027590	0.0001221	0.0134962
432	0.0028521	0.0001372	0.0139842
433	0.0029352	0.0001534	0.0144275
434	0.0030087	0.0001705	0.0148269
435	0.0030728	0.0001886	0.0151831
436	0.0031276	0.0002077	0.0154960
437	0.0031730	0.0002277	0.0157663
438	0.0032096	0.0002486	0.0159962
439	0.0032377	0.0002702	0.0161881
440	0.0032578	0.0002926	0.0163441
441	0.0032702	0.0003156	0.0164656
442	0.0032753	0.0003394	0.0165552
443	0.0032740	0.0003640	0.0166173
444	0.0032672	0.0003897	0.0166563
445	0.0032557	0.0004167	0.0166766
446	0.0032400	0.0004450	0.0166801
447	0.0032202	0.0004745	0.0166682

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
639	0.0043628	0.0001928	0.0000002
640	0.0041916	0.0001747	0.0000002
641	0.0040228	0.0001581	0.0000002
642	0.0038566	0.0001428	0.0000002
643	0.0036932	0.0001287	0.0000001
644	0.0035331	0.0001159	0.0000001
645	0.0033765	0.0001043	0.0000001
646	0.0032236	0.0000938	0.0000001
647	0.0030744	0.0000843	0.0000001
648	0.0029294	0.0000757	0.0000000
649	0.0027888	0.0000680	0.0000000
650	0.0026531	0.0000610	0.0000000
651	0.0025225	0.0000546	0.0000000
652	0.0023969	0.0000488	0.0000000
653	0.0022759	0.0000436	0.0000000
654	0.0021592	0.0000389	0.0000000
655	0.0020467	0.0000346	0.0000000
656	0.0019381	0.0000308	0.0000000
657	0.0018335	0.0000274	0.0000000
658	0.0017329	0.0000243	0.0000000
659	0.0016362	0.0000216	0.0000000
660	0.0015432	0.0000192	0.0000000
661	0.0014540	0.0000170	0.0000000
662	0.0013685	0.0000152	0.0000000
663	0.0012867	0.0000135	0.0000000
664	0.0012086	0.0000121	0.0000000
665	0.0011342	0.0000107	0.0000000
666	0.0010635	0.0000095	0.0000000
667	0.0009963	0.0000084	0.0000000
668	0.0009329	0.0000075	0.0000000
669	0.0008734	0.0000066	0.0000000
670	0.0008179	0.0000058	0.0000000
671	0.0007665	0.0000051	0.0000000
672	0.0007188	0.0000045	0.0000000
673	0.0006745	0.0000040	0.0000000
674	0.0006334	0.0000035	0.0000000
675	0.0005952	0.0000031	0.0000000
676	0.0005597	0.0000027	0.0000000
677	0.0005267	0.0000023	0.0000000
678	0.0004957	0.0000020	0.0000000
679	0.0004662	0.0000017	0.0000000
680	0.0004377	0.0000015	0.0000000
681	0.0004097	0.0000012	0.0000000
682	0.0003825	0.0000010	0.0000000
683	0.0003563	0.0000008	0.0000000

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
448	0.0031972	0.0005054	0.0166448
449	0.0031718	0.0005377	0.0166136
450	0.0031448	0.0005713	0.0165785
451	0.0031167	0.0006062	0.0165424
452	0.0030871	0.0006426	0.0165030
453	0.0030553	0.0006803	0.0164553
454	0.0030202	0.0007194	0.0163947
455	0.0029810	0.0007598	0.0163164
456	0.0029373	0.0008017	0.0162178
457	0.0028892	0.0008449	0.0160990
458	0.0028368	0.0008891	0.0159594
459	0.0027804	0.0009342	0.0157985
460	0.0027200	0.0009800	0.0156157
461	0.0026561	0.0010264	0.0154130
462	0.0025883	0.0010734	0.0151874
463	0.0025153	0.0011211	0.0149311
464	0.0024358	0.0011696	0.0146365
465	0.0023486	0.0012190	0.0142957
466	0.0022527	0.0012693	0.0139029
467	0.0021498	0.0013205	0.0134670
468	0.0020427	0.0013729	0.0130026
469	0.0019343	0.0014269	0.0125242
470	0.0018271	0.0014826	0.0120461
471	0.0017229	0.0015401	0.0115764
472	0.0016210	0.0015995	0.0111124
473	0.0015215	0.0016608	0.0106534
474	0.0014242	0.0017240	0.0101986
475	0.0013289	0.0017891	0.0097472
476	0.0012361	0.0018563	0.0093009
477	0.0011462	0.0019256	0.0088626
478	0.0010593	0.0019967	0.0084333
479	0.0009753	0.0020690	0.0080139
480	0.0008943	0.0021424	0.0076053
481	0.0008163	0.0022166	0.0072084
482	0.0007416	0.0022922	0.0068241
483	0.0006706	0.0023700	0.0064543
484	0.0006038	0.0024507	0.0061006
485	0.0005418	0.0025351	0.0057647
486	0.0004848	0.0026236	0.0054478
487	0.0004326	0.0027165	0.0051493
488	0.0003847	0.0028142	0.0048679
489	0.0003403	0.0029173	0.0046025
490	0.0002992	0.0030263	0.0043519
491	0.0002609	0.0031418	0.0041156
492	0.0002256	0.0032640	0.0038935

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
684	0.0003313	0.0000007	0.0000000
685	0.0003079	0.0000005	0.0000000
686	0.0002860	0.0000004	0.0000000
687	0.0002656	0.0000003	0.0000000
688	0.0002465	0.0000003	0.0000000
689	0.0002288	0.0000002	0.0000000
690	0.0002124	0.0000002	0.0000000
691	0.0001973	0.0000001	0.0000000
692	0.0001834	0.0000001	0.0000000
693	0.0001707	0.0000001	0.0000000
694	0.0001590	0.0000001	0.0000000
695	0.0001482	0.0000000	0.0000000
696	0.0001384	0.0000000	0.0000000
697	0.0001294	0.0000000	0.0000000
698	0.0001212	0.0000000	0.0000000
699	0.0001135	0.0000000	0.0000000
700	0.0001063	0.0000000	0.0000000
701	0.0000995	0.0000000	0.0000000
702	0.0000930	0.0000000	0.0000000
703	0.0000869	0.0000000	0.0000000
704	0.0000812	0.0000000	0.0000000
705	0.0000759	0.0000000	0.0000000
706	0.0000710	0.0000000	0.0000000
707	0.0000663	0.0000000	0.0000000
708	0.0000620	0.0000000	0.0000000
709	0.0000580	0.0000000	0.0000000
710	0.0000542	0.0000000	0.0000000
711	0.0000506	0.0000000	0.0000000
712	0.0000473	0.0000000	0.0000000
713	0.0000441	0.0000000	0.0000000
714	0.0000412	0.0000000	0.0000000
715	0.0000385	0.0000000	0.0000000
716	0.0000359	0.0000000	0.0000000
717	0.0000335	0.0000000	0.0000000
718	0.0000312	0.0000000	0.0000000
719	0.0000291	0.0000000	0.0000000
720	0.0000271	0.0000000	0.0000000
721	0.0000253	0.0000000	0.0000000
722	0.0000236	0.0000000	0.0000000
723	0.0000220	0.0000000	0.0000000
724	0.0000206	0.0000000	0.0000000
725	0.0000192	0.0000000	0.0000000
726	0.0000179	0.0000000	0.0000000
727	0.0000167	0.0000000	0.0000000
728	0.0000155	0.0000000	0.0000000

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
493	0.0001933	0.0033928	0.0036849
494	0.0001638	0.0035280	0.0034890
495	0.0001373	0.0036695	0.0033052
496	0.0001135	0.0038168	0.0031327
497	0.0000926	0.0039706	0.0029708
498	0.0000743	0.0041327	0.0028191
499	0.0000587	0.0043045	0.0026772
500	0.0000456	0.0044878	0.0025446
501	0.0000351	0.0046836	0.0024213
502	0.0000273	0.0048904	0.0023059
503	0.0000225	0.0051060	0.0021963
504	0.0000207	0.0053279	0.0020905
505	0.0000223	0.0055539	0.0019861
506	0.0000272	0.0057824	0.0018820
507	0.0000357	0.0060137	0.0017786
508	0.0000483	0.0062484	0.0016767
509	0.0000652	0.0064873	0.0015769
510	0.0000869	0.0067307	0.0014800
511	0.0001136	0.0069786	0.0013859
512	0.0001453	0.0072292	0.0012945
513	0.0001822	0.0074806	0.0012068
514	0.0002244	0.0077310	0.0011233
515	0.0002722	0.0079785	0.0010450
516	0.0003257	0.0082225	0.0009721
517	0.0003847	0.0084618	0.0009043
518	0.0004490	0.0086938	0.0008418
519	0.0005182	0.0089159	0.0007844
520	0.0005920	0.0091254	0.0007320
521	0.0006703	0.0093204	0.0006849
522	0.0007529	0.0095018	0.0006425
523	0.0008398	0.0096712	0.0006040
524	0.0009307	0.0098304	0.0005687
525	0.0010256	0.0099812	0.0005356
526	0.0011245	0.0101242	0.0005043
527	0.0012270	0.0102587	0.0004747
528	0.0013323	0.0103843	0.0004467
529	0.0014398	0.0105006	0.0004200
530	0.0015488	0.0106074	0.0003944
531	0.0016588	0.0107046	0.0003696
532	0.0017700	0.0107925	0.0003455
533	0.0018826	0.0108717	0.0003224
534	0.0019967	0.0109425	0.0003002
535	0.0021126	0.0110054	0.0002792
536	0.0022303	0.0110606	0.0002592
537	0.0023496	0.0111082	0.0002404

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
729	0.0000145	0.0000000	0.0000000
730	0.0000135	0.0000000	0.0000000
731	0.0000125	0.0000000	0.0000000
732	0.0000117	0.0000000	0.0000000
733	0.0000108	0.0000000	0.0000000
734	0.0000101	0.0000000	0.0000000
735	0.0000094	0.0000000	0.0000000
736	0.0000087	0.0000000	0.0000000
737	0.0000081	0.0000000	0.0000000
738	0.0000075	0.0000000	0.0000000
739	0.0000070	0.0000000	0.0000000
740	0.0000065	0.0000000	0.0000000
741	0.0000060	0.0000000	0.0000000
742	0.0000056	0.0000000	0.0000000
743	0.0000052	0.0000000	0.0000000
744	0.0000048	0.0000000	0.0000000
745	0.0000045	0.0000000	0.0000000
746	0.0000041	0.0000000	0.0000000
747	0.0000039	0.0000000	0.0000000
748	0.0000036	0.0000000	0.0000000
749	0.0000033	0.0000000	0.0000000
750	0.0000031	0.0000000	0.0000000
751	0.0000029	0.0000000	0.0000000
752	0.0000027	0.0000000	0.0000000
753	0.0000025	0.0000000	0.0000000
754	0.0000024	0.0000000	0.0000000
755	0.0000022	0.0000000	0.0000000
756	0.0000021	0.0000000	0.0000000
757	0.0000019	0.0000000	0.0000000
758	0.0000018	0.0000000	0.0000000
759	0.0000017	0.0000000	0.0000000
760	0.0000016	0.0000000	0.0000000
761	0.0000015	0.0000000	0.0000000
762	0.0000014	0.0000000	0.0000000
763	0.0000013	0.0000000	0.0000000
764	0.0000012	0.0000000	0.0000000
765	0.0000011	0.0000000	0.0000000
766	0.0000010	0.0000000	0.0000000
767	0.0000010	0.0000000	0.0000000
768	0.0000009	0.0000000	0.0000000
769	0.0000008	0.0000000	0.0000000
770	0.0000008	0.0000000	0.0000000
771	0.0000007	0.0000000	0.0000000
772	0.0000007	0.0000000	0.0000000
773	0.0000006	0.0000000	0.0000000

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
538	0.0024705	0.0111480	0.0002225
539	0.0025932	0.0111802	0.0002057
540	0.0027177	0.0112046	0.0001899
541	0.0028439	0.0112213	0.0001751
542	0.0029720	0.0112306	0.0001613
543	0.0031017	0.0112326	0.0001484
544	0.0032332	0.0112273	0.0001364
545	0.0033662	0.0112149	0.0001254
546	0.0035008	0.0111954	0.0001151
547	0.0036370	0.0111690	0.0001057
548	0.0037750	0.0111362	0.0000971
549	0.0039147	0.0110973	0.0000891
550	0.0040564	0.0110527	0.0000819
551	0.0042000	0.0110022	0.0000752
552	0.0043454	0.0109459	0.0000691
553	0.0044926	0.0108839	0.0000635
554	0.0046415	0.0108161	0.0000584
555	0.0047920	0.0107425	0.0000538
556	0.0049440	0.0106629	0.0000496
557	0.0050975	0.0105773	0.0000458
558	0.0052520	0.0104855	0.0000424
559	0.0054075	0.0103873	0.0000393
560	0.0055636	0.0102827	0.0000365
561	0.0057201	0.0101713	0.0000339
562	0.0058769	0.0100537	0.0000315
563	0.0060339	0.0099302	0.0000294
564	0.0061913	0.0098011	0.0000275
565	0.0063488	0.0096665	0.0000257
566	0.0065063	0.0095268	0.0000242
567	0.0066637	0.0093819	0.0000228
568	0.0068207	0.0092320	0.0000216
569	0.0069769	0.0090771	0.0000206
570	0.0071321	0.0089174	0.0000196
571	0.0072859	0.0087528	0.0000189
572	0.0074383	0.0085837	0.0000182
573	0.0075890	0.0084104	0.0000177
574	0.0077378	0.0082333	0.0000172
575	0.0078845	0.0080525	0.0000168
576	0.0080289	0.0078685	0.0000165
577	0.0081707	0.0076814	0.0000163
578	0.0083093	0.0074915	0.0000160
579	0.0084443	0.0072987	0.0000157
580	0.0085751	0.0071033	0.0000154
581	0.0087015	0.0069055	0.0000151
582	0.0088231	0.0067057	0.0000146

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
774	0.0000006	0.0000000	0.0000000
775	0.0000005	0.0000000	0.0000000
776	0.0000005	0.0000000	0.0000000
777	0.0000005	0.0000000	0.0000000
778	0.0000004	0.0000000	0.0000000
779	0.0000004	0.0000000	0.0000000
780	0.0000004	0.0000000	0.0000000
781	0.0000004	0.0000000	0.0000000
782	0.0000003	0.0000000	0.0000000
783	0.0000003	0.0000000	0.0000000
784	0.0000003	0.0000000	0.0000000
785	0.0000003	0.0000000	0.0000000
786	0.0000003	0.0000000	0.0000000
787	0.0000002	0.0000000	0.0000000
788	0.0000002	0.0000000	0.0000000
789	0.0000002	0.0000000	0.0000000
790	0.0000002	0.0000000	0.0000000
791	0.0000002	0.0000000	0.0000000
792	0.0000002	0.0000000	0.0000000
793	0.0000002	0.0000000	0.0000000
794	0.0000001	0.0000000	0.0000000
795	0.0000001	0.0000000	0.0000000
796	0.0000001	0.0000000	0.0000000
797	0.0000001	0.0000000	0.0000000
798	0.0000001	0.0000000	0.0000000
799	0.0000001	0.0000000	0.0000000
800	0.0000001	0.0000000	0.0000000
801	0.0000001	0.0000000	0.0000000
802	0.0000001	0.0000000	0.0000000
803	0.0000001	0.0000000	0.0000000
804	0.0000001	0.0000000	0.0000000
805	0.0000001	0.0000000	0.0000000
806	0.0000001	0.0000000	0.0000000
807	0.0000001	0.0000000	0.0000000
808	0.0000001	0.0000000	0.0000000
809	0.0000001	0.0000000	0.0000000
810	0.0000000	0.0000000	0.0000000
811	0.0000000	0.0000000	0.0000000
812	0.0000000	0.0000000	0.0000000
813	0.0000000	0.0000000	0.0000000
814	0.0000000	0.0000000	0.0000000
815	0.0000000	0.0000000	0.0000000
816	0.0000000	0.0000000	0.0000000
817	0.0000000	0.0000000	0.0000000
818	0.0000000	0.0000000	0.0000000

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
583	0.0089399	0.0065044	0.0000142
584	0.0090516	0.0063021	0.0000136
585	0.0091582	0.0060993	0.0000131
586	0.0092591	0.0058964	0.0000125
587	0.0093542	0.0056937	0.0000119
588	0.0094435	0.0054917	0.0000113
589	0.0095269	0.0052906	0.0000107
590	0.0096046	0.0050910	0.0000103
591	0.0096765	0.0048931	0.0000100
592	0.0097420	0.0046974	0.0000098
593	0.0098000	0.0045043	0.0000097
594	0.0098494	0.0043144	0.0000096
595	0.0098891	0.0041283	0.0000094

wavelength λ , (nm)	\bar{r}	\bar{g}	\bar{b}
819	0.0000000	0.0000000	0.0000000
820	0.0000000	0.0000000	0.0000000
821	0.0000000	0.0000000	0.0000000
822	0.0000000	0.0000000	0.0000000
823	0.0000000	0.0000000	0.0000000
824	0.0000000	0.0000000	0.0000000
825	0.0000000	0.0000000	0.0000000
826	0.0000000	0.0000000	0.0000000
827	0.0000000	0.0000000	0.0000000
828	0.0000000	0.0000000	0.0000000
829	0.0000000	0.0000000	0.0000000
830	0.0000000	0.0000000	0.0000000

Annex B Characteristics of ACES RGB Color Encoding (Informative)

Table B.1 provides a summary of specifications contained within this document and is intended to enable a comparison of the ACES RGB color encoding and other color encodings. The table summarizes the characteristics of the ACES RGB color encoding relative to the terminology and requirements defined in ISO 22028.

In some cases a particular characteristic found in the table is either not explicitly specified or is not applicable to the ACES RGB encoding. In such cases the table value for that attribute is specified as not applicable (N/A).

Table B.1 — Characteristics of ACES RGB Encoding

Attributes	Academy Color Encoding Specification (ACES)
Standard	SMPTE ST 2065-1
Color Space Characteristics	
Color Space Type	Colorimetric: RGB Color Space ^a
Color Gamut	Extended
Colorimetric Specification	Scene colors as measured at the focal plane of the ACES Reference Image Capture Device.
RGB Primaries	R: $x = 0.73470,$ $y = 0.26530$ G: $x = 0.00000,$ $y = 1.00000$ B: $x = 0.00010,$ $y = -0.07700$
Color Component Transfer Function	Linear
Luma-chroma matrix	N/A
Color space white point luminance	1.0 (relative)
Color space white point chromaticity	$x = 0.32168, y = 0.33767$
Color Space Characteristics	
Color space value range	Linear RGB: -65504.0 to +65504.0 ^b
Digital code value range	-65504.0 to +65504.0 (16-bit half float)
Color image encoding characteristics	
Image State	Scene Referred
Surround	"Normal" ^c
Adapted white point luminance	$\geq 1,600 \text{ cd/m}^2$
Adapted white point chromaticity	$x = 0.32168, y = 0.33767$
Luminance of adapting field	$\geq 1,600 \text{ cd/m}^2$
Viewing Flare	0%
Valid relative luminance range (excluding viewing flare and veiling glare)	-65504.0 to +65504.0
Reference medium white point luminance	N/A
Reference medium white point chromaticity	N/A
Reference medium black point luminance	N/A
Reference medium black point chromaticity	N/A
^a The ACES color space type can also be considered to be of the type input-device-dependent and as such has an associated reference image capture device known as the ACES reference image captured device (RICD). The spectral sensitivities of the RICD, which are linear combinations of the CIE 1931 color-matching functions, are tabulated in Annex A	
^b The set of valid ACES RGB values also includes members whose projection onto the CIE chromaticity diagram falls outside the region representing visible colors. These ACES RGB values include those with one or more negative ACES color component values; they also include those whose color component values are all positive and whose projection onto the chromaticity diagram is outside the spectral locus. Such colors ought to be maintained in anticipation of subsequent processing. Values well above 1.0 are expected and ought not be clamped except as part of the color correction needed to produce a desired artistic intent.	
^c Some other publications use the term 'average surround' where ACES uses 'normal surround'. These terms can be considered equivalent.	

Annex C ACES RICD Camera Flare (Informative)

The ACES RICD specified in Section 5.2.2 that captured camera stimuli are free of capture system noise.

The ACES RICD definition also includes the camera flare model specified in Section 5.2.2, which in turn was specified to match the simplest plausible model of camera flare that could be used with the RRT and produce a visually pleasing result.

This camera flare model assumes that captured color stimuli contain an amount of camera flare equal to 0.5% of the relative exposure values of a perfect reflecting diffuser. Moreover, it assumes that this level of camera flare is constant across the image plane and is constant for all values of captured content.

Figure C.1 below illustrates the effect of this addition of a constant level of camera flare and subsequent scaling (as specified in Section 5.2.2) to the RGB relative exposure values produced by the interaction of a captured spectral stimulus and the RICD's spectral sensitivities (given in Annex A), compared to the values which would have been recorded without applying the RICD's camera flare model, that is, without those addition and scaling operations.

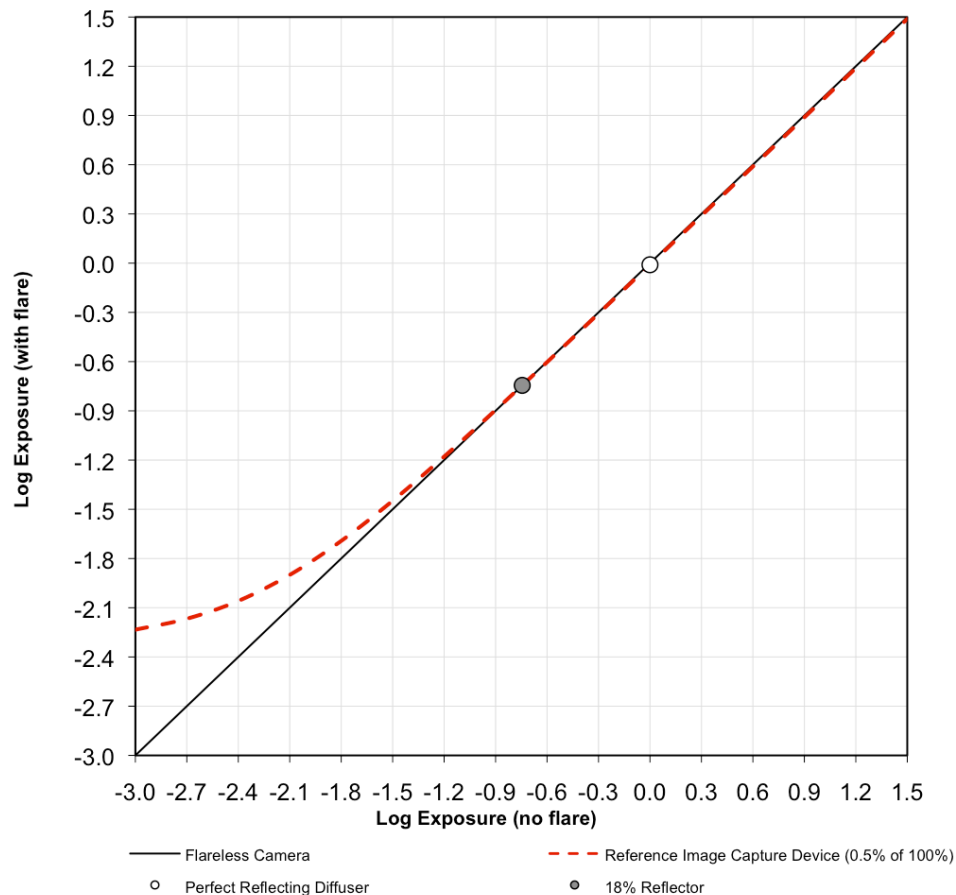


Figure C.1 — Flare Characteristics

Note: Though ACES data can be treated as being radiometrically linear the relationship between measurements containing camera flare and measurements not containing camera flare is presented here on logarithmic axes to make the difference between the two more visibly evident.

Annex D ACES RGB Values of Common Stimuli as Produced by the ACES RICD (Informative)

The values that the RICD would produce for a captured set of stimuli are determined by the spectral sensitivities of the RICD (tabulated in Annex A), the RICD capture system noise and camera flare model (described in Section 5.2.2), and the spectral power distribution of the stimuli being captured. As an aid to Input Device Transform (IDT) developers, Table D.1 presents the ACES RGB relative exposure values that the RICD would produce for an 18% neutral reflecting diffuser, a perfect reflecting diffuser and a color chart specified in ISO 17321-1 Tables C.2 and C.3, all illuminated by a CIE Standard Illuminant D₆₀ source.

Table D.1 — Color chart ACES values

Stimulus	ACES R	ACES G	ACES B
Spectrally non-selective 18% reflecting diffuser	0.18000	0.18000	0.18000
Perfect reflecting diffuser	0.97784	0.97784	0.97784
ISO 17321-1 C.2 Patch 1	0.11877	0.08709	0.05895
ISO 17321-1 C.2 Patch 2	0.40003	0.31916	0.23737
ISO 17321-1 C.2 Patch 3	0.18476	0.20398	0.31310
ISO 17321-1 C.2 Patch 4	0.10901	0.13511	0.06493
ISO 17321-1 C.2 Patch 5	0.26684	0.24604	0.40932
ISO 17321-1 C.2 Patch 6	0.32283	0.46208	0.40606
ISO 17321-1 C.2 Patch 7	0.38607	0.22744	0.05777
ISO 17321-1 C.2 Patch 8	0.13822	0.13037	0.33703
ISO 17321-1 C.2 Patch 9	0.30203	0.13752	0.12758
ISO 17321-1 C.2 Patch 10	0.09310	0.06347	0.13525
ISO 17321-1 C.2 Patch 11	0.34877	0.43655	0.10613
ISO 17321-1 C.2 Patch 12	0.48657	0.36686	0.08061
ISO 17321-1 C.3 Patch 13	0.08731	0.07443	0.27274
ISO 17321-1 C.3 Patch 14	0.15366	0.25692	0.09071
ISO 17321-1 C.3 Patch 15	0.21743	0.07070	0.05130
ISO 17321-1 C.3 Patch 16	0.58921	0.53944	0.09157
ISO 17321-1 C.3 Patch 17	0.30904	0.14818	0.27426
ISO 17321-1 C.3 Patch 18	0.14900	0.23377	0.35939
ISO 17321-1 C.3 Patch 19	0.86653	0.86792	0.85818
ISO 17321-1 C.3 Patch 20	0.57356	0.57256	0.57169
ISO 17321-1 C.3 Patch 21	0.35346	0.35337	0.35391
ISO 17321-1 C.3 Patch 22	0.20253	0.20243	0.20287
ISO 17321-1 C.3 Patch 23	0.09467	0.09520	0.09637
ISO 17321-1 C.3 Patch 24	0.03745	0.03766	0.03895

The color chart specified in ISO 17321-1 Tables C.2 and C.3 was chosen as an example reference for two reasons. First, it represents a ubiquitous color chart. Second, the spectral reflectances of its samples are such that differences in capture system camera flare behavior make little contribution to differences in captured values. When two digital cameras, for example, capture the chart lit by a daylight illuminant, the differences in their output will be due almost entirely to differences in camera spectral sensitivities.

Calculation of the values above used the following elements:

- the published CIE Standard Illuminant D_{60} spectral power distribution
- the area-normalized RICD spectral sensitivities from Annex A.
- red, green and blue scale factors k_r , k_g and k_b which white-balance those area-normalized RICD spectral sensitivities for CIE Standard Illuminant D_{60}
- hypothetical 18% and 100% neutral reflectors
- the spectral reflectances of the patches specified in ISO 17321-1 Tables C.2 and C.3

The scale factors applied to the RICD spectral sensitivity curves are each the reciprocal of the scalar product of that curve and the illuminant. These scale factors k_r , k_g and k_b are calculated using Equation D.1.

$$k_r = \frac{1}{I \cdot S_r}, k_g = \frac{1}{I \cdot S_g}, k_b = \frac{1}{I \cdot S_b}$$

Equation D.1

where I represents the illuminant and S_r , S_g and S_b represent the area-normalized spectral sensitivities from Annex C.

Once these scale factors have been determined, the ACES relative exposure values E_r , E_g and E_b are calculated using Equation D.2.

$$E_r = k_r \sum_i IRS_{ri}, E_g = k_g \sum_i IRS_{gi}, E_b = k_b \sum_i IRS_{bi}$$

Equation D.2

where (as before) I represents the illuminant and S_r , S_g , and S_b represent the area-normalized spectral sensitivities from Annex A, and where R represents the spectral reflectance of the object being captured.

IDT developers wishing to verify their understanding of the calculation are encouraged to compute the ACES RGB relative exposure values for the hypothetical 18% and 100% neutral reflectors and verify their results against the chart above. Since this calculation involves only ideal illuminant spectra, ideal reflectance spectra and ideal spectral sensitivities, the match to the table data for those reflectors ought to be exact.

If this test is followed by computation of ACES RGB values using the CIE Standard Illuminant D_{60} , the actual measured patch reflectances of the IDT developer's color chart, the RICD spectral sensitivities and the RICD camera flare model, the computed differences from the tabulated values above ought to provide a sense of how that actual color chart differs from the specified chart used in the creation of the table above.

In the likely case that the actual illuminant used with a particular color chart is other than CIE Standard Illuminant D_{60} , the IDT developer ought to generate a new table of RICD capture results, particular to the actual illuminant instead of to CIE Standard Illuminant D_{60} , and to the IDT developer's actual color chart. Three new scale factors k_r , k_g and k_b for the area-normalized RICD spectral sensitivity curves from Annex A ought to be determined, such that under the actual illuminant, the hypothetical 18% neutral reflector would be captured by the RICD with red, green and blue relative exposure values each equal to 0.18000 (including the contribution from and scaling implied by the RICD camera flare model). This procedure white-balances the RICD to a hypothetical gray card under the actual illuminant.

The contents of the resulting table can thus be compared with the output of the developer's IDT, when that IDT is supplied with the device values from the real camera being characterized, yielding a sense of how the real camera captures colors relative to the ideal behavior embodied by the RICD. Results for multiple cameras of the same type can be computed to assess camera-to-camera variance. When results for different types of cameras are computed, and the scene content to be photographed is known in advance, such calculations can aid the cinematographer in choosing an appropriate type of camera. This is especially true when anticipated use of the captured images requires them to adhere as closely as possible to actual scene colors, as is often the case in visual effects photography.

Annex E Bibliography (Informative)

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