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SMPTE STANDARD

for Television — Color Reference Pattern



Page 1 of 13 pages

1 Scope

This standard defines the electrical and physical representation of a television color reference pattern. It also specifies colorimetry, geometry, and related parameters.

2 Colorimetry

2.1 Colorimetric data in tables 1, 2, and 3 represent the color reference pattern using white-point definitions for television (D₆₅), studio lighting (3100 K), and film (D₅₅). The data are based on a 2° standard observer (CIE S002).

2.2 The CIE tristimulus data specified in tables 1, 2, and 3 are aim-point specifications for each color reference pattern sample.

2.3 Common television practice is to set up the camera for the desired appearance on a D65 monitor, regardless of the original scene illumination. Therefore, tables 4, 5, 6, and 7 are based on D65, and values for 3100 K studio lighting are not included. The values in table 8, based on D55, should not be used for television.

3 Geometry

3.1 The color reference pattern is made up of 24 sample colors whose colorimetric designations are distributed throughout the color television gamut. These samples are square and arranged in four rows of six samples per row. The first two rows consist of colors that are designed to simulate the color appearance of natural objects. The third row consists of colors that represent subtractive primaries (cyan, magenta, and yellow) as well as the binary combinations of these colors (red, green, and blue). The last row consists of a six-step neutral gray scale; the neutral numbers are Munsell values.

3.2 Each color sample is represented as a square 18% of picture height.

3.3 The rows and columns of color samples are separated by black spaces around the color samples. The black spaces are 3% of picture height.

3.4 The six columns of color samples are surrounded by a black border on the left and right. The left and right borders are 5% of picture height at 4:3 aspect ratio and 27.5% of picture height at 16:9 aspect ratio.

The four rows of color samples are surrounded by a black border at the top and bottom of the chart. The top and bottom borders are defined to be 9.5% of picture height for both 4:3 and 16:9 aspect ratios. Some existing charts have a 5% border and do not provide 4:3 aspect ratio. These older charts should be framed to fill a 4:3 raster horizontally, giving overscan at the top and bottom of the chart. They should be overscanned both vertically and horizontally in 16:9 applications to match best the geometric specifications of this standard (see figure 1).

4 Video color representations

4.1 All video signal levels are calculated using SMPTE RP 177, the standard television system D₆₅ white point, and each of the following standard television primary colorimetry definitions: ITU-R BT.709, SMPTE 170M / SMPTE 240M, PAL (EBU), and original NTSC (1953 FCC) (see table 9). In addition, a set of video color representations is calculated using illuminant D₅₅ for only the ITU-R BT.709 primaries.

4.2 The linear video signal levels in tables 4 through 8 are video voltages ranging between 0.0 V (black) and 1.0 V (white). The user must apply the appropriate gamma or transfer characteristic. Because of the number of possible gamma or transfer curves which could be used, no gamma correction is applied to any of the video representations listed in this standard.

4.3 Any color sample having any video levels outside the 0.0 V to 1.0 V range cannot be reproduced using the reference primaries for that system. For example, the cyan sample 18 results in a negative red value with ITU-R BT.709, PAL, and SMPTE 240M primaries and a D₆₅ white point. Both yellow sample 16 and cyan sample 18 result in negative values with illuminant D₅₅ and ITU-R BT.709 primaries (see figure 2).

4.4 The video signal levels in tables 4 through 8 assume that 1.0 V corresponds to a perfect 100% white reflector.

5 Considerations in using the color reference pattern

5.1 The color reference pattern should be illuminated and the camera positioned as shown in figure 3. The illuminator, camera, and reference pattern should be in the same horizontal plane. The illuminator should be positioned to the side at 45° off camera axis. Two illuminators, one on each side, may make it easier to achieve uniform illumination.

5.2 The camera should be properly set up using other appropriate test patterns. The gray samples on this reference pattern are not intended to be used for setting camera color balance, white levels, or black levels. The preferred white reference is a 100% reflecting white sample, such as halon or barium sulfate. Alternately, gain may be set to match the white levels shown in tables 4-8. The preferred black level reference is a capped lens or light trap.

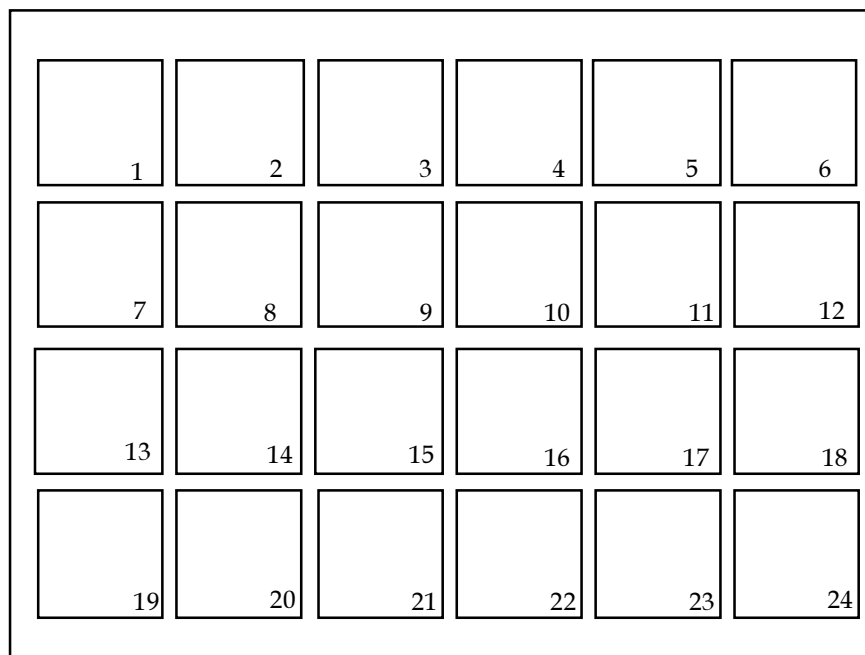


Figure 1 – Color reference pattern sample numbers

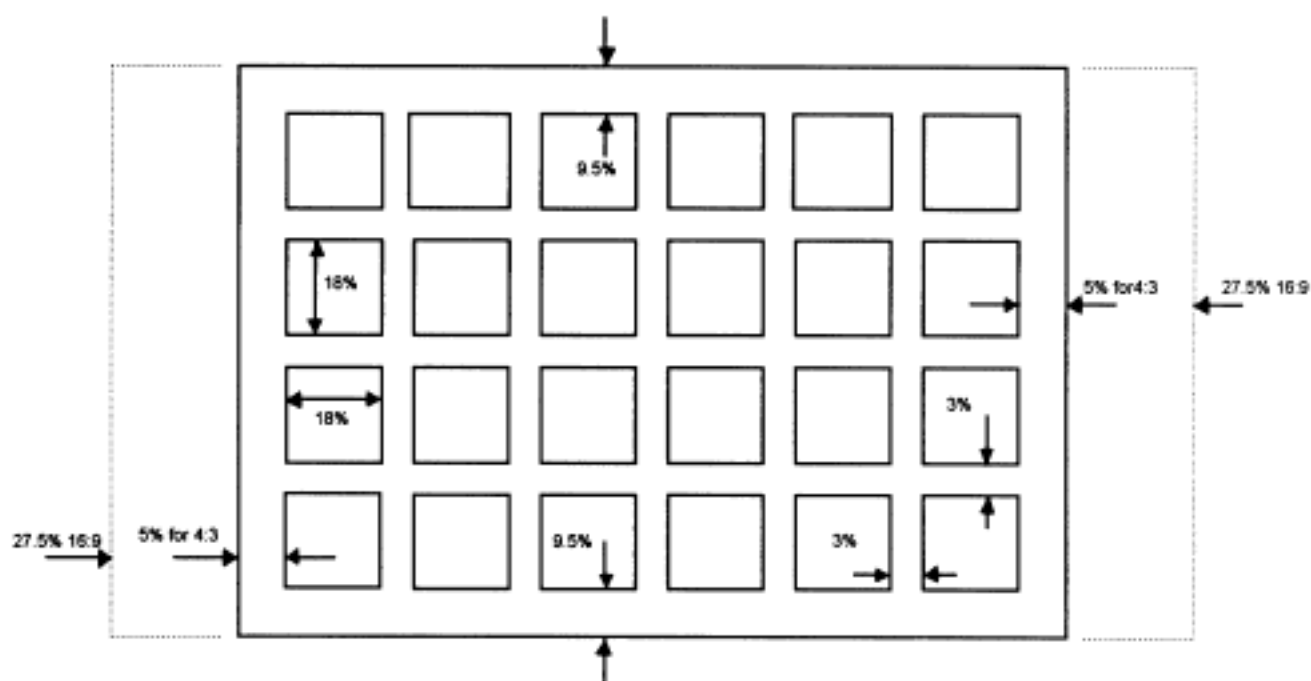


Figure 2 – Color reference pattern geometry expressed in percentage of picture height

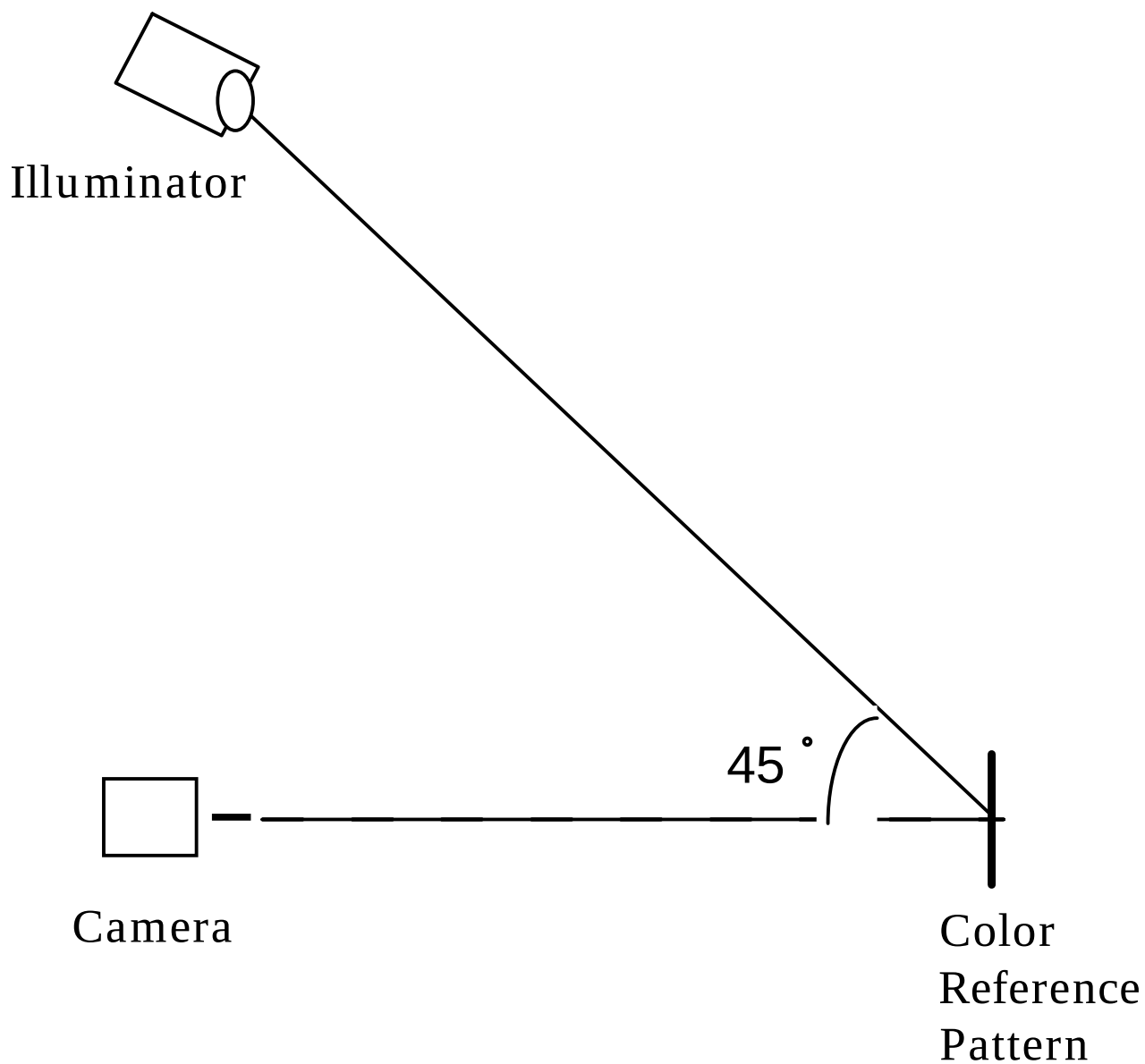


Figure 3 – Measurement configuration