VIDEO TAPES

CHOOSING THE ONE THAT'S RIGHT FOR YOU

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All video tapes are created equal...but some video tapes are more equal than others.

WHY IS IT THAT SOME BLANK VIDEO TAPES cost twice or even three times as much as others having the same total recording time? How come some major manufacturers of video tape offer as many as six or eight different "grades" of video recording tape? Does it ever pay to purchase the more expensive tapes offered by those companies? What makes some video tapes "better" than others?

For several years now, *Video Review Magazine*, where the author serves as Technical Editor, has been conducting extensive tape tests, using the facilities known as Advanced Product Evaluation Laboratories, directed by Mr. Frank Barr, who was formerly in charge of the consumer-products testing laboratories of the now defunct CBS Technology Center. Mr. Barr's labs, known by their acronym APEL, have developed a most exacting test system for evaluating the performance of video tape. Industrial, rather than consumer, VCR's are used in the tests, to ensure that the results will not be limited by the performance of the tape recorder rather than the tape itself. By the way, there's no point in using a tape that provides a video signal-to-noise ratio of, say, 45 dB when your VCR's own signal-to-noise ratio is limited to 42 dB!

The most important parameter

When it comes to video performance, there are four major parameters that generally need to be considered. The first, and most important, is dropouts. A dropout on videotape simply means that a measurable amount of signal is missing from the tape. That can be caused by lack of uniformity of the magnetic-particle dispersion on the surface of the tape, or because the tape, for one reason or another, fails to make intimate contact with the rapidly spinning head-drum of the VCR during recording and/or playback. That type of poor contact, in turn, may be caused by an actual bump or lump that appears along the surface of the tape or by an overall lack of smoothness.

The visible effect of dropouts is the appearance of a white speck or even a horizontal streak on your TV screen. Many inexperienced viewers attribute such flecks or streaks to a poor signal-to-noise ratio. That's because those white flecks *do* resemble video "snow" with which we are all familiar. Actually, it's easy to tell the difference between video "noise" and tape dropouts. Noise, though random in content, appears all over the picture, and usually throughout the entire tape. Dropouts, on the other hand, occur randomly; they may occur frequently, or there may be periods when the screen is free of flecks. Human vision can tolerate noise more readily than dropouts.

Short- vs. long-term dropouts

It takes approximately 63 microseconds for the electron beam of the

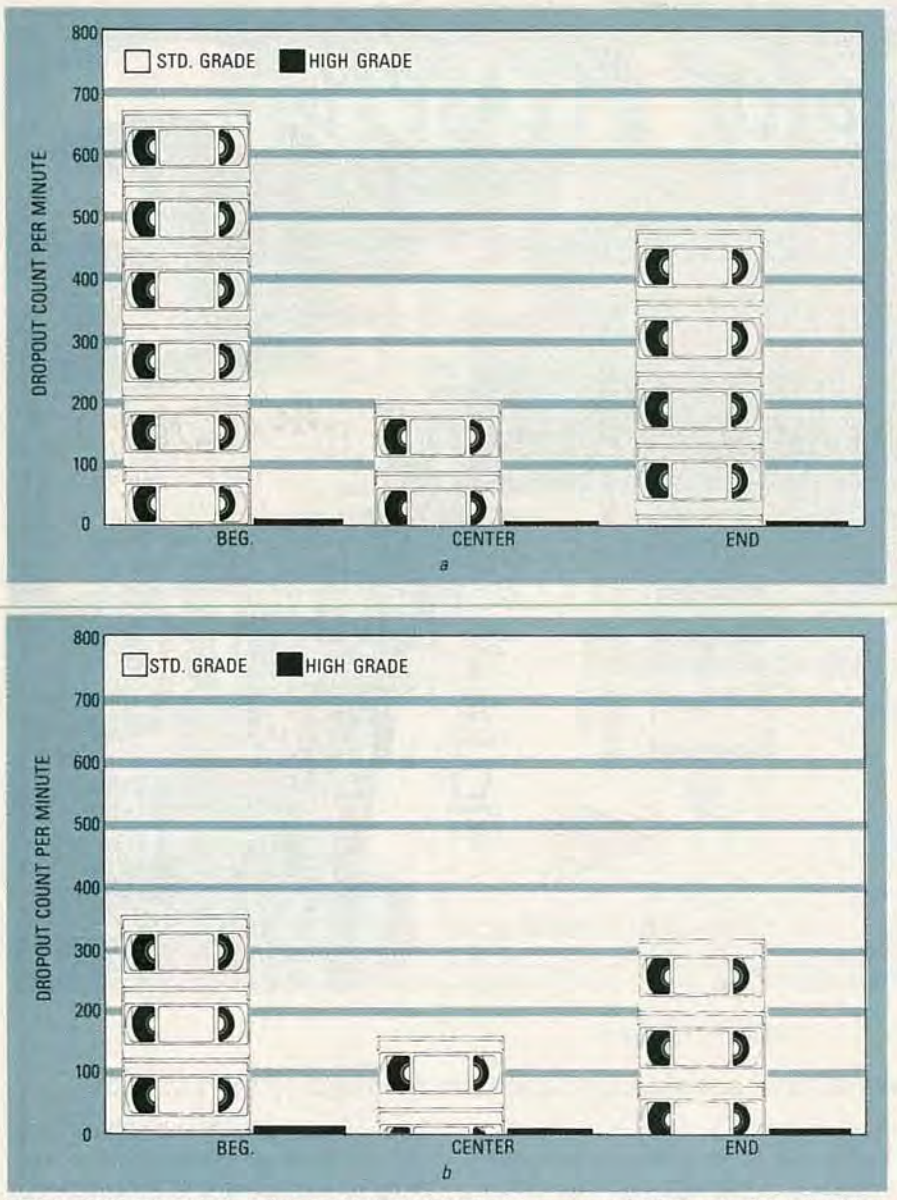

FIG. 1—THE SHORT- (1-*a*) AND LONG-TERM (1-*b*) dropout count of standard-grade video tape, compared with the dropout count for high-grade tape. Three values are given because dropout rates are higher at the beginning and end of a tape than at the center.

CRT in an American TV set to "paint" one line of a picture. That being the case, short-term dropouts have been defined as dropouts of 5 microseconds or less. Those would show up as white flecks along a scan line for about 1/12th of the length of the line or less. Long-term dropouts are defined as those that cause streaks lasting for 15 microseconds or more. Such dropouts show up as streaks occupying at least 1/5th of a scan line and are therefore highly visible and distracting to viewers.

Figures 1-*a* and 1-*b* show the short- and long-term dropout count of the very poorest standard-grade video tape, measured in a group of 22 standard-grade tapes, compared with the short- and long-term dropout count for the very best of 22 high-grade tapes. Three dropout values are given in each case because, as a rule, dropout rates are likely to be higher at the beginning and end of a tape than they are at the center (due to the way videocassettes are manufactured). That's why seasoned video-tape users fast-forward through the first few minutes of their tapes before recording on them. Most tape suppliers provide a bit more than the nominal recording time, so that practice still permits a full 2-hour recording time (at the SP VHS speed) on a T-120 tape. Figure 1 compares the worst standard-grade tapes with the best high-grade tapes; but on an average, high-grade tapes exhibit fewer dropouts than the standard-grade tapes.

Signal-to-noise ratios

In evaluating video-tape performance, signal-to-noise (or S/N for short) ratios are also of some significance, but far less so than dropouts. There are three types of S/N measurements that are worth noting. The first, called luminance S/N ratio, is measured with respect to signal brightness or the black-and-white portion of the video signal. The second is known as chroma AM (*A*mplitude *M*odulation) S/N, and it defines the color saturation or intensity. The third measurement is called chroma PM (*P*hase *M*odulation) noise, and a poor figure here results in a noticeable lack of color purity or accuracy of hues. Generally speaking, viewers are more sensitive to poor luminance S/N ratios than to the other two readings.

Although many manufacturers boast about the high S/N ratios associated with their high-grade tapes, the truth is that the S/N ratios of most tapes—even the standard grades—are better than the inherent S/N ratios of the home VCR's upon which they are used. Furthermore, the differences between the best readings for the high-grade tapes and the best readings for the standard-grade tapes are relatively small. The same holds true for the poorest readings of the standard-grade when compared with the poorest readings for the high-grade tapes. Figure 2 shows a comparison between standard- and high-grade best readings as well as the standard- and high-grade poorest readings. Notice that the very best luminance S/N reading obtained from the high-grade tapes (around 50 dB) was only marginally higher than the best reading obtained from the standard-grade tapes—or about 48 dB.

Similarly, even the worst standard-grade tapes, with regard to luminance S/N readings (a reading of about 46 dB), were only slightly poorer than the worst luminance S/N readings from the high-grade tapes. And, the two poorest readings were generally higher than the S/N ratio of most home VCR's. Home VCR's generally exhibit luminance S/N ratios for play and record of not much more than 43 to 45 dB, regardless of the tape used. The same thing pretty much holds true for the chroma AM and chroma PM S/N ratios.

HOW VIDEO TAPES ARE TESTED AND EVALUATED*

Tests of video tapes conducted by APEL are as rigorous as those conducted by the tape manufacturers themselves, if not more so. All tape tests are conducted in a 70°F. climate-controlled room, with a relative humidity of 60%. The tapes are stored in the room for 48 hours before testing. To ensure accurate results, tapes are bulk-erased and run back and forth in the test deck before testing. Tape decks are thoroughly cleaned after a tape is tested, reducing contamination between samples.

Dropout count

DROPOUT COUNTER used for measuring video dropouts.

For dropout testing, a one-minute long gray field of 50 IRE intensity is recorded on relevant sections of each tape (beginning, middle, and end). (Video brightness is measured in "IRE." 140 IRE, which is the maximum peak-to-peak brightness level for a video signal, corresponds to a completely bright screen, while 20 IRE is, for all intents and purposes, a black screen.) The tape is then played back and any dropout of 20-dB or more is counted and categorized as either a long or short dropout. The device used to measure dropouts is manufactured by *ShibaSoku*, a highly respected Japanese manufacturer of precision test equipment. One of the major causes of dropouts and high signal-to-noise ratios is an irregular tape surface. When such surfaces are suspected as being the cause of poor readings, a powerful microscope/camera combination is used to precisely examine and record the tape surface.

Luminance and chroma

Luminance S/N ratio indicates how much snow or video noise you are likely to see on a black and white video picture. A background signal level of 50 IRE (corresponding to a medium shade of gray) is used as a reference level. Using a noise meter, unweighted noise is measured over a video bandwidth extending from 10 kHz to 4 MHz, without the usual "trap" circuit at 3.58 MHz. AM chroma noise is similar to luminance noise and appears along horizontal lines of a color picture. PM chroma noise shows up as a change in color rather than as noise or graininess, and is generally less objectionable than either AM or luminance noise. Both forms of chroma noise are measured by the noise meter.

NOISE METER used for measuring luma and chroma noise.

Frequency response

B/H METER used for making magnetic measurements.

Frequency response of video tape is tested by using a multiburst signal consisting of frequencies at 0.5, 1.25, 2, 3, and 3.58 MHz. In the case of some of the newer formulations, such as S-VHS, additional, higher frequency bursts would have to be used. Attenuation at those test frequencies is recorded and a response curve for each tape can be drawn.

As for the magnetic properties of a tape, normally, a B/H meter is used to measure them. That meter can be used to evaluate signal loss with repeated playing of a tape, and magnetic properties such as coercivity and remanence can be measured.

Mechanical properties

TENSILE TESTER used for measuring elongation and breaking strength.

Base materials of video tapes vary considerably. Some tapes, when under tension, will stretch enough to mar picture quality. Others may have such low tensile strengths that repeated use may actually cause them to tear or break. Elongation and breaking strength can be measured using a calibrated tensile tester. **R-E**

*Mr. Frank Barr of *Advanced Product Evaluation Labs* (APEL) has kindly provided the photographs of their test equipment.

Frequency response

Frequency response is directly related to the picture detail or picture resolution that you can expect from a given tape/VCR combination. Horizontal resolution is defined as the number of distinct picture elements that can be discerned across the length of a single scanning line of a TV picture. It should not be confused with the number of scanning lines in the picture itself, which defines vertical resolution. Typically, conventional VHS VCR's deliver between 240 and 260 lines of horizontal resolution at best. That falls somewhat short of the maximum resolution that can be broadcast over the air using the NTSC transmission standard. The rule of thumb is that for every MHz of frequency response in the system, you can expect about 80 lines of horizontal resolution. So, to obtain a resolution of 240 lines, you must have a frequency response to at least 3 MHz, with relatively little attenuation. Figure 3 shows the response (in dB) at a frequency of 3.58 MHz, for the best of the standard- and high-grade tapes, and also for the poorest of both. Even the poorest standard-grade tapes were "down" only around −2.5 dB at 3.58 MHz and, surprisingly, the poorest high-grade tapes were actually down a fraction more at that high video frequency.

The truth is that just about any video tape will exhibit a frequency response that's considerably better than the limitations of the home VCR. Of course, we are only talking about conventional VHS, Beta, and 8-mm video recorders and tapes. If you happen to own one of the new S-VHS machines, the story is quite different. Those machines are capable of delivering 400 or more lines of horizontal resolution, and require special S-VHS tapes that use metal particles instead of an oxide of magnetic particles in their formulations. S-VHS tapes will generally exhibit a frequency response extending all the way out to 4.2 MHz, or even to 5.0 MHz, but those benefits will not be realized if the S-VHS tapes are recorded on or played back using a conventional VHS machine.

Repeated plays

How long will most video tapes last? If you are using a tape to record a once-in-a-lifetime family event or a major sports event that's not likely to

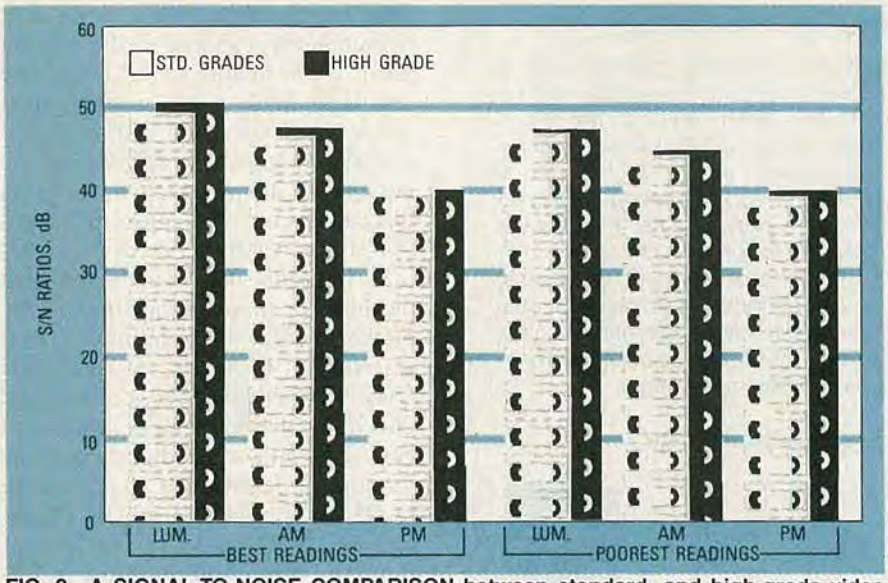

FIG. 2—A SIGNAL-TO-NOISE COMPARISON between standard- and high-grade video tape. Notice marginal differences between tape grades in this respect.

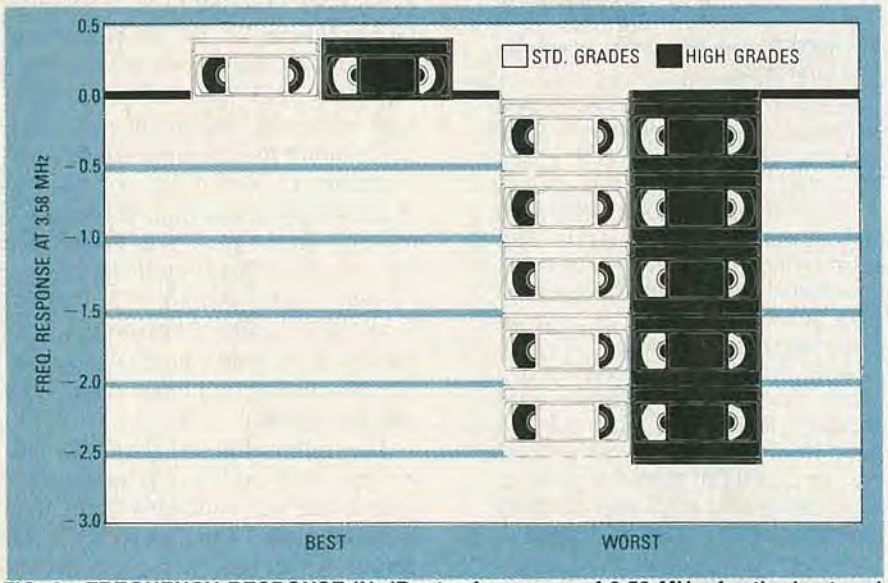

FIG. 3—FREQUENCY RESPONSE IN dB, at a frequency of 3.58 MHz, for the best and poorest of the standard- and high-grade tapes.

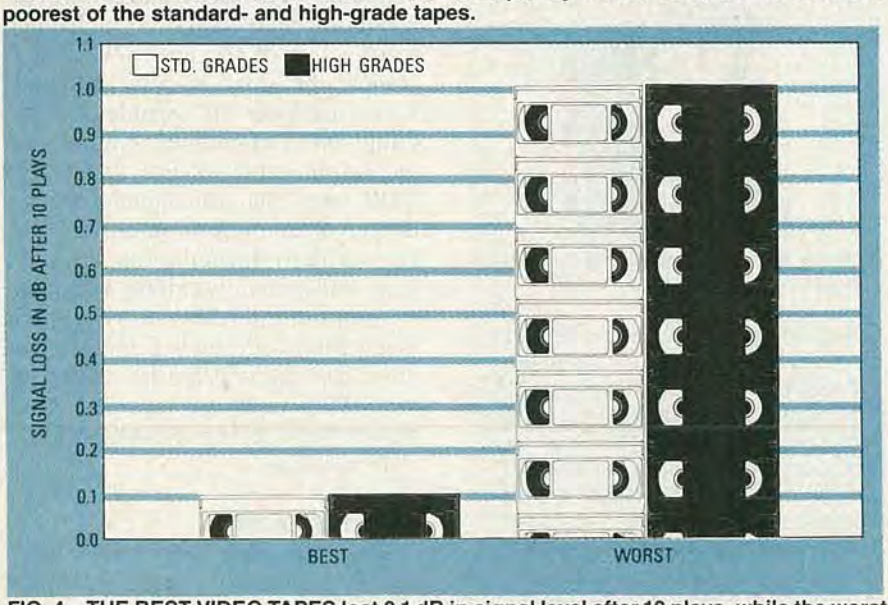

FIG. 4—THE BEST VIDEO TAPES lost 0.1 dB in signal level after 10 plays, while the worst of them lost less than 1 dB after the same number of plays.

be repeated or available on pre-recorded tape, the question of durability is important. If you are simply recording a program "off the air" for viewing at a more convenient time, after which you plan to record something over it, then durability is of little importance. Most video tapes are excellent in their ability to preserve picture and sound with repeated playing with very little loss of signal level. Furthermore, there seems to be little difference between the standard- and high-grade tapes insofar as signal loss with repeated playing is concerned. That is illustrated in Fig. 4, where we see that the best standard- and high-grade tapes lost a mere 0.1 dB in signal level after 10 plays, while the worst standard- and high-grade tapes lost less than 1 dB after the same number of plays.

Audio performance

If you own a VHS or Beta VCR that has hi-fi audio, virtually any tape that produces good video with minimum dropout will also deliver wide-response, low-distortion stereo audio. That's because the audio signals are recorded as FM carriers along with the video signals, on the same area of the tape. The same holds true for 8-mm camcorders or VCR's where AFM (*A*udio *F*requency *M*odulation) audio recording is mandatory, even if the audio is only single-channel. Audio troubles arise when you own a VCR that uses the edge of the tape for so-called "conventional" or "linear track" audio recording.

The limited frequency response of the audio electronics of most VCR's is likely to be poorer than the capability of most tapes. You may also find that some inferior tapes have been slit improperly, and will exhibit dropouts of the sound recorded on the track closest to the edge of the tape. Friction within the cassette housing can also result in high levels of "wow" and "flutter," or variations in pitch when playing back musical programming.

Which tape to use?

There's no single answer to that question. It all depends upon the type of recording you do, what you plan to do with it, and how important the finished tape is to you. Dropouts remain the single most important criterion by which to judge video tape. And once you find the brand that suits your needs, stick with it. **R-E**