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Using SMPTE Color Bars to Calibrate a Standard-definition Monitor

experience level: **beginner** - everyone should know this

The SMPTE NTSC color bar calibration pattern (shown at right) was established in 1953 to provide a means to accurately calibrate monitors to assure the viewer was seeing what was being recorded or broadcast. The pattern is comprised of three areas essential to monitor setup:

- **color bars** - white, yellow, cyan, green, magenta, red, blue - which, when observed in black & white, also define a grayscale
- **sub color bars** - below the main color bars - not displayed by all devices - the white, magenta, cyan, and blue bars displayed in reverse order
- **pluge bars** - at lower-right - a super-black, black, and near-black bar



Calibration

Luminance (works with black & white monitors and viewfinders as well):

- Allow the monitor to **warm up** for five to ten minutes. If you must calibrate before then, do so again after the monitor is warm.
- Assure the video line is **terminated** with a 75-ohm resistor. Many contemporary monitors have a switch near the terminals for this. Others perform termination automatically. If not, 75-ohm resistors integrated with a BNC connector may be obtained at almost any electronics store. Only the last device in a daisy-chained video line should be terminated.
- Display **SMPTE** color bars on monitor. If you will be using the monitor to observe a specific device, like a camera, use the color bars generated by that device and with the cables that will be used to connect the device.
- Turn the **CHROMA** (color level) control all the way down.
- Note the **PLUGE** (super-black, black, and gray bars from left to right) at the lower right of the pattern. Adjust the **BRIGHTNESS** control until there is no difference visible between the super-black and black bars, but the gray bar is still visible next to the black.
- Adjust the **CONTRAST** control to achieve a balanced gray scale across the top bars.

Color:

- Engage the **BLUE GUN ONLY** switch. If your monitor does not have a BLUE GUN ONLY switch, you should obtain a blue filter through which to observe the bars. The following filters work well:
 - Wratten 47B Blue camera lens filter from any photo store
 - pure blue lighting gel such as Rosco's #80 Primary blue
- Turn up the **CHROMA** control until the two outermost bars (white and blue) appear to match each other in brightness (or the white and blue bars match their respective sub color bars.)
- Adjust **COLOR PHASE** control until the third bar from the left (cyan) and the third bar from the right (magenta) match each other in brightness (or the cyan and magenta bars match their respective sub color bars.)
- Your monitor is now properly adjusted.

Glossary:

Black - On NTSC monitors, black is not quite black. It is actually a very dark gray (defined as "7.5% IRE.") This less-than-black black was defined by the NTSC-I broadcast standard to assure that monitors of that age would operate properly.

Brightness - Overall brightness of the monitor picture. Adjusting monitor brightness changes all tones in the same direction.

Chroma - controls color saturation level - from black & white to oversaturated, bleeding colors

Contrast - the difference between the darkest area of the picture and the lightest area of the picture. A low contrast picture will vary from dark gray to light gray. A high contrast picture will vary from darkest black to brightest white.

Phase - controls color hue. Hue is determined by the phase relationship between a timing pulse and the sine-wave that defines the color, hence the term.

Pluge - BBC acronym for **P**icture **L**ine **U**p **G**eneration **E**quipment - consisting of super-black, black, and near black rectangles - used to calibrate the brightness and contrast of a monitor.

NTSC - National Television Standards Committee - established in 1940 by the Federal Communications Commission to resolve the conflicts which had arisen between companies over the introduction of a nationwide analog television system in the U.S. The black & white, analog standard approved by the committee in 1941 (NTSC-I) was subsequently amended to include color in 1953 (NTSC-II.) In the digital age, the NTSC analog standard is showing its age. Many standard-definition digital standards have emerged in the last years. Unfortunately, most of these must still be observed with an analogue monitor, thus the need for image calibration.

SMPTE - Society of Motion Picture and Television Engineers - www.smpte.org.

Super-black – a true, zero-voltage black.