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13 Point Video Tape Quality Guidelines

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Until high definition television (ATV) arrives, in the U.S. we must still contend with the National Television Systems Committee (NTSC) video standard (or PAL or SECAM-depending on your country). NTSC, a 40-year old standard designed for transmission of color video camera images over a small bandwidth, is not well suited for the sharp, full-color images that todays computers are capable of producing. PAL and SECAM also suffers from many of NTSC's problems, but to varying degrees.

Video professionals, when working with computer graphic (CG) images, use two monitors: a computer monitor for producing CGs and an NTSC monitor to view how a CG will look on video. More often than not, the NTSC image will differ significantly from the CG image, and outputting it to NTSC as an artist works enables the him or her to see the images as others will see it.

Below are thirteen guidelines designed to increase the quality of computer graphics recorded onto video tape. Viewing your work in NTSC and attempting to follow the below tips will enable you to create higher quality videos. No video is perfect, so don't expect to abide by every guideline every time.

13 Quality Guidelines

Avoid thin, single-scanline horizontal lines and dots. Due to the interlacing of a video image, fine lines will flicker and produce visually annoying displays. You can either smooth out the fine line by blurring it, or you can simply add an identical line directly above or below the first. Horizontal lines should be an even number of scan lines wide, and the thicker they are, the more visible they will be.

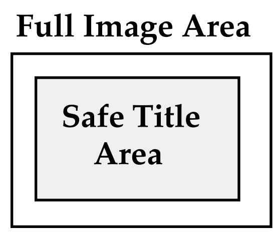
Avoid Chroma Crawl. Chroma crawl is a region between two colors creating a border of creeping colored lines. It is most noticeable between the green and magenta regions on standard colorbars. Chroma crawl can make small, colored text almost unreadable against some backgrounds. By carefully selecting colors, viewing the results and making adjustments, chroma crawl can be minimized. Often, finding good color combinations will take some experimentation. Hints: Avoid red backgrounds or letters combined with solid green or blue colors. For text, the safest color combination is white letters on a blue background. White against a black background can cause buzzing in the audio (use a gray background instead). Pastel letters on a black or dark-gray background may be acceptable. The more saturated colors you add to the image, the more you risk chroma crawl.

Plan for Surprising Color Changes From Your Computer Monitor to the Video Monitor. Certain colors on your high-quality RGB monitor look entirely different when viewed on an NTSC monitor, yellow is especially a problem. There are also technical constraints placed on colors and, unlike your RGB screen, colors are not distributed evenly within the NTSC frequency band. For example, human vision tends to be more sensitive to the green spectrum. To save bandwidth, the NTSC video signal is deliberately biased on the color green, less on red, and even less on blue. Low luminance blues will be seen as black, so it is important to maintain some degree of brightness on blue objects.

Avoid Highly Saturated Colors. No way around it, NTSC does not support highly saturated colors. In fact, the FCC established laws regarding out-of-range colors in video broadcasts. Deep rich colors which are delightful on film or print are off limits in NTSC. In video, saturated blues and reds turn to pastels. Yellow drifts towards white when overly saturated. In fact, red tends to go outside the limits very quickly and can overdrive an NTSC monitor's analog video amplifiers, resulting in a ugly buzzing black patch. Many professional video paint applications offer some means of indicating or avoiding these colors. If your application has no video color limiting feature but uses a Hue, Saturation, Value color model, then set the saturation to less than 70%.

Orient Primary Graphics Content in the Center of the Screen. Viewers are accustomed to seeing the action in the center of their screen.   Artistic license and creativity may be nice, but off-center messages and objects may be missed. Here it's best not to fight human nature. Long messages can be displayed over several screens, crawled from right to left, or rolled from bottom to top.

Keep Within the Safe Titling Area. The *Safe titling Area* is the center region that is 80% inside the viewable screen area. Consumer television sets can cut up to 20% of the picture off the sides. While computer monitors show every pixel, this is not so on TVs. Text outside the safe title area will be overscanned, cut-off and become unreadable.



Avoid Finely Detailed Grids. Closely spaced, high-contrast thin parallel lines will create a beautiful, but undesirable, rainbow pattern. This happens because the video color processors mix some of the chroma signal with some of the luminance component in the fine lines, resulting in false color artifacts. A remedy is to smooth lines with blurring or widening. Monitors with comb-filters can help to reduce this effect also.

Make Your Text Large and Watch Those Fonts. The text on your master video tape may be sharp and clear, but after duplication, transmission, and processing, colors become blurred and distorted, noise increases, and fine letters become illegible. Make the text large enough to account for the degradation of the video signal. Remember, for the most part it's still an analog world out there, so your images will be degraded. Viewers typically sit ten to twenty feet back from a TV screen, so make your text readable from the back of the room.

Use Sans Serif fonts, and avoid Serif-like fonts.   Many typefaces, designed for the print medium, are not appropriate for video. Serif fonts (such as Bodoni and Baskerville) have tapering thin tails that cause flicker and audio buzzing. If you must use those fonts, anti-alias them or blend the text with the background.

Know the Aspect Ratio You Are Using. NTSC has a 4:3 aspect ratio, your computer screen is something else, so converting screen video to NTSC is not 1:1. There are two methods of scan converting computer monitor images to video: either a 640x480 region of the screen is converted one-for-one to video, or the entire screen is pixel-averaged to NTSC resolution. Depending on the scan converter used, nice square computer pixels can become nice rectangles in NTSC, circles can become ovals. Test your video scan converter to see how square and circular objects are output. Additionally, video hardware and software use various image sizes. An image created at 640 x 480 resolution, when transferred to a 720 x 486 system may result in elongated objects or the image may be shifted to the left of center. There are professional applications which convert aspect ratios, resolutions, color depth and file types to their own internal values. You need to conform to a single aspect ratio especially when combining and compositing images from varying sources.

Calibrate and Care For Your System. Calibration is very important so you won't be unpleasantly surprised when you show your video on a another system. You must remain within the NTSC luminance and chroma specifications to have any hope of similar results from various monitors. Don't trust your eye for color calibration; use a vectorscope and waveform analyzer. My first video (using eyeball calibration under fluorescent lights) looked great on my monitor, but when I took it to a calibrated studio, all my images were slightly green. The timing of the sync pulse and burst pulse must be within 3ns of FCC specifications. Nonstandard sync timing will cause your image to be shifted to the left or right. An out of phase burst pulse will cause a color shift. Once your system is calibrated, tape over the controls so they don't get changed, and periodically recheck the calibration of your system.

Keep the heads of your VCR clean. Dirt will cause video static. If you are not a competent video technician, don't clean the heads yourself. Video heads are very, VERY brittle and can easily be damaged. Replacing heads on any VCR is expensive. Don't kink or step on your coaxial cables, this will change the bandwidth characteristics at the least, or at worst, break the inner center conductor.

Render to NTSC Resolution. Most likely the resolution of your computer screen is higher than NTSC. For video, it’s best to render images to NTSC resolution to save rendering time and memory space. Computer video frame buffers vary in size between 512x480 to 640x480 to 720x486, so know the resolution of your buffer and render to that size. Details at resolutions greater than NTSC will not be seen, and unfiltered high frequency energy can produce unwanted color artifacts. A graphics programmer that I work with renders images at two or four times the NTSC size and then pixel-averages the images to 720x486. His images are then passed through a high-frequency filter to prevent color problems. Only use this method if you have hardware filtering on your frame buffer.

Compress Sparingly and Avoid Generation Loss. Because of space restrictions or hardware limitations, raster images are often compressed on desktop video systems. Most compression schemes designed for video are lossey and produce image artifacts. For best results, avoid using compression, or as much as poossible minimize compression. It’s best to maintain uncompressed images and then compress only at the latest possible time. Compression ratios of 4:1 are near studio-quality, and 20:1 is VHS quality. Greater compression will result in poor image quality. On the other hand if you are creating MPEG-1 animations for CD-ROM, then high resolution is not a critical factor.

Avoiding generation loss is especially important with compressed images. Each generation of uncompressing and recompressing multiplies image artifacts, resulting in increasingly poor quality images. Compression methods very between application programs on the same type platform; it’s easy to have more than one type of compression artifact imbedded in an image. For example, you could have JPEG artifacts in a wavelet compressed image due to moving the image from one application to another.

Many video disk recorders convert RGB images to YUV. When an image is read back off the disk into the computer it is converted back to RGB, resulting in noise , loss of resolution, and color shifts. Again, each generation to and from the video disk recorder can multiply artifacts. Some high-end recorders keep the image in RGB format. These are the best, if you have the pocket change.

Reduce Noise Before Compressing Images. What’s the one type of image that doesn’t compress? Random noise. Lossey compression schemes (DCT, wavelet, fractal, etc.) are based on the assumption that neighboring pixels are similar. This is not the case with random noise, and noise in an image will significantly increase compression time, bandwidth, and image space. If noise becomes too great, it is possible to exceed the transmission bandwidth. In Discrete Cosine Transform compression, for example, noise appears as high-frequency energy which can’t be compressed. As multiple generations of an image are made, the noise goes exponential.

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