

# TALK

SOUND

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

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## FREQUENCY DEPENDENCE OF PERMISSABLE RECORDING CURRENT

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In magnetic recording, there is a widespread tacit assumption that overload occurs for a given recording current regardless of frequency. In some careful work, allowance is made for decreasing head efficiency at high frequencies, but no experimental data have been published confirming the basic assumption.

The reason for this is that the measurements are not easy. With harmonic distortion measurements, the third harmonic frequency becomes too high for a fundamental frequency above one-third the highest frequency response. Intermodulation data employing a high and low frequency is of no value, because any analysis of such data requires a knowledge of the distortion characteristic at both recording frequencies.

The method that has proven useful for these tests, as also for many other tests, is that of cross modulation distortion between two nearly equal frequencies. If two frequencies,  $F_1$  and  $F_2$  are recorded by a non-linear system, there will in general be observed at the output all of the possible sum and difference frequencies. The third order differences ( $2F_1 - F_2$  and  $2F_2 - F_1$ ) are the most significant in testing magnetic media, corresponding as they do to third order harmonic distortion.

Using this method of measurement, the dis-

ortion characteristic of the medium may be determined up to the highest recordable frequencies with each measurement indicating the distortion characteristic of a narrow range of frequencies. When this is done, it is found that various tapes differ in the recording characteristic which will result in equal distortion at all frequencies. With "SCOTCH" Sound Recording Tape No. 111 at 7-1/2 inches per second, the permissible recording current is constant up to about 1200 cps., and above that rises gradually until at 7000 cycles, 4 db. greater recording current may be used.

This behavior is different for different types of magnetic material. With "SCOTCH" Sound Recording Tape No. 112 the permissible recording current is constant to about 4000 cycles above which it decreases until at 7000 cycles it is about 2 db. less. Various foreign and competitive tapes have still different characteristics. In general, there appears to be a direct correlation between coercive forces and the permissible high frequency pre-equalization. Since recording levels are usually set at low audio frequencies, it is important to realize that different tapes may show different high frequency intermodulation effects and to use the pre-equalization which gives the best compromise between distortion and signal to noise ratio.

Magnetic Products Division



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These data apply to a speed of 7.5 inches per second, but measurements at a variety of speeds have been made. These data indicate that the effect is a wavelength rather than a frequency effect. These same data also indicate that the change in distortion at high frequencies is not due to the variable ratio between audio and bias frequencies.

Tests similar to these have been performed at the Stromberg-Carlson Company, and the data are available in their twentieth Monthly Progress Report to Evans Signal Laboratory, March 15, 1948. Their tests showed comparable results with the ones performed at 3M.

Another question which has often been raised relates to the effect on pre-equalization caused by changing bias current. It is well

known that, other things being equal, a higher bias current results in poorer high frequency response. Without specific data (and none has ever been published) it is impossible to predict whether this loss of highs could be made up by additional pre-equalization or not. If the distortion is a function of the recording field, one would expect that it could not be compensated through pre-equalization whereas if it is a function of the recorded level of magnetization, it could be recovered simply by increasing the recording current. Our tests have shown that the former is more nearly correct, and that for all practical purposes, the loss of highs due to the effect of bias cannot be recovered by pre-equalization without a comparable increase in distortion of high frequencies.