SMPTE STANDARD

Academy Color Encoding Specification (ACES)

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Approved September 9, 2020

Foreword

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SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual. This SMPTE Engineering Document was prepared by Technology Committee 10E Essence.

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.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; then formal languages; then figures; and then any other language forms.

The following changes were made during the revision process:

- Reference Image Capture Device definition updated and moved to normative Annex A
- Reference Image Capture Device definition changed from a list of tabulated values to a mathematical formula
- Editorial changes

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 Color Encoding System. 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 Image 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 ACES Input Transform (formerly referred to as an Input Device Transform, or 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.

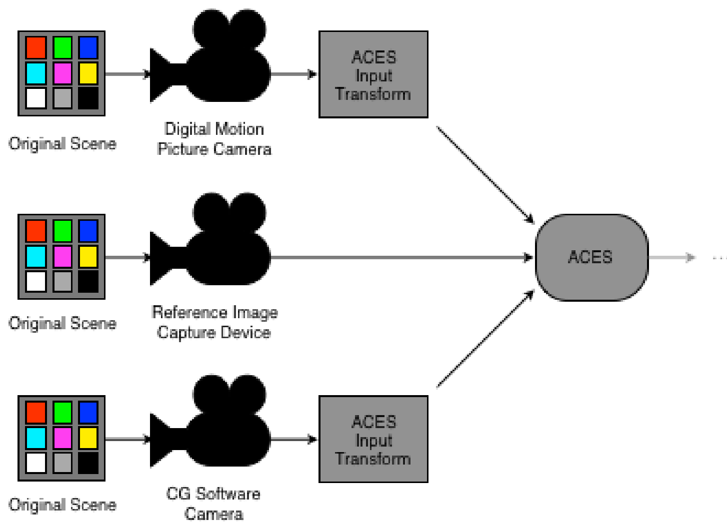

Figure 1 — Creation of ACES images from various image capture devices

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, an ACES Output Transform (formerly referred to as an Output Device Transform, or ODT) is used to produce a viewable image for a selected output device. Figure 2 illustrates the ACES image capture and reproduction pipeline using the RICD.

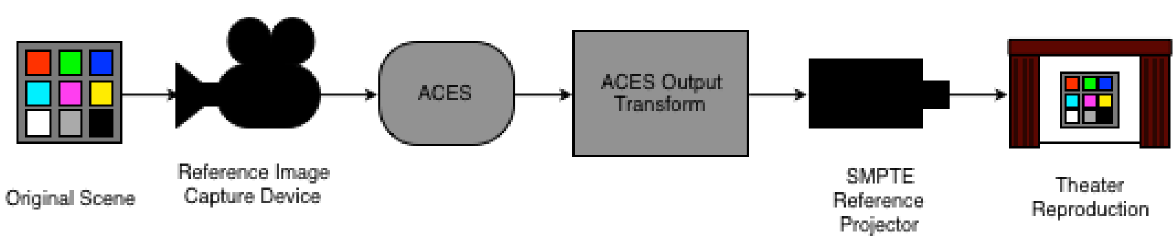

Figure 2 — ACES Capture and Reproduction using the RICD

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 Academy Color Encoding System 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.

At the time of publication, no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. 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.

1 Scope

This document specifies the Academy Color Encoding Specification (ACES). ACES is an RGB color encoding for exchange of image data that have not been color rendered.

2 Normative references

The following standards contain provisions that, through reference in this text, constitute provisions of this standard. Dated references require that the specific edition cited shall be used as the reference. Undated citations refer to the edition of the referenced document (including any amendments) current at the date of publication of this document. All standards are subject to revision, and users of this engineering document are encouraged to investigate the possibility of applying the most recent edition of any undated reference.

CIE 015:2018, Colorimetry, 4th edition

IEEE Std 754-2019, IEEE Standard for Floating-Point Arithmetic

ISO 22028-1:2016, Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 1: Architecture and requirements

ISO/CIE 11664-1:2019, Colorimetry — Part 1: CIE Standard Colorimetric Observers

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22028-1 and the following apply:

3.1
average surround
surround 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

3.2
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

3.3
capture system noise
positive or negative signal value fluctuations, unmodulated by scene image content, introduced into an image by the image capture system

3.4

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

3.5
Reference Image Capture Device
RICD
hypothetical camera with defined spectral sensitivities

3.6
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

3.7
scaled XYZ color space
color space based upon the CIE 1931 Standard Colorimetric Observer, with *X*, *Y*, and *Z* tristimulus values uniformly scaled such that the *Y* tristimulus value of a perfect reflecting diffuser is 1.0

3.8
surround
area adjacent to the border of an image, which, upon viewing the image, can affect the local state of adaptation of the eye

3.9
viewing environment
context in which a color stimulus is viewed, producing a color appearance

Note 1 to entry: Typical viewing environment components include viewing flare, surround, absolute luminance and observer adapted white.

4 Academy Color Encoding Specification (ACES)

4.1 General

The Academy Color Encoding Specification (ACES) is an RGB color encoding for exchange of image data that have not been color rendered. 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.

A summary of the Academy Color Encoding Specification is given in Annex B.

4.2 ACES color space

4.2.1 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 Capture Device (RICD).

4.2.2 Colorimetric specification

ACES *R*, *G*, and *B* values shall represent scene colors as measured at the focal plane of the ACES Reference Image Capture Device (RICD).

The ACES RICD shall determine idealized ACES values for real image capture systems to target in the practical conversion of photographic exposures. The RICD and its characteristics are specified in Annex A.

4.2.3 RGB primaries chromaticity values

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

Table 1 — ACES RGB primaries chromaticity values

	CIE *x*	CIE *y*
Red	0.7347	0.2653
Green	0.0	1.0
Blue	0.0001	–0.077

4.2.4 Color space white point

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

Table 2 — ACES RGB white point chromaticity values

	CIE *x*	CIE *y*
White	0.32168	0.33767

NOTE The total absence of light is represented by CIE $X = 0.0$, $Y = 0.0$, $Z = 0.0$

4.2.5 Converting ACES RGB values to CIE XYZ tristimulus values

ACES RGB values shall be converted to scaled CIE XYZ tristimulus values using the normalized primary matrix (NPM). The NPM shall be derived as defined in SMPTE RP 177 using the color space chromaticity coordinates specified in sections 4.2.3 and 4.2.4.

Equation (1) shows the relationship between ACES RGB values and scaled CIE XYZ tristimulus values.

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = NPM \cdot \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{1}$$

where

R, G, B	are ACES RGB values, as defined in 4.2.2
X, Y, Z	are CIE XYZ tristimulus values, as defined in CIE 015
NPM	is the normalized primary matrix as defined in SMPTE RP 177

EXAMPLE: The NPM calculated using the color space chromaticity coordinates specified in sections 4.2.3 and 4.2.4. The elements are rounded to 10 decimal places.

$$NPM = \begin{bmatrix} 0.9525523959 & 0.0 & 0.0000936786 \\ 0.3439664498 & 0.7281660966 & -0.0721325464 \\ 0.0 & 0.0 & 1.0088251844 \end{bmatrix}$$

4.2.6 Converting CIE XYZ tristimulus values to ACES RGB values

CIE XYZ tristimulus values shall be converted to ACES RGB values using the matrix inverse of the normalized primary matrix specified in section 4.2.5.

Equation (2) shows the relationship between scaled CIE XYZ tristimulus values and ACES RGB values.

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = NPM^{-1} \cdot \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \tag{2}$$

where

R, G, B	are ACES RGB values, as defined in 4.2.2
X, Y, Z	are CIE XYZ tristimulus values, as defined in CIE 015
NPM^{-1}	is the matrix inverse of the normalized primary matrix

4.2.7 Color component transfer function

The color component transfer function to encode relative exposure values that would be captured from the scene by the RICD as ACES color component values shall be linear. The calculation of the resulting ACES color component values shall be as specified by equation (3).

$$R = E_r\,, \quad G = E_g\,, \quad B = E_b \tag{3}$$

where

E_r, E_g, E_b	are relative exposure values that would be captured from the scene by the ACES RICD
R, G, B	are the resulting ACES color component values, as defined in 4.2.2

4.3 ACES color space encoding

4.3.1 Color space

The color space shall be the ACES color space specified in section 4.2.

4.3.2 Digital encoding method

4.3.2.1 Floating-point digital encoding

ACES values shall be encoded as 16-bit floating-point numbers using binary16. The binary16 format is specified in IEEE 754.

NOTE: Binary16 is also known as half precision.

4.3.2.2 Color component value range

The valid color component value range shall be [–65 504.0, +65 504.0].

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 Binary16 allows encoding of non-real number values, including NaN (Not a Number), Inf (Positive Infinity), –Inf (Negative Infinity), and –NaN (Negative Not a Number). Such values representing non-real numbers are not valid ACES values but are valid binary16 values and might still be present in files. Implementers are advised that such values might be present. The interpretation and processing of such values is beyond the scope of this document.

NOTE 2 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 3 ACES is scaled such that a perfect reflecting diffuser under a particular illuminant produces ACES values of 1.0 (prior to the flare addition and the scaling operation specified in Annex A). Many scenes include objects with radiance values greater than that of a perfect reflecting diffuser. Therefore, ACES values well above 1.0 are expected.

4.4 ACES color image encoding

4.4.1 Color space encoding

The color space encoding shall be the ACES color space encoding specified in Section 4.3.

4.4.2 Image state

The image state shall be scene-referred as defined by ISO 22028-1.

4.4.3 Reference image viewing environment

4.4.3.1 Image surround

The ACES reference viewing environment shall have an average surround.

4.4.3.2 Assumed adapted white point

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

4.4.3.3 Luminance of adapting field

The luminance level of the adapting field shall be consistent with luminance levels typical of daylight-illuminated outdoor scenes, in which a perfect reflecting diffuser would have a luminance level of at least 1 600 cd/m^2.

NOTE In cases where the luminance of the the original scene differs from the luminance of the adapting field of the ACES reference viewing environment, the creator of the ACES image can choose to compensate for that difference using a variety of methods, but often the desired creative intent will be realized without such compensation.

4.4.3.4 Viewing flare

The reference viewing environment shall have 0 % viewing flare.

NOTE Viewing flare is unrelated to camera flare. Camera flare is specified in Annex A.

Annex A ACES Reference Image Capture Device (normative)

The ACES Reference Image Capture Device (RICD) records an image of a scene directly as ACES RGB relative exposure values.

The RICD 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 ACES RICD has the spectral sensitivities $\bar{r}$, $\bar{g}$, $\bar{b}$, normalized such that the summation of values in each is equal to 1.0, as shown in equation (4) and equation (5).

$$\begin{bmatrix} S_r \\ S_g \\ S_b \end{bmatrix} = NPM^{-1} \cdot \begin{bmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{bmatrix} \tag{4}$$

where

NPM^{-1}	is the matrix inversion of the normalized primary matrix calculated as defined in SMPTE RP 177 and using the color space chromaticity coordinates specified in 4.2.3 and 4.2.4
$\bar{x}, \bar{y}, \bar{z}$	are the color matching functions of the CIE 1931 standard colorimetric observer sampled at 1 nm wavelength intervals from 360 nm to 830 nm, specified in Table 1 of ISO 11664-1
S_r, S_g, S_b	are the pre-normalized red, green, and blue spectral sensitivities of the ACES RICD sampled at 1 nm wavelength intervals from 360 nm to 830 nm

$$\bar{r} = \frac{S_r}{\sum_i S_{ri}}, \quad \bar{g} = \frac{S_g}{\sum_i S_{gi}}, \quad \bar{b} = \frac{S_b}{\sum_i S_{bi}} \tag{5}$$

where

S_r, S_g, S_b	are the pre-normalized red, green, and blue spectral sensitivities of the ACES RICD sampled at 1 nm wavelength intervals from 360 nm to 830 nm
$\bar{r}, \bar{g}, \bar{b}$	are red, green, and blue spectral sensitivities of the ACES RICD, sampled at 1 nm wavelength intervals from 360 nm to 830 nm and scaled such that the summation of each is equal to 1

The ACES RICD is free of capture system noise.

Calculations using the RICD should introduce camera flare equal to 0.5 % of the captured values of a perfect reflecting diffuser. Flare-augmented values should then be scaled by the factor *S,* defined in equation (6).

$$S = \frac{0.18}{0.18 + 0.005} \tag{6}$$

where

0.18	is the reflectance of an 18 % perfect reflecting diffuser
0.005	is the camera flare equal to 0.5 % of a 100 % perfect reflecting diffuser

NOTE 1 More information on the ACES RICD camera flare model can be found in Annex C.

NOTE 2 The scale factor, *S*, is designed to renormalize values such that capture of an 'ideal' 18 % gray card (isotropic, non-fluorescing and spectrally nonselective) will produce relative ACES exposure values of [0.18, 0.18, 0.18] (after flare addition and scaling).

NOTE 3 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 4 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 5 For the ACES RICD, camera flare is normally considered to be equivalent to veiling glare.

NOTE 6 ACES RGB values of common stimuli, as produced by the ACES RICD, are tabulated in Annex D.

The ACES RICD spectral sensitivities are illustrated in Figure A.1.

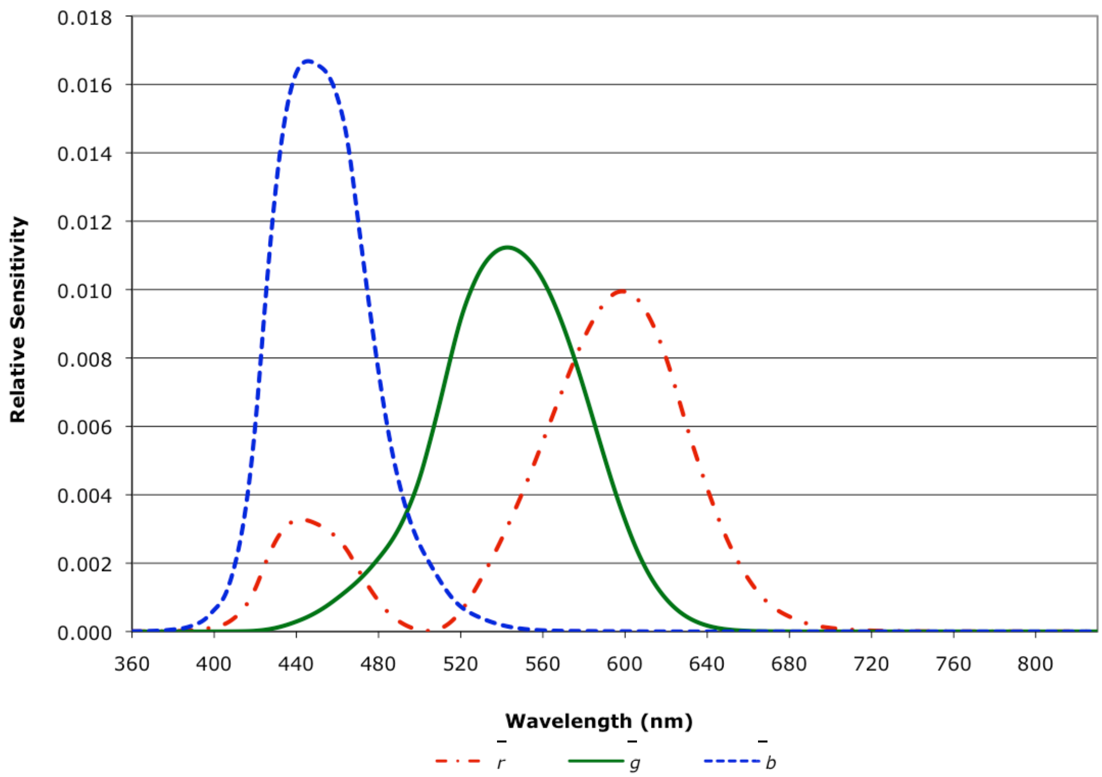

Figure A.1 — ACES RICD Spectral Sensitivities

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 22028-1.

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 encoding characteristics	
Color space value range	Linear RGB: –65 504.0 to +65 504.0 [b]
Digital code value range	–65 504.0 to +65 504.0 (16-bit half float)
Color image encoding characteristics	
Image State	Scene Referred
Surround	Average
Adapted white point luminance	>= 1 600 cd/m^2
Adapted white point chromaticity	x = 0.32168, y = 0.33767
Luminance of adapting field	>= 1 600 cd/m^2
Viewing Flare	0 %
Valid relative luminance range **(excluding viewing flare and veiling glare)**	–65 504.0 to +65 504.0
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 Capture Device (RICD). The spectral sensitivities of the RICD, which are linear combinations of the CIE 1931 color-matching functions, are defined 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 can be maintained in anticipation of subsequent processing. Values well above 1.0 are expected. Values are not expected to be clamped except as part of the color correction needed to produce a desired artistic intent.

Annex C ACES RICD camera flare (informative)

The ACES RICD is defined such that captured camera stimuli are free of capture system noise. The ACES RICD definition also includes a simple camera flare model, which was chosen as the simplest plausible model of camera flare that could be used with an ACES Output Transform 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 illustrates the effect of the addition of a constant level of camera flare and subsequent scaling to the RGB relative exposure values produced by the interaction of a captured spectral stimulus and the RICD's spectral sensitivities, 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.

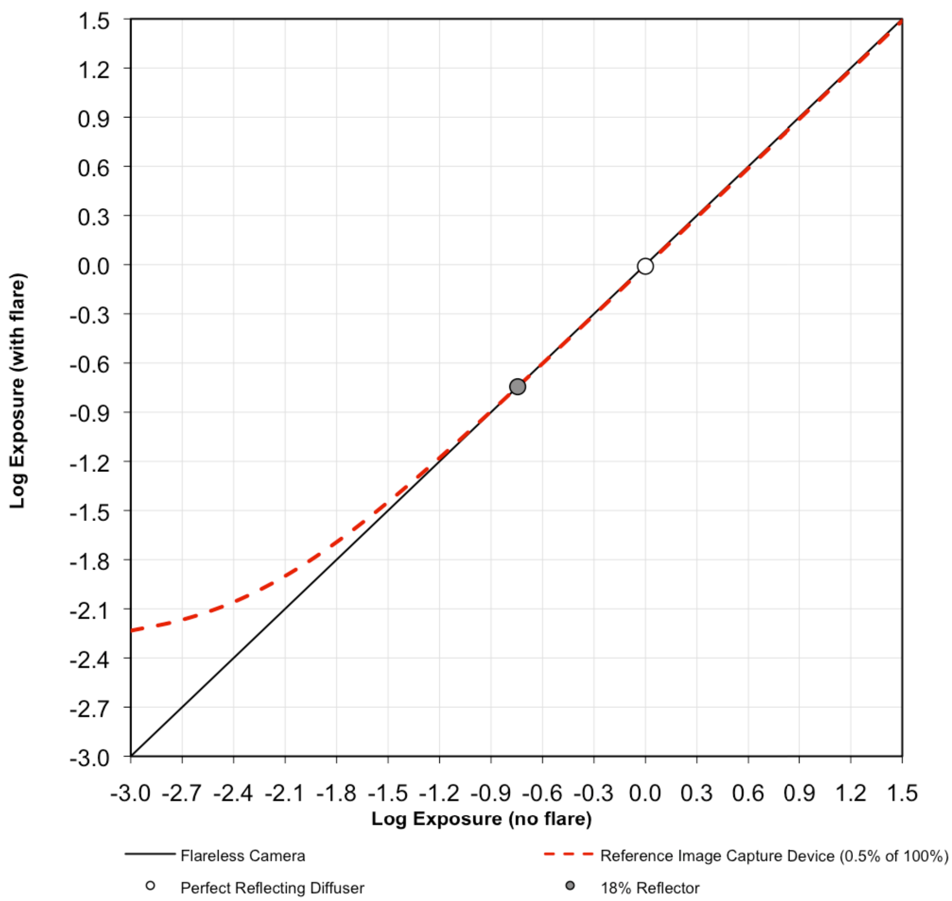

Figure C.1 — Flare Characteristics

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 (informative)

Tables D.1 and D.2 provide ACES RGB relative exposure values for an 18 % neutral reflecting diffuser, a perfect reflecting diffuser and a color chart that is specified in ISO 17321-1 Tables C.2 and C.3, as illuminated by a both a CIE D Illuminant for 6000 K and a 3200 K Planckian blackbody radiator, respectively.

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 reflectance values 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.

The values that the RICD would produce for a captured set of stimuli are determined using the following elements:

- the spectral power distribution of the capture illumination
- hypothetical 18 % and 100 % neutral reflectors
- the spectral reflectance values of the patches specified in ISO 17321-1 Tables C.2 and C.3
- the area-normalized RICD spectral sensitivities from Annex A
- the RICD capture system noise and camera flare model

It is generally desirable to provide compensation to reconcile differences between the chromaticity of the scene adopted white and the ACES neutral chromaticity. This can be achieved using different approaches that variously model standard practice in film and digital still camera workflows. The full procedure for re-encoding actual camera exposures into an ACES colorimetric encoding is beyond the scope of this document.

The calculation of the values in Tables D.1 and D.2 used a CAT02 chromatic adaptation matrix (see CIE 159) to compensate for the differences between the capture illuminant's chromaticity and the ACES encoding white point.

ACES Input Transform 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 first two data rows in Tables D.1 and D.2. Since this calculation involves only ideal illuminant spectra, ideal reflectance spectra and ideal spectral sensitivities, the match to the table data for those reflectors is expected to be exact.

Table D.1 — Color chart ACES values for 6000 K CIE D Illuminant chart illumination

Stimulus	ACES *R*	ACES *G*	ACES *B*
Spectrally non-selective 18 % reflecting diffuser	0.18	0.18	0.18
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	0.40002	0.31916	0.23736
ISO 17321-1 C.2 Patch 3	0.18476	0.20398	0.31311
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	0.38605	0.22743	0.05777
ISO 17321-1 C.2 Patch 8	0.13822	0.13037	0.33703
ISO 17321-1 C.2 Patch 9	0.30202	0.13752	0.12758
ISO 17321-1 C.2 Patch 10	0.09310	0.06347	0.13525
ISO 17321-1 C.2 Patch 11	0.34876	0.43654	0.10613
ISO 17321-1 C.2 Patch 12	0.48655	0.36685	0.08061
ISO 17321-1 C.3 Patch 13	0.08732	0.07443	0.27274
ISO 17321-1 C.3 Patch 14	0.15366	0.25692	0.09071
ISO 17321-1 C.3 Patch 15	0.21742	0.07070	0.05130
ISO 17321-1 C.3 Patch 16	0.58919	0.53943	0.09157
ISO 17321-1 C.3 Patch 17	0.30904	0.14818	0.27426
ISO 17321-1 C.3 Patch 18	0.14901	0.23378	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

Table D.2 — Color chart ACES values for 3200K Planckian blackbody chart illumination

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	0.12717	0.09035	0.06044
ISO 17321-1 C.2 Patch 2	0.42632	0.32385	0.24624
ISO 17321-1 C.2 Patch 3	0.17744	0.20111	0.30565
ISO 17321-1 C.2 Patch 4	0.10519	0.13269	0.06866
ISO 17321-1 C.2 Patch 5	0.27148	0.24442	0.39925
ISO 17321-1 C.2 Patch 6	0.30238	0.44250	0.41790
ISO 17321-1 C.2 Patch 7	0.41889	0.25068	0.06615
ISO 17321-1 C.2 Patch 8	0.13521	0.12942	0.32328
ISO 17321-1 C.2 Patch 9	0.34513	0.14904	0.12907
ISO 17321-1 C.2 Patch 10	0.09869	0.06538	0.12778
ISO 17321-1 C.2 Patch 11	0.33584	0.43109	0.12578
ISO 17321-1 C.2 Patch 12	0.51058	0.38935	0.09484
ISO 17321-1 C.3 Patch 13	0.08458	0.07504	0.25993
ISO 17321-1 C.3 Patch 14	0.13562	0.24661	0.10090
ISO 17321-1 C.3 Patch 15	0.26348	0.07701	0.05404
ISO 17321-1 C.3 Patch 16	0.60762	0.55093	0.11822
ISO 17321-1 C.3 Patch 17	0.35141	0.15664	0.26417
ISO 17321-1 C.3 Patch 18	0.13899	0.21633	0.36129
ISO 17321-1 C.3 Patch 19	0.86744	0.86754	0.86072
ISO 17321-1 C.3 Patch 20	0.57346	0.57297	0.57198
ISO 17321-1 C.3 Patch 21	0.35306	0.35364	0.35383
ISO 17321-1 C.3 Patch 22	0.20229	0.20259	0.20279
ISO 17321-1 C.3 Patch 23	0.09439	0.09522	0.09623
ISO 17321-1 C.3 Patch 24	0.03736	0.03763	0.03884

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