RP 428-6-2009

SMPTE RECOMMENDED PRACTICE

D-Cinema Distribution Master — Digital Leader

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Approved June 3, 2009

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, Recommended Practices 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 Recommended Practice RP 428-6 was prepared by Technology Committee 21DC.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Recommended Practice. 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 document describes the makeup and use of a digital leader primarily intended for use in digital cinema. Although the use of a leader is not necessary for digital cinema exhibition, it is nevertheless useful as a known reference for verifying that the program content distributed with the leader appears correct if an optional playlist is used to view the leader. It is also useful during post production to provide a known "first frame" (beginning of file sequence) and a "sync pop" frame for combining multiple picture and sound elements. The image is described as filling the entire "2K" image size of 2048 x 1080 pixels, or the "4K" image size of 4096 x 2160 pixels. In practice, the imagery of the digital leader will be cropped to the same aspect ratio as the program content that it is associated with. Similarly, although the code values for colors and gray levels presented in this document are defined according to the *X'Y'Z'* color space described in SMPTE RP 431-2, the colors and gray levels would be converted to the appropriate color space and code values if the associated program content used a different color space. The description of the digital leader is presented in a general manner so that it may also describe a leader used for content intended to be presented at frame rates other than at 24 frames per second and/or for stereoscopic content.

This document also describes the use of a "sync pop" tone that may be used to verify synchronization between picture and sound. An optional foot leader with an optional sync pop is also described.

1 Scope

This recommended practice is intended to specify the source images and make-up of leaders and use of sound synchronization cue marks and tones as part of a Digital Cinema Distribution Master (DCDM) as described in SMPTE 428-1 and/or as part of a Digital Cinema Package (DCP).

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.

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.

3 Normative References

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

SMPTE 428-1-2006, D-Cinema Distribution Master — Image Characteristics

SMPTE 428-3-2006, D-Cinema Distribution Master — Audio Channel Mapping and Channel Labeling

SMPTE RP 155-2004, Motion-Picture and Television — Reference Level for Digital Audio Systems

4 Overview

This document describes a countdown leader that is intended to be used in a manner similar to the use of the Universal Leader defined by ASA PH22.55-1966 and SMPTE 55-2000. The Universal Leader is based upon a sweeping clock arm completing one revolution per second, with a decrementing large numeral to assist in synchronization and projection. Most of the other types of film leaders are typically based upon film footage and typically do not have the sweeping clock arm. Virtually all types of film leaders have additional content

including identification and protection sections which are not needed for a Digital Leader and are thus not included as part of this specification. A “sync pop” synchronization verification tone similar to the one described in SMPTE RP 25 is included as part of the Digital Leader.

Throughout this document, there are references to “2K” and “4K” images. “2K” refers to an image that is 2048 × 1080 pixels prior to cropping the image to a different aspect ratio, and “4K” refers to an image that is 4096 × 2160 pixels prior to cropping. The “Digital Leader” described in this document is based upon a common image format that completely fills these areas. The actual Digital Leader used in a final Digital Cinema Package (DCP) or other content may be a cropped and modified version of the original imagery. For example, there is a provision for a stereoscopic indicator for left-eye and right-eye views that would be absent for non-stereoscopic content.

5 Image Content

5.1 Background Image Colors

Unless otherwise specified, for the purposes of this document the definitions of the shades of gray using the 12-bit *X'Y'Z'* code values shown in Table 1 shall apply. Included in the table are the gray shades “countdown light-gray” and “countdown dark-gray” which are used in the countdown area of the image, and “gamma-match gray” which is a gray shade that is approximately the same shade as what the eye would see upon looking at slightly defocused alternating white and black lines.

Table 1 – 12-bit code values for general shades of gray

SHADE OF GRAY	*X'*	*Y'*	*Z'*
White	3794	3960	3890
Near-white	3612	3770	3703
Black	0	0	0
Background-gray	570	595	585
Mid-gray	1897	1980	1945
Countdown light-gray	3035	3168	3112
Countdown dark-gray	1518	1584	1556
Gamma-match gray	2906	3033	2979

The 12-bit code values for the ten gray shades ranging from near-black to white shall be as defined in Table 2.

Note: These code values are based upon the code values that are given in Table A-2 of SMPTE 431-2.

Table 2 – 12-bit code values for full-range near-black to white gray step-scale pattern

STEP	*X′*	*Y′*	*Z′*
1	379	396	389
2	759	792	778
3	1138	1188	1167
4	1518	1584	1556
5	1897	1980	1945
6	2276	2376	2334
7	2656	2772	2723
8	3035	3168	3112
9	3415	3564	3501
10	3794	3960	3890

The 12-bit code values for the ten gray shades ranging from black to a dark shade of gray shall be as defined in Table 3.

Note: These code values are based upon the code values that are given in Table A-3 of SMPTE 431-2, except that the lightest shade of gray has been removed and a new step using the code values for Black has been added to the pattern.

Table 3 – 12-bit code values for dark gray step-scale pattern

STEP	*X′*	*Y′*	*Z′*
1	0	0	0
2	122	128	125
3	245	255	251
4	367	383	376
5	490	511	502
6	612	639	627
7	734	766	753
8	857	894	878
9	979	1022	1004
10	1101	1150	1129

The 12-bit code values for other colors shall be as defined in Table 4.

Note: These code values are based upon the code values that are given in Table A-4 of SMPTE RP 431-2, except that for the Red-1 color the code value for *Z′* is “0” rather than “100”. This is to ensure the proper code values are obtained if the image is converted from RGB to *X′Y′Z′*. (The *Z′* value of “100” was used for Red-1 in SMPTE RP 431-2 to avoid the use of “0”.)

Table 4 – 12-bit code values for colors

Color	*X'*	*Y'*	*Z'*
Red-1	2901	2171	0
Green-1	2417	3493	1222
Blue-1	2014	1416	3816
Cyan-1	2911	3618	3890
Magenta-1	3289	2421	3814
Yellow-1	3494	3853	1221
Red-2	2738	2171	1233
Green-2	2767	3493	2325
Blue-2	1800	1416	3203
Cyan-2	3085	3590	3756
Magenta-2	3062	2421	3497
Yellow-2	3461	3777	2065

5.2 Duration

The Digital Leader shall be exactly 8 seconds in duration. Thus, for 24 frames per second content, the Digital Leader is 192 frames in duration.

5.3 "Picture Start" Frame

Frame 1 – The first frame of the Digital Leader shall consist of the words "PICTURE START" using all upper case letters using a black sans-serif font against a countdown light-gray background. The letters of the word "PICTURE" shall be approximately 20% of the un-cropped image height; thus the letters will be approximately 216 pixels in height for 2K imagery and approximately 432 pixels in height for 4K imagery. The letters of the word "START" shall be approximately 45% of un-cropped the image height; thus the letters will be approximately 486 pixels tall for 2K imagery and approximately 972 pixels tall for 4K imagery. To account for cropping and the screen masking, the letters of both words shall be contained in a rectangular area that is bounded ± 400 pixels vertically from the center of the image for 2K imagery (± 800 pixels vertically for 4K imagery) and ± 720 pixels horizontally from the center of the image for 2K imagery (± 1440 pixels horizontally for 4K imagery). The "Picture Start" frame shall correspond to a frame that is 8 seconds before the beginning of the program content.

5.4 Countdown Frames

Note: For the sake of clarity, the frame counts listed for the remainder of Section 5 and its subsections are for 24 frame-per-second content only as an example. This example of a Digital Leader is illustrated in Figure 1. For other frame rates, the descriptions are the same except the frame counts will be different.

Frame 2 – The frame following the "PICTURE START" frame shall consist of the background image as described in Section 6, with the numeral "8" shown as the countdown numeral and with the clock arm positioned at a clockwise angle relative to the 12:00 hour position equal to 360 degrees divided by the frames per second rate of the content. Thus, for 24 frames per second content, the clock arm would be 15 degrees clockwise past the 12:00 hour position for the first frame following the "PICTURE START" frame.

Frames 3-24 – For subsequent frames until the frame corresponding to 7 seconds before the first frame of action, the countdown numeral "8" shall persist with the clock arm advancing clockwise each frame at an angle of 360 degrees divided by the frames per second rate of the content for each frame. The background within the concentric circles shall be countdown light-gray in advance of the clock arm and countdown dark-gray trailing the clock arm.

Frame 25 – At the frame corresponding to 7 seconds before the first frame of action, the countdown numeral shall change to a "7"; the background within the outer countdown circle shall change back to countdown light-gray; and the inner concentric countdown circle and the sweeping clock arm and the crosshairs between the outer concentric circle and the focus squares in the center of the frame shall not be present.

Frames 26-48 – For subsequent frames until the frame corresponding to 6 seconds before the first frame of action, the countdown numeral "7" shall persist with the clock arm advancing clockwise each frame at an angle of 360 degrees divided by the frames per second rate for each frame. The background within the concentric circles shall be countdown light-gray in advance of the clock arm and countdown dark-gray trailing the clock arm.

Frame 49 – At the frame corresponding to 6 seconds before the first frame of action, the countdown numeral shall change to a "6"; the background within the outer countdown circle shall change back to countdown light-gray; and the inner concentric countdown circle and the sweeping clock arm and the crosshairs between the outer concentric circle and the focus squares in the center of the frame shall not be present.

Frames 50-72 – For subsequent frames until the frame corresponding to 5 seconds before the first frame of action, the countdown numeral "6" shall persist with the clock arm advancing clockwise each frame at an angle of 360 degrees divided by the frames per second rate of the content for each frame. The background within the concentric circles shall be countdown light-gray in advance of the clock arm and countdown dark-gray trailing the clock arm.

Frame 73 – At the frame corresponding to 5 seconds before the first frame of action, the countdown numeral shall change to a "5"; the background within the outer countdown circle shall change back to countdown light-gray; and the inner concentric countdown circle and the sweeping clock arm and the crosshairs between the outer concentric circle and the focus squares in the center of the frame shall not be present.

Frames 74-96 – For subsequent frames until the frame corresponding to 4 seconds before the first frame of action, the countdown numeral "5" shall persist with the clock arm advancing clockwise each frame at an angle of 360 degrees divided by the frames per second rate of the content for each frame. The background within the concentric circles shall be countdown light-gray in advance of the clock arm and countdown dark-gray trailing the clock arm.

Frame 97 – At the frame corresponding to 4 seconds before the first frame of action, the countdown numeral shall change to a "4"; the background within the outer countdown circle shall change back to countdown light-gray; and the inner concentric countdown circle and the sweeping clock arm and the crosshairs between the outer concentric circle and the focus squares in the center of the frame shall not be present.

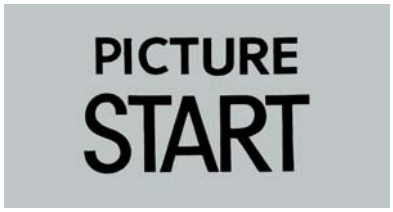
Frames 98-120 – For subsequent frames until the frame corresponding to 3 seconds before the first frame of action, the countdown numeral "4" shall persist with the clock arm advancing clockwise each frame at an angle of 360 degrees divided by the frames per second rate of the content for each frame. The background within the concentric circles shall be countdown light-gray in advance of the clock arm and countdown dark-gray trailing the clock arm.

Frame 121 – At the frame corresponding to 3 seconds before the first frame of action, the countdown numeral shall change to a "3"; the background within the outer countdown circle shall change back to countdown light-gray; and the inner concentric countdown circle and the sweeping clock arm and the crosshairs between the outer concentric circle and the focus squares in the center of the frame shall not be present.

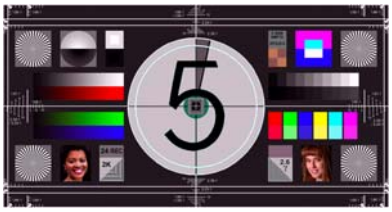
Frames 122-144 – For subsequent frames until the frame corresponding to 2 seconds before the first frame of action, the countdown numeral "3" shall persist with the clock arm advancing clockwise each frame at an angle of 360 degrees divided by the frames per second rate of the content for each frame. The background within the concentric circles shall be countdown light-gray in advance of the clock arm and countdown dark-gray trailing the clock arm.

Frame 145 – At the frame corresponding to 2 seconds before the first frame of action, the frame shall consist of the background image, except that the entire area within the outer countdown circle shall be white, and the imagery in front of the background-gray area shall be absent except for the crosshairs, perimeter lines, cropping scales with associated text and corner arrowheads.

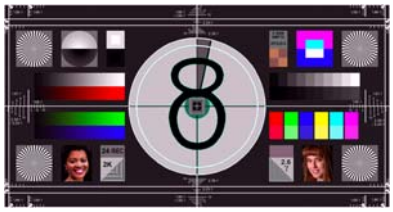
Frames 146-192 – For subsequent frames until the frame prior to the first frame of action, the frames shall be black with no other imagery.



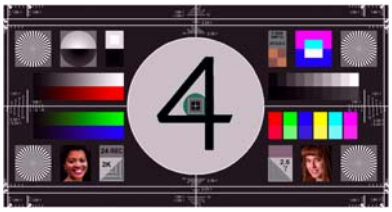
Frame 1



Frame 74

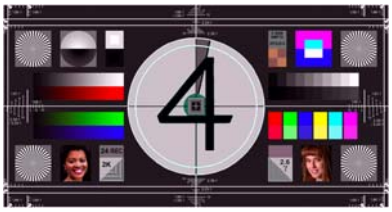


Frame 2

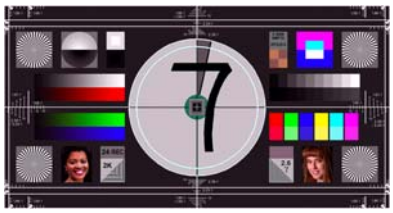


Frame 97

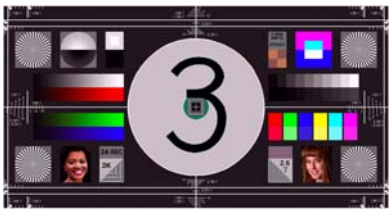
Frame 25



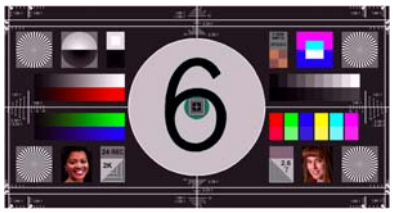
Frame 98



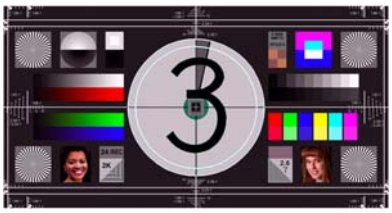
Frame 26



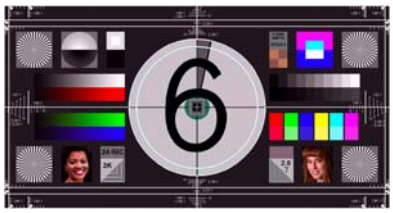
Frame 121



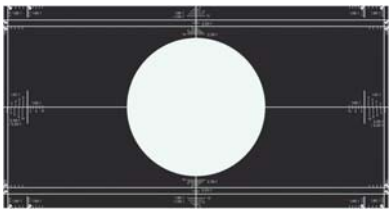
Frame 49



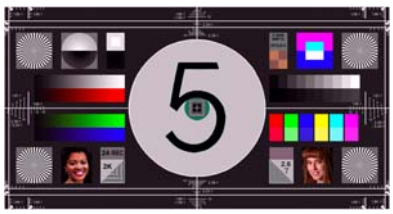
Frame 122



Frame 50



Frame 145



Frame 73

Frames146-192

Figure 1 – Major frames for a 24 frames per second example leader

6 Background Image

The Digital Leader shall have a background image that persists from the frame after the “PICTURE START” frame until the frame at the “2 second” point. The background image shall be as indicated in Figure 2. The main elements of the image are numbered and shown in Figure 3. (The circular area in the center of the frame is the “countdown area” and is described in Section 8. The countdown area shown in Figures 2 and 3 are examples only.)

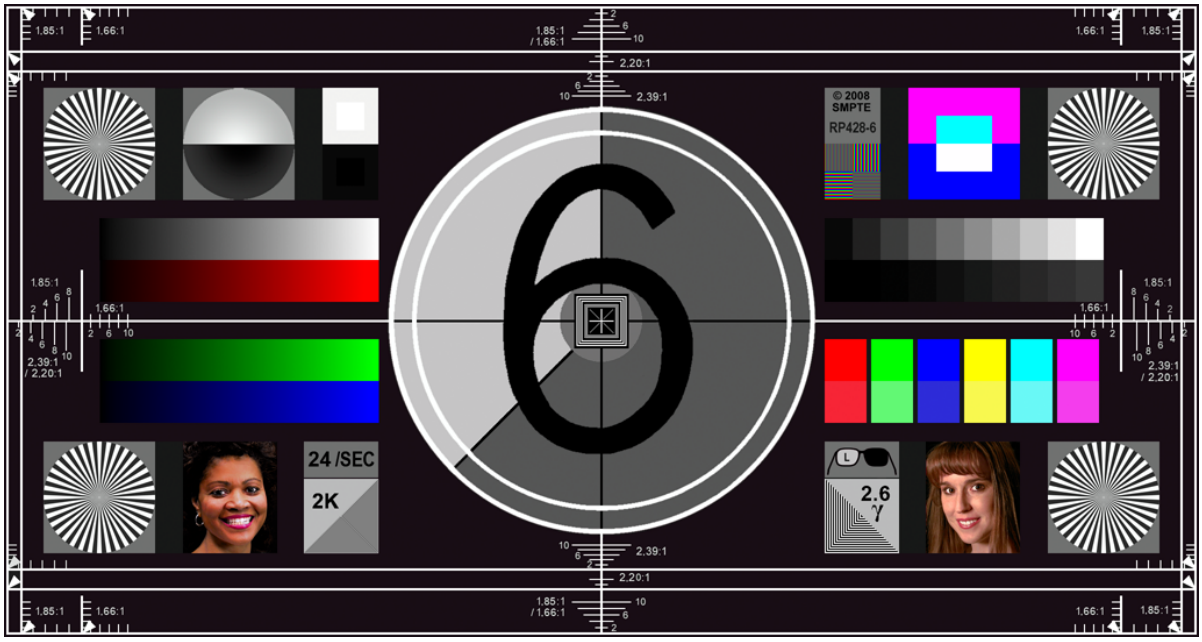


Figure 2 – Background image with example countdown area image

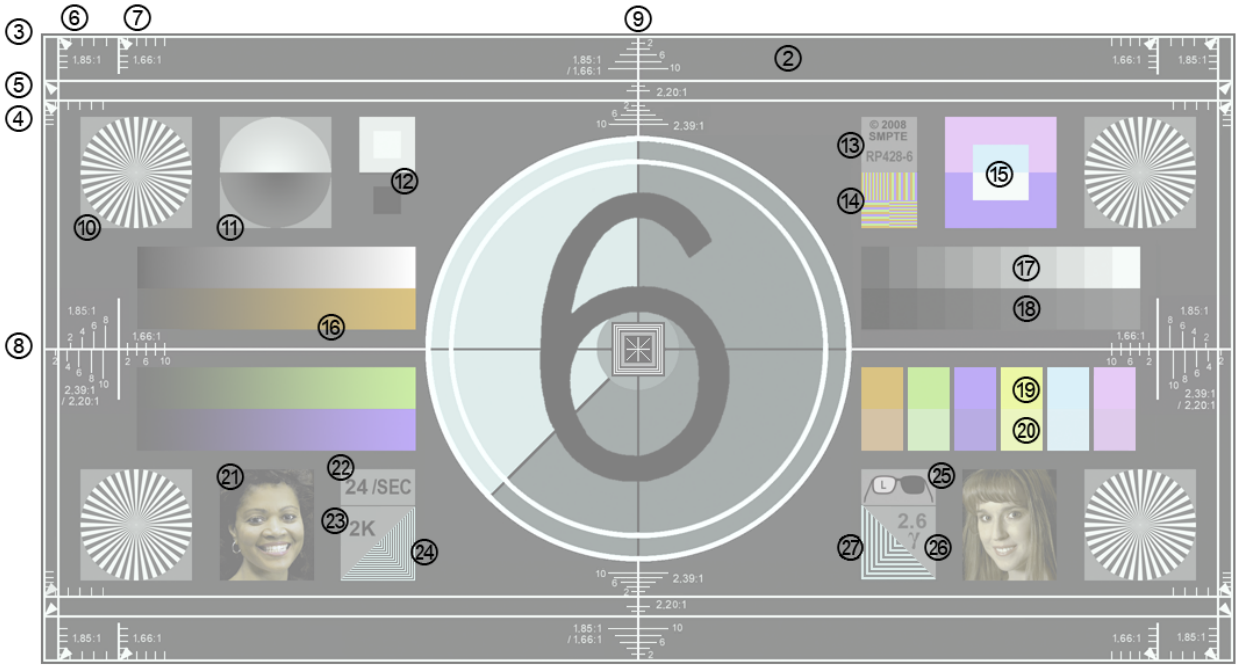


Figure 3 – Identification of main elements in background image

6.1 Background Image Elements

Unless otherwise specified, for the purposes of this document the following definitions shall apply:

The Background Image elements shall consist of the following elements. The numbering of the elements corresponds to the numbers for the elements shown in Figure 3.

(1) A circular area centered on the frame shall be used for the countdown area (described in Section 8).

(2) The background color shall be background-gray.

(3) The perimeter of the entire image shall consist of a white line 4 pixels in width for a 2K image, and 8 pixels in width for a 4K image.

(4) White lines 4 pixels in width for a 2K image, and 8 pixels in width for a 4K image, shall indicate the top and bottom of the area used for a 2.39:1 image, and white arrowheads shall indicate the corners of this area as indicated in the Figure 2. Markers indicating the percent cropped or masked from the sides and top and bottom shall be included as described in Section 7.1 and Section 7.2.

(5) An additional set of white lines and arrowheads, of the same style as those used for the 2.39:1 area, shall be used to indicate the area used for a 2.20:1 image. Markers indicating the percent cropped or masked from the top and bottom shall be included as described in Section 7.2.

(6) An additional set of white lines and arrowheads, of the same style as those used for the 2.39:1 area, shall be used to indicate the area used for a 1.85:1 image. Markers indicating the percent cropped or masked from the sides and top and bottom shall be included as described in Section 7.1 and Section 7.2.

(7) An additional set of white lines and arrowheads, of the same style as those used for the 2.39:1 area, shall be used to indicate the area used for a 1.66:1 image, with the following exception: The sides of the 1.66:1 area shall use the white line only at the top and bottom of each side of the frame, and at the middle of each side of the frame using a line 192 pixels tall for a 2K image, or 384 pixels tall for a 4K image, as indicated in Figure 2. Markers indicating the percent cropped or masked from the sides shall be included as described in Section 7.1.

(8) There shall be crosshairs aligned with the center of the frame, and extending from the center countdown area to the edge of the frame. The crosshairs shall be white lines 4 pixels in width for a 2K image, and 8 pixels in width for a 4K image. Markers indicating the percent cropped or masked from the sides shall be included as described in Section 7.1.

(9) Markers indicating the percent cropped or masked from the top and bottom of the 2.39:1, 2.20:1, 1.85:1 and 1.66:1 image areas shall be included as described in Section 7.2.

(10) Polar star circles set against a mid-gray squares shall be positioned near the corners of the 2.39:1 image area as indicated in Figures 2, 3, 4, 5 and 6. The exact position is where the outer edges of the squares line up with the edges of the area that would be equivalent to a 1.78:1 image (1920 pixels wide for a 2K image). This spacing ensures that the focus stars are visible even with cropping of the image due to the screen masking. The polar star circles shall consist of alternating 36 white and 36 black sectors.

(11) Two half-circle gradient shaded patterns shall be positioned as indicated in Figures 2, 3 and 4, and 6. They may be used to check for contouring. The upper half circle is a gradient from white in the center to 75% of this value at the edges. The lower half circle is a gradient from black in the center to 25% of the white value at the edges. The two half-circles shall be set against a mid-gray square the same width as the diameter of the half circles which are also the same size as the polar stars.

(12) A set of concentric white and concentric black squares shall be positioned as indicated in Figures 2, 3, 4 and 6. The outer squares are one-half the width of the squares behind the polar stars and the dome gradient patterns. The inner squares are one-half the width of the outer squares. The inner upper square shall be white; the outer upper square shall be the near-white. The inner lower square shall be black; the outer lower square shall be the gray value shown as “Step 2” in Table 3.

(13) A mid-gray patch with a black copyright “©“ symbol, the year of the copyright, the letters “SMPTE” and “RP428-6” in a black sans-serif font shall be positioned as indicated in Figures 2, 3, 4 and 6.

(14) A patch of the size indicted in Figures 2, 3, 4 and 6 shall be positioned immediately below the identifier. The patch shall be divided into four quadrants: The upper-left quadrant shall consist of vertical red-1, green-1 and blue-1 lines, each 1 pixel in width for both 2K and 4K images. The upper-right quadrant shall consist of vertical red-1, green-1 and blue-1 lines, each 2 pixels in width for both 2K and 4K images. The lower-left quadrant shall consist of horizontal red-1, green-1 and blue-1 lines, each 2 pixels in width for both 2K and 4K images. The lower-right quadrant shall consist of horizontal red-1, green-1 and blue-1 lines, each 1 pixel in width for both 2K and 4K images. All colors shall be as defined in Table 4.

(15) A set of two concentric color verification squares shall have the dimensions and position as indicated in Figures 2, 3, 4 and 6. The outer square shall be the same size as the square surrounding the polar star circles used for focus checking. The upper half of the outer square shall be magenta-1. The lower half of the outer square shall be blue-1. The upper half of the inner square shall be cyan-1. All colors shall be as defined in Table 4. The lower half of the inner square shall be white as defined in Table 1. These color verification squares are designed to be used in the same way as video color bars: When observed through a dark blue filter of the same characteristics as a Wratten 47B filter, all four sections of the inner and outer squares will appear to have approximately the same brightness.

(16) A set of perceptually linear ramps each extending from black to white, red-1, green-1, and blue-1 respectively shall be positioned as indicated in Figures 2, 3, 4, 5 and 6. All colors shall be as defined in Table 4.

(17) A set of 10 gray levels (“staircase”) ranging from a dark gray shade to white as described in Table 2 shall be positioned as indicated in Figures 2, 3, 4 and 6.

(18) A set of 10 dark gray levels (“staircase”) as described in Table 3 shall be positioned as indicated in Figures 2, 3, 4 and 6.

(19) A set of bright saturated color patches corresponding to red-1, green-1, blue-1, yellow-1, cyan-1 and magenta-1 as represented in the color space as defined in Table 4 shall be positioned as indicated in Figures 2, 3, 5 and 6.

(20) A set of desaturated color patches corresponding to red-2, green-2, blue-2, yellow-2, cyan-2 and magenta-2 as represented in the color space as defined in Table 4 shall be positioned as indicated in Figures 2, 3, 5 and 6.

(21) A set of two human faces, one with a dark complexion and the other with a light complexion, shall be positioned as indicated in Figures 2, 3, 5 and 6. (A master set of high resolution images of the faces is on deposit with SMPTE to create the Digital Leader.)

(22) A mid-gray patch shall be positioned as indicated in Figures 2, 3, 5 and 6 with a number (typically “24” or “48”) followed by the black letters “/SEC” in black sans-serif characters shall be shown within the gray square. This is intended as a quick and clear indication of the frame rate at which the content was intended to be shown.

(23) A gamma-match gray triangular patch shall be positioned as indicated in Figures 2, 3, 5 and 6 with the characters “2K” shown in black sans-serif characters if the image is a 2K image, or “4K” shown in black sans-serif characters if the image is a 4K image.

(24) A triangular patch composed of lines 1 pixel in width for both 2K and 4K imagery, alternating between white and black shall be positioned as indicated in Figures 2, 3, 5 and 6. The triangular patch shall be divided into two equal sized triangular areas: the lower left area shall be composed of alternating horizontal lines, while the upper right area shall be composed of alternating vertical lines.

(25) A mid-gray patch that may be used with a stereoscopic indicator shall have the dimensions and position as indicated in Figures 2, 3, 5 and 6. For stereoscopic material using two images (as opposed to a combined image as is done with anaglyphic stereoscopic imagery, for example), the patch shall have a black eyeglasses icon with one of the lenses light-gray (representing a “clear lens” in the glasses) and the other lens black. The clear lens in the icon shall include within it either an upper case “L” or “R” in black sans-serif font corresponding to the appropriate left or right stereoscopic view. The presence of the “L” or “R” in the clear lens in the icon emphasizes that the image can be seen through that lens.

(Note: In other words, the clear lens with an “L” will appear on the left side for the left-eye view, and clear lens with an “R” will appear on the right side for the right-eye view. If both views are being presented, then both lenses in the icon will appear to be the same shade of gray. If both views are being presented, and the image is viewed through the appropriate 3-D glasses, the icon will confirm that each view is going to the appropriate eye. If only one of the views is being shown, the icon identifies which view is being presented. The icon works with both single-projector (sequential) and dual-projector stereoscopic presentations.)

For anaglyphic stereoscopic content, the lenses in the icon shall have the colors corresponding to the desired colors in the anaglyphic 3-D glasses to be used by the audience. For non-stereoscopic content, a glasses icon shall not be present on the gray patch.

(26) A gamma-match gray triangular patch shall be positioned as indicated in Figures 2, 3, 5 and 6 with the value of the gamma of the image (typically 2.6) and a Greek letter gamma symbol shown as black sans-serif characters.

(27) A triangular patch composed of lines 2 pixels in width for 2K imagery or 4 pixels in width for 4K imagery, alternating between white and black, shall be positioned as indicated in Figures 2, 3, 5 and 6. The triangular patch shall be divided into two equal sized triangular areas: the lower right area shall be composed of alternating horizontal lines, while the upper left area shall be composed of alternating vertical lines.

6.2 Background Image Elements Dimensions and Positioning

The background image elements shall have the sizes and positions as indicated in Figures 4 through 6. The dimensions shown in Figures 4 through 6 represent the number of pixels for a 2K image; the numbers should be doubled for a 4K image. The dimensions and positions in the parts of the image not shown in Figures 4 through 6 shall be positioned in a symmetric manner to the elements shown in the figures.

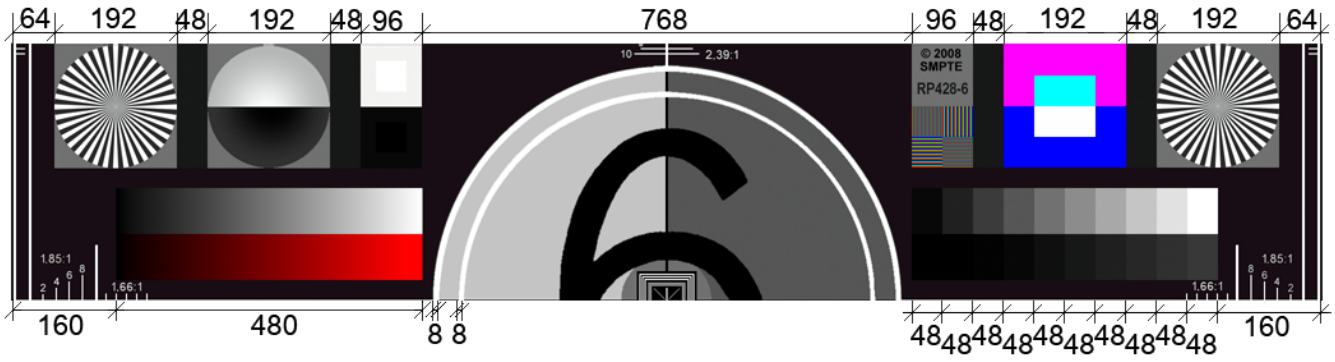


Figure 4 – Upper elements horizontal dimensions and positions

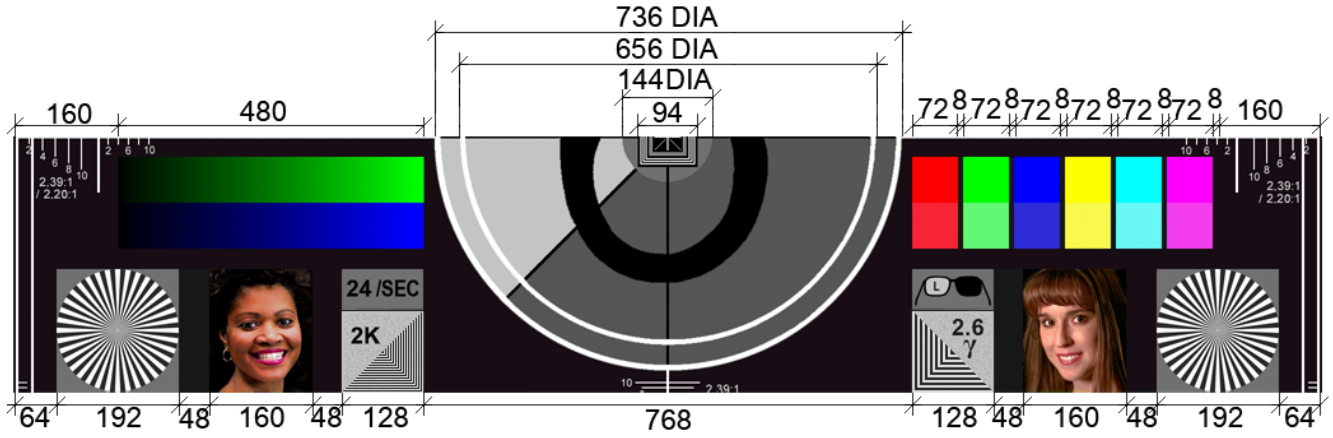


Figure 5 – Lower elements horizontal dimensions and positions

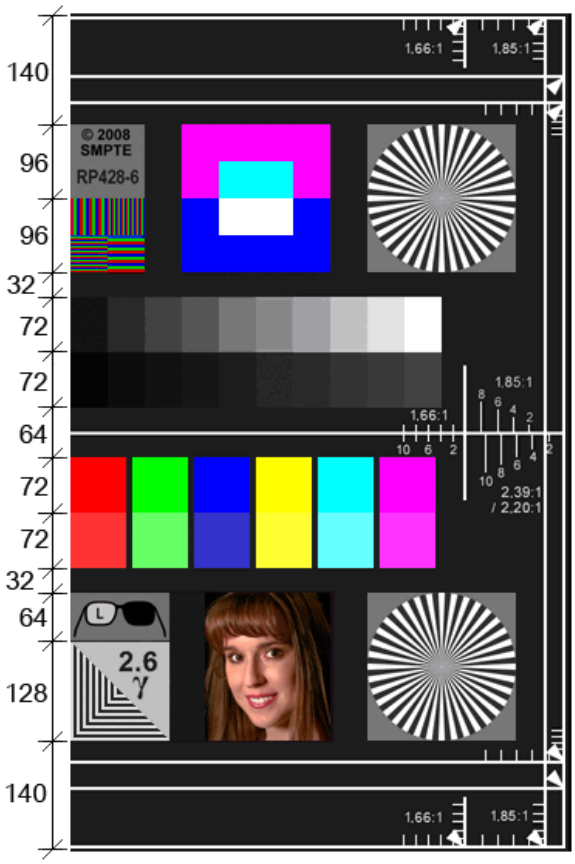


Figure 6 – Inner elements vertical dimensions and positions

7 Cropping Markers

7.1 Side Cropping Markers

A tapered set of white lines 2 pixels in width for a 2K image and 4 pixels in width for a 4K image, indicating 2%, 4%, 6%, and 8% cropping from the side of the image to the center, shall be positioned above the crosshair at the left and right sides of the area used for a 1.85:1 image. The scale shall be labeled “1.85:1” using a white sans-serif font. A set of short equal-length white markers shall be included at the four corners of the 1.85:1 image area corresponding to the same cropping as indicated in the markings at the center of the image. The corner markers shall be labeled “1.85:1” using a white sans-serif font.

A second tapered set of white lines 2 pixels in width for a 2K image and 4 pixels in width for a 4K image, indicating 2%, 4%, 6%, and 8% cropping from the side of the image to the center, shall be positioned below the crosshair at the left and right sides of the area used for a 2.39:1 image. The scale shall be labeled “2.39:1 / 2.20:1” using a white sans-serif font. A set of short equal-length white markers shall be included at the four corners of the 2.39:1 and 2.20:1 image areas corresponding to the same cropping as indicated in the markings at the center of the image.

A set of short equal-length white markers indicating 2%, 4%, 6%, 8%, and 10% cropping from the outer edge of the 1.66:1 image to the center shall be positioned above and below the crosshair at the left and right sides of the area used for a 1.66:1 image. The scale shall be labeled “1.66:1” using a white sans-serif font. A set of short equal-length white markers shall be included at the four corners of the 1.66:1 image area corresponding to the same cropping as indicated in the markings at the center of the image. The corner markers shall be labeled “1.66:1” using a white sans-serif font.

7.2 Top and Bottom Cropping Markers

A tapered set of white lines 2 pixels in width for a 2K image and 4 pixels in width for a 4K image, indicating 2%, 4%, 6%, and 8% cropping from the top or bottom of the image to the center, shall be positioned on the crosshair at the top and bottom of the area used for a 1.85:1 image. The scale shall be labeled “1.85:1 / 1.66:1” using a white sans-serif font. A set of short equal-length white markers shall be included at the four corners of the 1.85:1 image area and the 1.66:1 image area corresponding to the same cropping as indicated in the markings at the center of the image. These additional lines are intended to aid situations with keystone or with horizon sag due to curved screens.

A second tapered set of white lines 2 pixels in width for a 2K image and 4 pixels in width for a 4K image, indicating 2% and 4% cropping from the top or bottom of the image to the center, shall be positioned on the crosshair at the top and bottom of the area used for a 2.20:1 image.

A tapered set of white lines 2 pixels in width for a 2K image and 4 pixels in width for a 4K image, indicating 2%, 4%, 6%, 8%, and 10% cropping from the top or bottom of the image to the center, shall be positioned on the crosshair at the top and bottom of the area used for a 2.39:1 image. The scale shall be labeled “2.39:1” using a white sans-serif font. A set of short equal-length white markers shall be included at the four corners of the 2.39:1 image area corresponding to the same cropping as indicated in the markings at the center of the image. These additional lines are intended to aid situations with keystone or with horizon sag due to curved screens.

A set of short equal-length white lines 2 pixels in width for a 2K image and 4 pixels in width for a 4K image, indicating 2%, 4%, 6%, 8%, and 10% cropping from the outer edge of the 1.66:1 image to the center shall be positioned above and below the crosshair at the left and right sides of the area used for a 1.66:1 image. A set of short equal-length white markers shall be included at the four corners of the 1.66:1 image area corresponding to the same cropping as indicated in the markings at the center of the image. The corner markers shall be labeled “1.66:1” using a white sans-serif font. These additional lines are intended to aid situations with keystone or with horizon sag due to curved screens.

8 Countdown Area

8.1 Countdown Area Imagery

The countdown area shall be contained within a circular area at the center of the frame as indicated in Figures 2 and 3. The countdown area shall consist of the following elements:

1. Dual concentric white circles centered on the frame shall have the size and in width as indicated in Figures 3 and 4.

2. The exact center of the frame shall have concentric white and black focus squares and a white crosshair and white diagonal lines set against a black background. The crosshair shall be 2 pixels in width for 2K content and 4 pixels in width for 4K content. The diagonal white lines are essentially diagonal rows of single white pixels, and shall be 1 pixel in width for both 2K and 4K content, and shall be positioned as indicated in Figure 7. The focus squares shall consist of a set of three concentric black and white squares using lines 2 pixels in width for 2K content and 4 pixels in width for 4K content. Within this set is another set of three concentric black and white squares using lines 1 pixel in width for 2K content and 2 pixels in width for 4K content.

Figure 7 – Detail of focus squares

3. The focus squares shall be set against a mid-gray circular background of the size shown in Figure 5.

4. Black crosshair lines, 4 pixels in width for 2K content and 8 pixels in width for 4K content, shall extend from the outer edge of the focus squares to the inner edge of the outer white circle, with the exception that they will not obscure the inner white circle. These crosshair lines shall be absent for each instance of the first frame where a new numeral appears.

5. A black clock arm, approximately 4 pixels in width for 2K content and 8 pixels in width for 4K content, shall sweep clockwise 360 degrees per second. Thus, for 24 frames per second content, the arm moves 15 degrees each frame. For 48 frames per second content, the arm would move 7.5 degrees per frame. The clock arm shall extend from the mid-gray circular background surrounding the focus squares in the center of the countdown area to the inner edge of the outer white circle at the edge of the countdown area, with the exception that it will not obscure the inner white circle. The clock arm shall be absent for each instance of the first frame where a new numeral appears.

6. The area within the concentric countdown circles shall be countdown light-gray for each instance of the first frame where a new numeral appears, and remain countdown light-gray until after being swept by the clock arm each second.

7. The area within the concentric countdown circles but trailing the sweeping clock arm shall be countdown dark-gray.

8. The countdown digits shall be black sans-serif numerals designed to avoid obscuring the focus squares. The countdown digits shall be approximately 512 pixels in height for 2K imagery, or approximately 1024 pixels in height for 4K imagery.

9 Audio Content

9.1 Audio Synchronization Verification Signal Characteristic

The “sync pop” audio synchronization verification signal shall consist of a duration equivalent to one picture frame of 1000 Hz sine wave +/- 10%. Modulation of said signal shall be at -20dB Full Scale in the center sound channel in accordance with SMPTE RP 155 and SMPTE 428-3.

There shall be no audio content in the audio channels other than the center channel during the synchronization verification signal.

9.2 Audio Synchronization Verification Signal Location

The audio synchronization verification signal shall be so located on the center audio channel as to coincide with the single frame that is exactly 2 seconds from the first frame of action (the first frame of content following the leader) and shall coincide with the single No. 2 (2-second) frame Digital Leader image when audio and picture are aligned in parallel (editorial) sync. If images are stored as interleaved sequences, such as for stereoscopic presentations, the synchronization verification signal position shall be relative to the first image frame of the interleaved sequence.

There shall be no audio content on any of the channels for the duration from the "PICTURE START" frame until the frame 2 seconds before the first frame of action.

10 Trailer (Foot Leader)

An optional trailer (foot leader) may be added to the end of the action content for the digital reel. If used, the foot leader shall be 4 seconds in length (96 frames for 24 frames per second content). The durations chosen for the digital leader ensure that the durations will be the same no matter what frame rate is used for content.

10.1 Trailer (Foot Leader) Imagery

An optional trailer (foot leader) may be added to the end of the action content for the digital reel. If used, the foot leader shall be 4 seconds in length (96 frames for 24 frames per second content). The foot leader shall be comprised of the following:

1. Black frames shall follow the last frame of action (the last frame of content prior to the foot leader) for the duration of two seconds minus one frame. Thus, for 24 frames per second content, there will be 47 black frames.

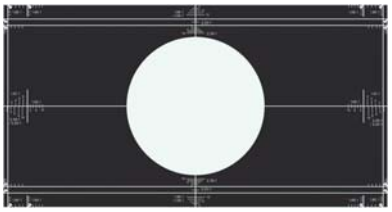
2. The black frames shall be followed by a "sync pop" frame with the same imagery as that used for the "sync pop" frame in the leader used at the beginning of the reel.

3. The "sync pop" frame shall be followed by black frames for the duration of two seconds minus one frame. Thus, for 24 frames per second content, there will be 47 black frames.

4. The black frames following the "sync pop" frame shall be followed by a single frame with the word "FINISH" in black sans-serif font set against a countdown light-gray background. The letters shall be 1/2 of the un-cropped image height which is approximately 540 pixels in height for 2K content, or 1080 pixels in height for 4K content.

An illustration of the major frames for a foot leader at 24 frames per second is shown in Figure 8.

Frames 1-47



Frame 48

Frames 49-95

Frame 96

Figure 8 – Major frames for a 24 frames per second example foot leader

10.2 Trailer (Foot Leader) Audio

If used, the foot leader may include a “tail pop” tone with the same characteristics as the “sync pop” tone may be used for the duration of the one frame coinciding with the frame with the “tail pop” circle in the foot leader.

11 Aspect Ratio Support (Informative)

The Digital Leader is designed to provide varying levels of support for various aspect ratios while avoiding cluttering the image with excessive detail. The following sections illustrate the supported aspect ratios. The pixel dimensions given are for 2K content; the pixel dimensions are doubled for 4K content.

11.1 1.90:1 Aspect Ratio

The entire 2048 x 1080 image is used for 1.90:1 aspect ratio content. The amount of horizontal cropping of the image is determined by using the side markings labeled “2.39:1 / 2.20:1”. The amount of vertical cropping of the image is determined by using the upper and lower markings labeled “1.85:1 / 1.66:1”. This type of image is illustrated in Figure 2.

11.2 2.20:1 Aspect Ratio

A 2048 x 928 image is used for 2.20:1 aspect ratio content. Such content is often associated with content photographed using 65-mm 5-perforation camera formats. The amount of horizontal cropping of the image is determined by using the side markings labeled “2.39:1 / 2.20:1”. The amount of vertical cropping may be read directly up to 4% and estimated for greater amounts of cropping. This type of image is illustrated in Figure 9.

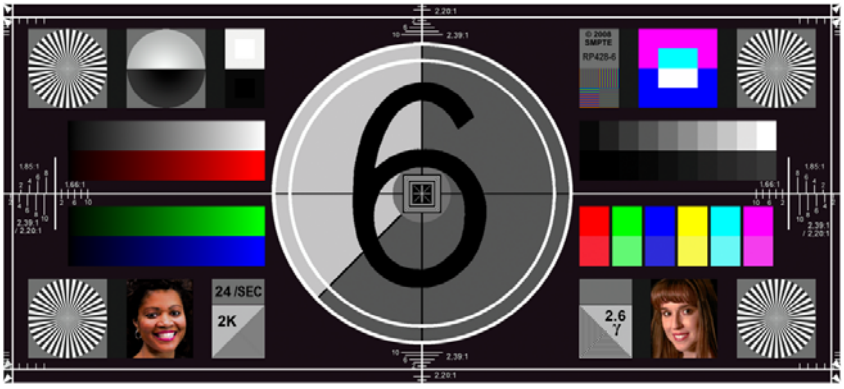


Figure 9 – 2.20:1 aspect ratio cropped image

11.3 2.39:1 Aspect Ratio

A 2048 x 858 image is used for 2.39:1 aspect ratio content. Such content is often associated with content photographed using anamorphic 35-mm camera formats. The amount of horizontal and vertical cropping may be read directly using the markings provided. This type of image is illustrated in Figure 10.

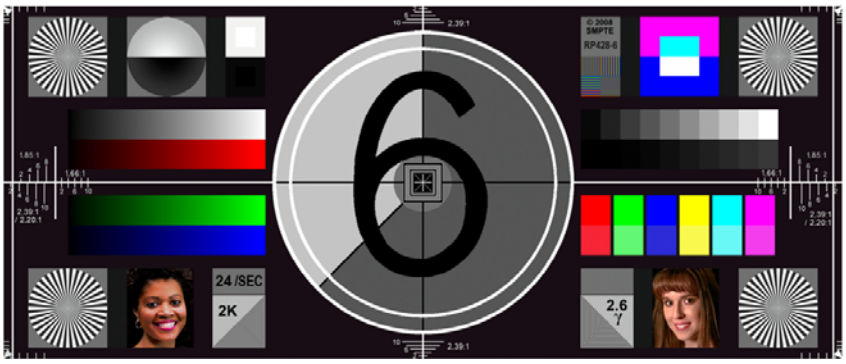


Figure 10 – 2.39:1 aspect ratio cropped image

11.4 2.55:1 Aspect Ratio

A 2048 x 800 image is used for 2.55:1 aspect ratio content. Such content is often associated with content photographed using early anamorphic 35mm camera formats. The top and bottom of the image is aligned with the outer edges of the focus stars. The amount of horizontal cropping of the image is determined by using the side markings labeled “2.39:1 / 2.20:1”. The amount of vertical cropping can be estimated by using the focus stars as a guide. This type of image is illustrated in Figure 11.

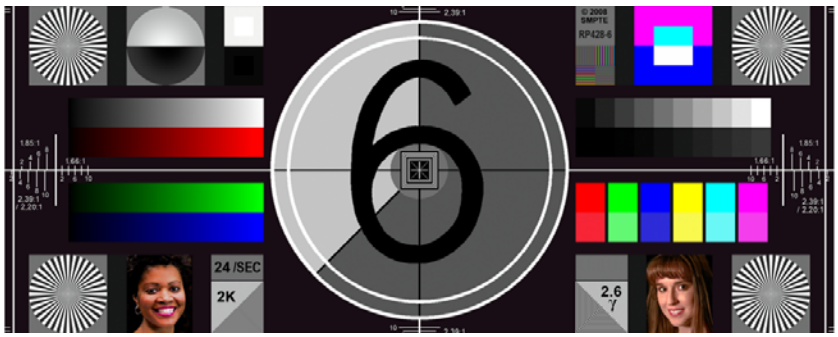


Figure 11 – 2.55:1 aspect ratio cropped image

11.5 1.85:1 Aspect Ratio

A 1998 x 1080 image is used for 1.85:1 aspect ratio content. The amount of horizontal and vertical cropping may be read directly using the markings provided. This type of image is illustrated in Figure 12.

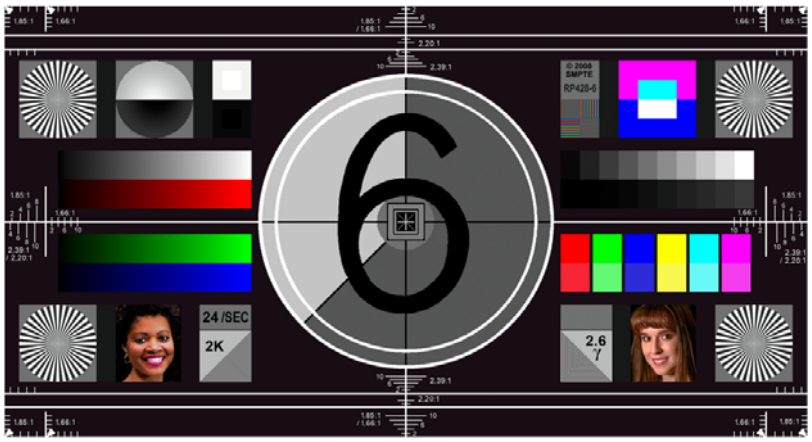


Figure 12 – 1.85:1 aspect ratio cropped image

11.6 1.78:1 Aspect Ratio

A 1920 x 1080 image is used for 1.78:1 aspect ratio content. Such content is often associated with content photographed using HDTV camera formats. The sides of the image are aligned with the outer edges of the focus stars. The amount of horizontal cropping can be estimated by using the focus stars as a guide. This type of image is illustrated in Figure 13.

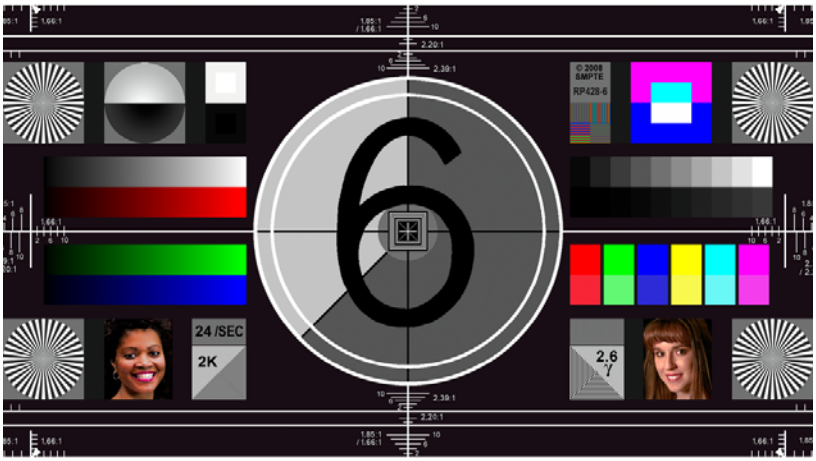


Figure 13 – 1.78:1 aspect ratio cropped image

11.7 1.66:1 Aspect Ratio

A 1792 x 1080 image is used for 1.66:1 aspect ratio content. The amount of horizontal and vertical cropping may be read directly using the markings provided. This type of image is illustrated in Figure 14.

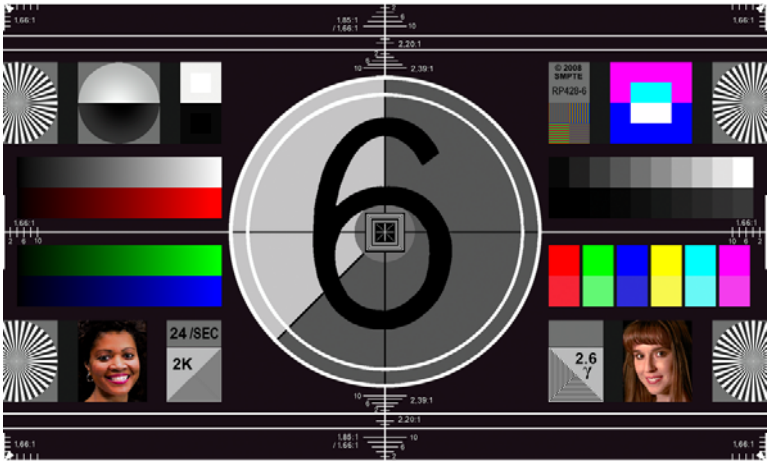


Figure 14 – 1.66:1 aspect ratio cropped image

11.8 1.33:1 Aspect Ratio

A 1440 x 1080 image is used for 1.33:1 aspect ratio content. The sides of the image are aligned with the outer edges of the dome shaded and color verification pattern. The amount of horizontal cropping of the image can be estimated using the dome shaded pattern and the color verification pattern. The amount of vertical cropping of the image is determined by using the markings labeled “1.85:1 / 1.66:1”. This type of image is illustrated in Figure 15.

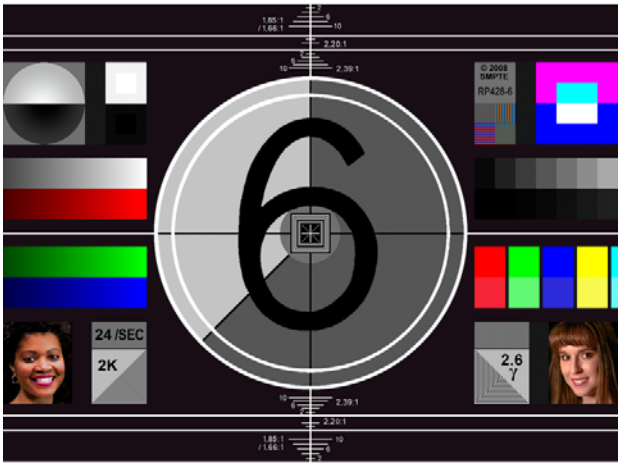


Figure 15 – 1.33:1 aspect ratio cropped image

Annex A (Informative)
Bibliography

ASA PH22.55-1966, Leaders and Cue Marks for 35-mm and 16-mm Sound Motion-Picture Release Prints

SMPTE 55-2000, Motion-Picture Film — 35- and 16-mm Television Release Prints — Leaders and Cue Marks

SMPTE 428-2-2006, D-Cinema Distribution Master — Audio Characteristics

SMPTE RP 25-1995, Audio and Picture Synchronization on Motion-Picture Film Relative to the Universal Leader for Magnetic and Photographic Records.

SMPTE RP 431-2-2007, D-Cinema Quality — Reference Projector and Environment