SOUND TALK

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

Bulletin No. 32

MECHANICAL CONSIDERATIONS IN THE USE OF THIN BASE RECORDING TAPES

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Thin base magnetic recording tapes, such as "Scotch" Brand No. 190 and No. 150 tapes, on 1 mil thick backings are enjoying widespread acceptance as a new and distinctive class of recording media.

These tapes offer certain advantages over standard thickness tapes, such as "Scotch" Brand No. 111, but at the same time, certain limitations must be recognized if optimum results are to be obtained.

Properly used, thin base tapes not only offer a 50% increase in playing time on existing standard equipment, but also represent an important step forward in the miniaturization of magnetic recording devices.

The magnetic coating which was developed for these tapes has been covered in previous Sound Talk Bulletins Nos. 30 and 31, and therefore, the present writing will be confined to a discussion of how mechanical properties affect the use of thin backed tapes in recording machines.

CONFORMABILITY

It is well known that the stiffness of a film decreases very rapidly as the thickness is reduced, and therefore, as might be expected, thin base tapes are considerably more flexible than those of standard thickness. It is this fact which accounts for an improvement in the steadiness of recorded signals when using thin base tapes. The effect is best understood by referring to two simple mechanical tests.

In the first of these, illustrated by figure 1, a standard No. 111 tape and a thin base No. 190 tape are draped over a flat microscope slide under the light tension afforded by the weight of a spring-type clip. The inability of standard tape to lay flat against the plane surface of the microscope slide is a consequence of the stiffness where the tape bends over the edge of the slide.

A similar situation exists in passing over the heads of a recording machine. A deviation in the smooth contour of the recording head may cause failure of the stiffer tape to conform to the head, whereas the thin base tape is more prone to accomodate to abrupt changes in contour. Loss of contact with the head in the region of the gap usually causes complete loss of high frequencies, and may drastically reduce the overall signal level. This effect may be sporadic, depending upon the tape

tension and small deviations in the path of the tape through the machine.

The second test which demonstrates not only the superior conformability of thin base tapes, but extensibility as well, is that of observing the surface of a tape which has passed over a recording head.

Under a microscope, an occasional nodule in the surface of the tape will appear as a shiny high spot in the middle of a dull area which is in turn surrounded by the generally shiny area of the tape. This dull area surrounding the nodule represents the portion of the tape coating which has been separated from the head by the nodule, and is roughly proportional to the magnitude of the dropout in the signal intensity.

In the case of thin base tapes it has been found that the dull area surrounding a nodule is much smaller than in the case of standard tapes. This is the result of improved conformability of the tape to the recording head made possible by the greater flexibility of the thin base. Severity of the dropout is therefore correspondingly less, evidenced by a general reduction in dropout intensity which has been noted using thin base tape.

Because of the increased head conformity, the tape tension may also be reduced without sacrifice in performance.

ACETATE VS. POLYESTER FILMS

Both acetate and polyester base films have been well established in the recording industry, each possessing some outstanding properties. Polyester film base used in No. 150 tape is more stable with respect to temperature, and humidity, than the acetate base of No. 190 tape, and is virtually free from dimensional changes and distortion induced by environmental changes. These effects are illustrated by the bar graphs of figure 2 which show the humidity and temperature coefficients for each film. Moreover, polyester base is somewhat stronger and more shock resistant than acetate base. The latter property sometimes works to the disadvantage of polybase, however, since when subjected to high shock loads, tape made from this film may elongate permanently to about twice its normal length before breaking. The resulting stretched portion of tape is extremely difficult, if not impossible, to repair. Acetate base tape, however, breaks sharply with no appreciable elongation when subjected to high shock loads, and is easily repaired with "Scotch" Brand pressure sensitive splicing tape No. 41. Cost factors are also on the side of acetate base tapes since polyester films command a higher price.

Since the base films used in the manufacture of thin backed tapes are identical to those of standard films, except for reduced thickness, the tensile strength is proportionately reduced. These relationships are shown in the stress-strain curves of figure 3 for 1.5 mil and 1 mil polyester films and of figure 4 for 1.5 mil and 1 mil acetate. The sharp hump in the curve represents the point at which permanent deformation begins, while the end of the curve represents the breaking point. It is apparent that the allowable tensile stress on thin base tape is about two-thirds that of corresponding standard base tape.

INERTIA EFFECT

Limitations on the mechanical design of a recording machine are determined in large by the stresses which can be placed upon the tape during its passage through the machine. In particular, the speed with which the machine may be started and stopped depends upon the ability of the tape to withstand the stresses attendant with acceleration of the full reels of tape. This problem is most acute in machines employing reels $10\frac{1}{2}$" or larger in diameter since the moments of inertia of these large reels of tape are very appreciable.

However, a fortuitous situation exists in the case of thin backed tapes. If the total tape length (i. e. playing time) is held constant, the reduced size of the full reel of tape very nearly compensates for the decreased strength of the

tape, so that the system can be accelerated safely at the same rate as with standard tapes.

This means that if the extra playing time afforded by thin tapes is not required, a smaller reel of thin base tape may be used more conveniently, with attendant decrease in breakage. Recording machine manufacturers and recorded tape producers can take advantage of thin base magnetic tapes to effect miniaturization of their products.

GUIDING AND WINDING

While the increased flexibility of thin base tapes improves conformability to the heads, it also poses problems in guiding and winding the tape.

The usual method for controlling the lateral position of the tape as it passes through the recording machine is by means of closely spaced guides which press against the edges of the tape to urge it into the proper lateral position. The increased flexibility of thin tapes makes them more prone to fold or wrinkle when edge-guided. However, this effect usually can be overcome by reducing the tape tension, thereby reducing the lateral force required to position the tape in the guide.

It is also apparent that thin base tapes are more subject to damage by crushing of the edges of poorly wound reels. If the tape is not stacked evenly, turn on turn, the protruding edges of the tape may be more easily damaged in subsequent handling of the reel.

Since this effect is most serious in longer rolls, the use of plastic 10-1/2" reels with close fitting flanges is recommended. These reels have a spacing between flanges of only .280" as compared with .345" for metal NARTB reels, and confine the lateral movement of the tape to a nominal amount.

In fast winding the tapes, air may become entrapped between the tape layers causing "skidding" of the turns as they are layed down. This effect is minimized by slowing the speed of winding. This "skidding" effect is usually negligible at winding speeds under 100"/second.

In summary, the following points on the use of thin base tapes should be kept in mind:

1. Lower winding tensions should be used to minimize the possibility of stretching or distorting the tape.

2. Reduced winding speed and the use of plastic $10\frac{1}{2}$" reels make for evenly wound rolls which protect the tape from edge damage.

3. Recording machines and tape libraries can be miniaturized through the use of thin base tapes.

4. Where extreme temperature and humidity variations may be incurred, polyester base tape may be advantageous.