SOUND TALK

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

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THE STORY OF #190 TAPE

Recent trends in magnetic recording have been toward longer uninterrupted playing time which heretofore have been obtained either by reducing the tape speed or by increasing the reel size. The first of these alternatives inevitably results in some loss of fidelity while the second increases the bulk of the recording machine. Realizing that a better answer to this problem was needed, 3M engineers and chemists have been working for over three years on the development of a thin tape construction which would permit winding longer lengths on standard size reels. The culmination of this work has been reached in the new "SCOTCH" Brand #190 Tape featuring 50% greater playing time on standard size reels, and an actual increase in the fidelity of reproduction.

Early in the development of #190 tape it was recognized that merely thinning the cellulose acetate backing to accomplish the reduction in thickness would result in a tape having poor strength and stability. Likewise reducing the coating thickness by lowering the output of the tape seemed undesirable. The ultimate answer to this question came only after a new high remanance coating was developed which made it possible to reduce the thickness of the magnetic coating to .0003 inches while still retaining full output and sensitivity. Using this coating, the thickness of the cellulose acetate backing need only be reduced 29% (from .0014" to .0010") to permit a full 50% increase in playing time as compared to standard tapes. Moreover the thin coating concentrates the active magnetic material closer to the surface which contacts the head gap during recording. This results in increased recording efficiency, particularly at high frequencies.

After the basic work by the 3M Research team had clearly defined this new #190 tape construction, the job was still only half done. The production problems attendant with coating the .0003" thick magnetic layer at first seemed unsurmountable in view of the tolerance of approximately 9

PHYSICAL SPECIFICATIONS

Ultimate Tensile Strength	4.5 lbs/1/4" Tape
Shock Tensile Strength	0.8 Ft-lbs/on 1/4" x 24" Sample
Caliper of Tape Backing	0.95 - 1.0 Mils
Coating	0.28 - 0.35
Total	1.23 - 1.35

Coefficient of Humidity Expansion -

Lengthwise	1.5×10^{-4}/%RH
Crosswise	2.0×10^{-4}/%RH

MAGNETIC SPECIFICATIONS

Intrinsic Coercive Force	220 - 240 Oersteds
Retentivity	900 - 1100 Gauss
Remanent Flux per 1/4" Tape	0.50 - 0.55 Maxwell
1000 cps Uniformity* -	
within a roll	±0.25 db
roll to roll	±0.50 db

Tape Speed - 7.5"/sec.

Magnetic Products Division 3M COMPANY

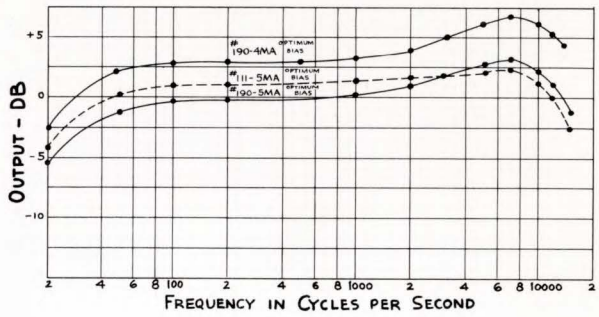
millionths of an inch imposed by the magnetic uniformity requirements. However, after numerous pilot plant runs and repeated modifications to the coating equipment, it was demonstrated that these tolerances can be held in large scale production runs of #190 tape. This production experience was then followed by an extensive testing and field evaluation program during the course of which hundreds of reels of #190 tape were given the acid test of actual use in recording operations. Only after receiving the stamp of approval from the Research, Development, Production and Field Evaluation groups was #190 tape released for general use.

In the design of #190 tape, it was recognized that a radical departure from existing magnetic standards would be unwise. Therefore every effort was made to design a better tape which would perform satisfactorily on existing equipment. Indeed for most uses #190 tape can be used inter-changeably with standard tape such as "SCOTCH" Brand #111. However, in certain critical uses, it may be desirable to readjust the recorder slightly to accommodate the increased sensitivity and response of #190 tape. The response curves of Figure 1 show clearly the performance that can be expected of #190 tape in comparison with standard tapes such as #111. The bias current for optimum recording on #190 tape is about 20% less than that of #111 tape. However, the increased sensitivity and response of #190 tape permit satisfactory (even superior) performance with the standard high bias. Regardless of the value of bias current used, the response (i.e. high frequency output with respect to low frequency output) of #190 tape is better than that of standard tapes. Also using #190 tape the optimum value of bias current is the same for high recorded frequencies as for low recorded frequencies, making it unnecessary to compromise sensitivity for response or visa versa. This unique property is again attributable to the proximity of the magnetic material to the recording gap made possible by the thin coating. The output capabilities of #190 tape (e.g. output for a given percent distortion) are also slightly higher than those of standard tapes at low frequencies and considerably higher (4 to 6 db) at high frequencies. This property of #190 tape greatly alleviates the problem of high frequency overload in recorders employing a large amount of high frequency pre-emphasis.

FIG. 1

FREQUENCY RESPONSE of #190 TAPE

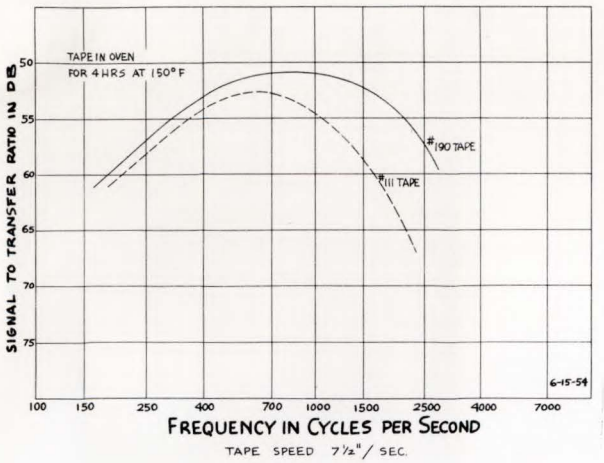
7.5" PER. SEC.



In a thin tape construction, a higher layer to layer signal transfer might be expected. Extensive tests have been conducted on this affect in #190 tape and the results are summarized in Figure 2. Layer to layer transfer being quite sensitive to the recorded frequency (wavelength), a number of frequencies were used and the signal to transfer ratio plotted against frequency. It is apparent that in the low and mid frequency regions the transfer ratios of #190 and standard tapes are about equal. Only in the high frequency range (where the signal to transfer ratio is again quite large in comparison to the mid frequencies do the higher transfer tendencies of #190 manifest themselves. Subjective listening tests on a variety of program selections revealed no detectable differences between #190 and standard tape, confirming the relative unimportance of the high frequency transfer components.

FIG. 2

LAYER TO LAYER SIGNAL TRANSFER



The physical properties of #190 tape are summarized in the data on page 1, and are very similar to those of standard tape. Extensive tests on various recording machines have proved conclusively that #190 tape will withstand any normal operating conditions likely to be encountered on a recorder. The tape is conservatively rated as to the length which can be accommodated on a reel and a generous flange clearance is provided in all sizes to minimize spillage. The patented silicone lubrication process has been employed in #190 tape resulting in complete freedom from sticking and squealing. However, existing friction testing methods have been found to be unreliable, making it impossible to specify a value for the coefficient of friction (μ) of #190 tape.

In summary it can be said that not only has the original goal of a long playing magnetic tape been realized in the #190 tape, but another milestone in the never ending search for better frequency response at slower tape speeds has been passed as well.