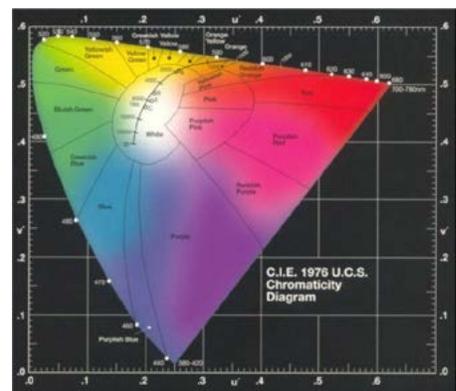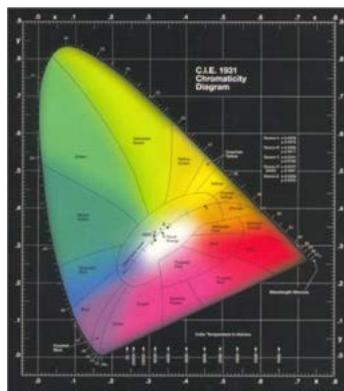# Monitor color gamut

## What does "percent of NTSC" mean?

### What is color gamut?

With rare exceptions, all LCD monitors operate by presenting just three primary colors to the eye: red, green and blue. All the colors you can see on the monitor are actually different blends of the three primaries. This works because of the way the human eye works. The complete set of colors that a monitor can present is called the "native color gamut", and is determined by the exact colors of the three primaries. Different monitors have slight (or not so slight) differences in the three primaries. These differences are a consequence of the technologies used in the LCD panel and the backlight, and sometimes of the age of the unit.

There are two diagrams commonly used for representing how color gamuts relate to the set of all colors visible to the human eye. These are called "chromaticity" diagrams. The first (left), which is commonly used, is the "CIE 1931" diagram, which uses the coordinates x and y.



The second diagram (right), which is newer (and, actually, a better representation of how we perceive color) is the "CIE 1976 UCS" diagram, which uses the coordinates u' and v' (called "u prime" and "v prime"). Any three-primary color gamut for a monitor can be plotted on these diagrams as a triangle of which the vertices are the exact colors of the red, green and blue primaries.

### The NTSC color space

There are many standard three-primary color spaces used in the industry. The NTSC color space, defined in 1953, is, however, not commonly used, as no displays at the time had primaries which matched it. However, it is still quoted as the reference color space for the "percent of NTSC" metric, which will be described below. Here is the CIE 1931 diagram with the NTSC gamut plotted as a triangle:
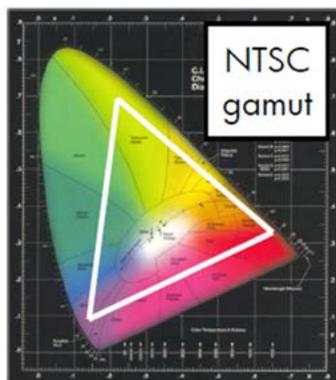
## Percent of NTSC

If one were to plot on this diagram the native color gamut of a given monitor, there would be a second triangle, which is bounded by the three primary colors generated by that monitor. The "percent of NTSC" metric is simply the area relationship between the monitor's native gamut triangle and the NTSC triangle. Hence, "102% of NTSC" means that the monitor's triangle has an area which is 102% of the area of the NTSC triangle. NOTE: This holds true only for one particular chromaticity diagram. If you plot the gamut triangles on the other diagram, the area relationship is going to be different. Therefore, when you see "percent of NTSC" quoted, look for "xy" or "u'v'" as an indication of which diagram was used. Many vendors are starting to use the 1976 chromaticity diagram (u'v') because you typically get larger "percent of NTSC" numbers. When comparing monitors, it's important to verify that the same diagram was used as the basis for the metric.

## Is it really meaningful?

While it's useful (especially for marketing) to have a single metric that can indicate the color capabilities of a monitor, the "percent of NTSC" metric has several shortcomings. First, it is dependent on the diagram used, as discussed above. Second, the metric relates only to area, and tells you nothing about the position of the monitor's native color gamut on the diagram. Two monitors for which identical "percent of NTSC" numbers are quoted may in reality have very different color capabilities.

## What's really important about a monitor's color gamut?

For color professionals, the most important gamut-related feature of a monitor is whether the monitor's native gamut fully encloses the standard color space which is appropriate for the user's workflow. For example, does the Adobe RGB 1998 color space's triangle lie entirely within the monitor's native gamut triangle? If so, color calibration can be used to set up an accurate, fully-covered Adobe RGB 1998 workflow. If the monitor's native gamut is too small, or wrongly placed, this would be impossible.

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