SOUND TALK

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

PHYSICAL LIMITATIONS OF MAGNETIC TAPE

by

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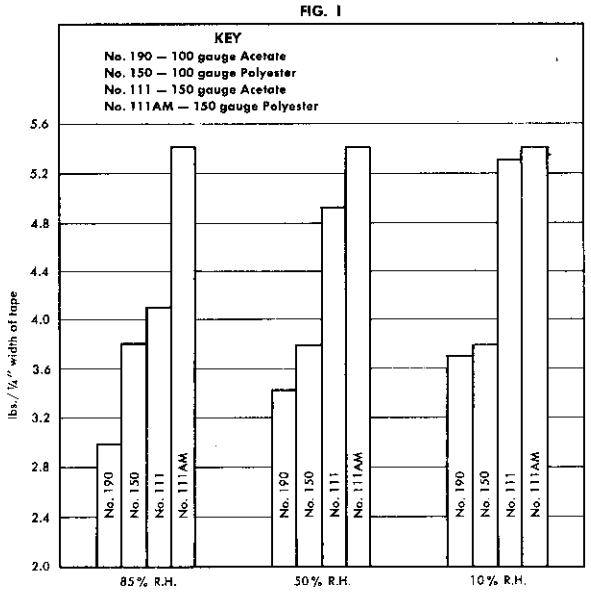
Magnetic recording tapes are generally used under conditions where physical properties of the tape are adequate for satisfactory performance. However, where magnetic tape is used under abnormal, or extreme conditions -- as, for example in recording instrumentation data at tape speeds as high as 100 inches per second in conjunction with high head pressures and high surrounding temperatures -- certain properties of the recording media may become critical. These include (1) stress strain characteristics, (2) softness of the coating, (3) anchorage of the coating to the base, and (4) flexibility of the base.

Stress Strain Characteristics

It is well known that the ultimate tensile strength of the tape is less important than the strength of the tape expressed as the force necessary to induce permanent distortion. The force necessary to give five percent elongation under stress (F5 value) has been considered in the field as the value which indicates how readily the tape distorts. The F5 values published for tapes are usually those obtained under standard conditions of temperature and humidity.

The relationship of F 5 vs. humidity for various tapes is shown in Figure 1.

FIG. 1



Here one can readily see that the higher humidity has a softening, or plasticizing, effect on the acetate backing, but has negligible effect on the polyester tape backing. This plasticizing effect also shows up in the relative tear strength of the acetate which accounts for the apparent brittleness of acetate at low humidities.

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The effect of temperature on the F5 value of acetate film is less gradual than the humidity effect and only small differences are noted when the test is conducted at temperatures below 150°F. Above these temperatures the film becomes relatively soft, so that at 180°F. the F5 value is less than half the value obtained at room temperature.

The temperature effect on polyester films is quite similar, in that the effect is small until the temperature is raised to 180°F. Above 180°F. the F5 value decreases rapidly with an increase in temperature.

It should be pointed out that, under normal audio recording conditions at tape speeds up to 15 inches per second, temperatures involved rarely, if ever, go beyond 110-120 degrees F. and therefore the effects discussed here generally do not apply.

Temperature Effects

In addition to having an effect on the stress strain characteristics, temperature has an effect on such properties as anchorage, flexibility and hardness of the magnetic coating.

Standard tapes can be used satisfactorily in the temperature range of -40°F. to 150°F. Below -60°F., however, there is a tendency for the coating to loosen from the backing if flexed over a mandrel of 1/8" diameter or less.

Above 150°F. the coating has a tendency to become soft and may cause some difficulty in moving the tape over the heads, especially if the tape comes in contact with other plastic materials. Tape stored at temperatures greater than 150°F. under humid conditions will have a tendency to block, resulting in layer-to-layer adhesion.

This is not true, however, in the case of a series of new long wear tapes developed by the 3M Company. For use in critical applications where high temperatures are a factor, such tapes can withstand prolonged temperatures up to 200 degrees F.

Wear Characteristics

Although the wear characteristics of magnetic tapes are dependent upon the tensions and pressures used to insure good contact with the recording head, tapes normally may be used for many thousands of plays on any existing machines.

When the tape tensions and speeds are such that tape wear does become a problem -- as in instrumentation use -- the effect is not one of the oxide slowly wearing away and causing a loss of signal, but is one of small bits of the coating relocating itself in the form of lumps on the tape surface or collecting on the head. Either case will result in a loss of signal by separating the tape from the head.

The phenomenon of rub-off in tape wear is found to be much more severe if magnetic heads used have a plastic component. This is because of increased friction between the tape and a plastic head material as compared to a metal head surface.

New tape constructions which are superior in wear characteristics are now being evaluated in special applications.

Dimensional Stability

The coefficient of linear expansion of the two backings -- cellulose acetate and polyester -- shown in Figures II and III are quite widely known. These figures represent the dimensional stability of the backings at normal temperatures up to about 120°F. Above this temperature the tapes have a tendency to shrink, due to the relaxation of the stresses set up in the backings during the film manufacturing process. This shrinkage amounts to about 0.5% at 200°F. and may be as much as 1% at 250°F.

This shrinkage increases as the caliper increases in polyester films and decreases as the caliper increases in acetate type films.

FIG. II

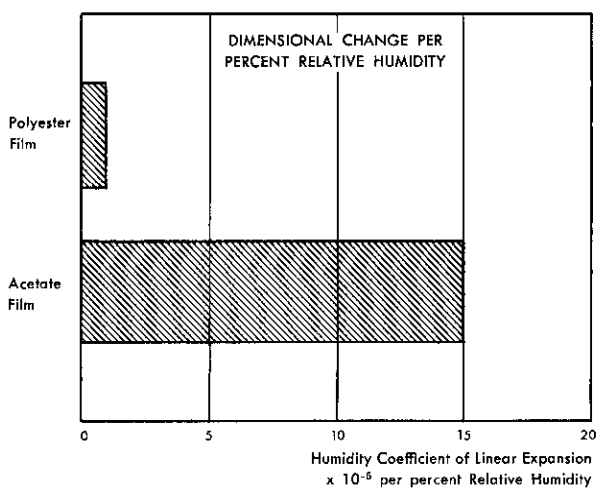

FIG. III