



The attached SMPTE Engineering Document has been declared “Stable” by the controlling Technology Committee.

The SMPTE Operations Manual for Standards states:

A document should be stabilized if it is believed to be substantially correct, does not contain harmful or misleading recommendations, may still be relevant to equipment or practices in use, is stable, but does not represent current technology, and need not be subject to future reviews.

A Stable document shall still be made available and offered for sale by the Society, but it shall be prefaced by a cover page explaining its current status.

At any time, a Technology Committee may revise, amend, or otherwise initiate a new Project on a Stable document.

A Stable document is “In Force”, and not deprecated or withdrawn.

*** * * * ***

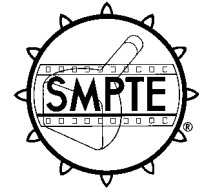
Note:

SMPTE “Stable” documents were previously described as “Archived” and the attached document may be marked as “Archived”. The status of a SMPTE document described as “Archived” is exactly as described above for a “Stable” document.

Stable documents may not adhere to the latest style and format of SMPTE documents, or to current usage of normative language. Suitable care should be taken in interpretation.

SMPTE RECOMMENDED PRACTICE

Center, Aspect Ratio and Blanking of Video Images



Page 1 of 12 pages

1 Scope

Most video standards documents specify tolerances for individual picture blanking edges; center and aspect ratio are only implied by nominal blanking values, and vary as the blanking edges move within permitted tolerances. Modern techniques of post-production require compositing of images generated by multiple devices (and sometimes originated in different video standards). These techniques demand a degree of precision not afforded by the implied definitions of center and aspect ratio.

This practice defines picture center and aspect ratio for a number of existing video standards, and provides an extensible technique that may be used to define center and aspect ratio for future standards. Test charts and test patterns are described which permit image generation and display devices to be calibrated to the recommended geometry. Recommendations are made for blanking widths at various stages of the production/post-production process. Additionally, a definition is provided for a set of recommended screen units permitting simple cross reference between standards with aspect ratios of 4×3 and 16×9 .

The practice is intended to be used for calibration of image generation and display devices. It is also intended as a reference for designers of such equipment (particularly graphics devices), and for designers of processing equipment such as image-manipulation devices.

2 Definitions

The following paragraphs define terms and concepts as used in this practice:

2.1 aspect ratio: Aspect ratio is the ratio of horizontal dimension to vertical dimension of an image area, when displayed according to the

specifications of the video standard. Within this practice, the reference for an aspect ratio of 16×9 is the reference image lattice. The reference for an aspect ratio of 4×3 is any subset of the reference image lattice with 1440 pixels horizontally and 1080 pixels (lines) vertically.

2.2 clean aperture: An image lattice that is a subset of the production aperture of a video standard, fixed in size and position, and nominally cocentric with the production aperture. The clean aperture lies completely inside the picture area remaining after application of the widest blanking permitted for the standard. The dimensions of the clean aperture for a given video standard define the nominal aspect ratio for that standard. Where both composite and component versions of a standard exist, clean aperture is defined with respect to the image lattice specified for the component version.

2.3 edge processing region: The region of the production aperture that lies outside the clean aperture. Processing equipment should be designed so that all edge-related artifacts are confined to the edge processing region. Blanking transitions should occur completely within the edge processing region.

2.4 image lattice: A two-dimensional array of pixels.

2.5 production aperture: The image lattice that represents the maximum possible image extent in a given standard. The production aperture represents the desirable extent for image acquisition, generation, and processing prior to blanking. Where both composite and component versions of a standard exist, production aperture is defined with respect to the image lattice specified for the component version.

2.6 reference image lattice (RIL): An image lattice of square pixels with 1920 pixels horizontally and 1080 pixels (lines) vertically.

2.7 square pixel: A picture element that represents an equal distance horizontally and vertically when the image is displayed at its defined aspect ratio.

3 Production and clean apertures

This practice recognizes that the video signal is operated on by many processing devices. Many of these operations (including most filters) produce edge-related artifacts. Blanking often is applied many times to the signal, and this usually results in distortion of the blanking edge or in an increase in blanking width. The result of this processing is that the useful image area is gradually reduced. It is, therefore, advantageous to acquire the maximum possible image area, and to define a region where artifacts are acceptable.

The production aperture, as defined above, is the maximum possible image area that can be supported by the video standard. The clean aperture is a slightly smaller image area, of similar aspect ratio to the production aperture, and contained within it. The part of the production aperture not included in the clean aperture is the edge processing region.

Ideally, a video source will capture or generate the full production aperture. This may not always be practical, but source blanking should be as close as possible to this ideal. When these conditions are met, a test chart of the correct aspect ratio may be imaged and superimposed on an electronic graticule representing the clean aperture, thus ensuring correct aspect ratio and centering.

Although underscanned monitors are used for technical monitoring, the ideal display for program viewing will display exactly the clean aperture. An electronic graticule representing the clean aperture may be used as a reference for display adjustment.

It should be noted that it is not the intent of this practice that information outside the clean aperture be discarded. Some or all of this information may be blanked (horizontally and/or vertically), depending upon the transmission standards and operational practice. Subject to these limitations, this information should be retained and, to the extent permitted by transmission blanking standards, it should be transmitted.

4 Center of image

The center of an image is defined as the point at the center of the clean aperture.

Horizontally, there will be an equal number of pixels within the clean aperture to the left and to the right of the center point. Vertically, there will be an equal number of pixels (lines) within the clean aperture above and below the center point.

The center position for each video standard is specified in the appropriate table of clause 11.

5 Horizontal blanking

5.1 Picture sources

As described above, it is desirable to capture the maximum possible extent of picture information. Some authorities believe the optimum position for horizontal blanking is where the midpoint of the blanking rise and fall are coincident with the first and last pixels of the production aperture. Others prefer that the blanking edges be contained (just) within the production aperture.

5.2 In-plant blanking

In-plant blanking should remain as narrow as possible, and should always be narrower than transmission blanking.

5.3 Narrow transmission blanking

This is the narrowest blanking permitted by a transmission standard and is provided for reference in appropriate tables of clause 11. This width of blanking may be very useful within a facility for signals that may be aired directly (without further blanking), but where it is desired to maintain as much information as possible for further processing. This figure may represent a useful operating practice for blanking of taped signals that may be aired directly or that may be used as inputs for further processing.

5.4 Wide transmission blanking

This figure, quoted in appropriate tables of clause 11, represents the widest blanking permitted by a transmission standard and is placed just outside the clean aperture. It should be noted that once this blanking has been applied, further processing or blanking will

likely result in distortion of the blanking edge and/or loss of information from the clean aperture.

6 Vertical blanking

Vertical blanking is less frequently impacted by processing equipment than is horizontal blanking, but processes such as vertical filtering will result in distortion at the top and bottom of the image. In general, the full height of the production aperture should be captured or generated at the source. A transmission standard may specify an exact number of lines that should be transmitted.

Where processing requires wider vertical blanking than determined by the production aperture, such blanking should remain outside the clean aperture.

It should be noted that increasing the width of horizontal blanking but not of vertical blanking, as is common practice, results in an apparent change in aspect ratio. For this reason, both source and display aspect ratios should be set using an electronic graticule representing the clean aperture.

7 Screen units

Many items of equipment such as picture manipulation devices make use of a system of screen units as part of the operator interface. In equipment designed for systems with an aspect ratio of 4:3, it is common practice to define a grid 8 screen units horizontally by 6 screen units vertically. The nominal edges of the picture are then 4 units to the left and right of, and 3 units above and below, the center of the image.

For 16:9 systems, a similar approach is recommended. The grid should be 32 screen units horizontally by 18 screen units vertically. The nominal edges of the picture are then 16 units to the left and right of, and 9 units above and below, the center of the image.

The nominal edges of the picture referenced above should be the boundaries of the clean aperture. The clean aperture will be exactly 32×18 screen units in 16:9 systems. The 4:3 subset of a 16:9 image will measure 24×18 screen units, which is exactly three times the current practice (8×6) for 4:3 systems.

8 Conversion ratios

The tables in clause 11 contain horizontal and vertical conversion ratios to derive each scanning system from the reference image lattice. It is possible, therefore, to derive conversion ratios between any two scanning systems.

Ratios derived in this way should form the target ratios for standards converters. In practice, standards converters may use filters with a relatively small number of taps. An appropriate balance of cost and video quality may mean that some practical converters will not use the exact ratios calculated from the tables. The tables provide a reference for calculating the resulting image size and/or aspect ratio errors.

9 Test charts and signals

Figure 1 shows a pattern that may be used for both physical test charts and electronic graticules, for both 4:3 and 16:9 applications. The outer rectangles represent the clean apertures. (The markers represent 2.5%, 5%, 7.5%, and 10% overscan.)

10 Safe action and safe title areas

Safe action and safe title areas are defined in other SMPTE Recommended Practices as subsets of the image area. The definition of the image area of a video picture used in deriving safe action and safe title areas should be the clean aperture for the appropriate video standard, as defined by this practice.

11 Tables of parameters

Tables 1--6 define parameters for a number of television standards. The information includes the extent of the production and clean apertures, the picture center, and where appropriate, values for horizontal blanking as discussed in clause 5.

All horizontal timings are expressed as fractions of the total line time τ_H .