TECHNICAL TALK

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

INSTRUMENTATION BULLETIN
NUMBER 1

# Handling and Storage of Instrumentation Tape

*Successful results in instrumentation recording depend not only upon using magnetic tapes of high quality on reliable equipment, but also upon handling and storing these tapes with reasonable care. The following discussion deals with some problems in the handling and storage of magnetic tapes and suggests how they may be overcome.*

## Signal Dropouts

A common problem in instrumentation recording is the dropout, generally defined as a 50% signal reduction, and most frequently caused by poor head to tape contact. This poor contact may be due to improper handling of the tape or to unclean heads on the recorder, which lead, in turn, to contamination of the oxide surface of the tape. It may also be caused by distortion of the base material of the tape – or by a combination of all the factors cited here.

The signal attenuation resulting from poor contact between tape and head is most pronounced in the shorter recorded wave lengths. This effect, in playback, is illustrated by the formula:

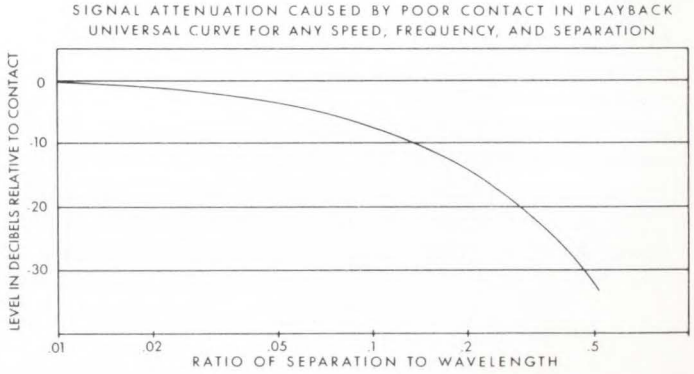
$$\text{Drop in playback level (in decibels)} = 54\,\frac{d}{\lambda}$$

where: $d$ = separation of tape from head

$\lambda$ = recorded wave length on tape

Figure 1 shows attenuation plotted against the ratio of separation to wave length. This curve is universally applicable for any speed, frequency, and separation. It should be remembered that Figure 1 illustrates the loss in signal level in playback only, assuming that the signal has been

**Figure 1.**




Magnetic Products Division 3M COMPANY



M-TTIP-1(21.5)R

perfectly recorded. An equal or greater effect may be present in the record mode.

In playing a low frequency signal of 15 mil wave length, a separation of 1 or 2 mils affects the level only slightly, but at a high frequency, of 1 mil wave length, for instance, even a half mil spacing results in a drop of more than 20 db. (A 1 mil wave length would result, of course, from 15,000 cps at 15 ips and from 60,000 cps at 60 ips, etc., typical of many FM carrier frequencies.) In instrumentation recording a 6 db or 50% drop in signal is considered critical. With a 1 mil wave length this takes place at 111 micro-inches (.111 mil) head to tape separation. Since a dust particle might easily approach this size, this illustrates the importance of a clean operation.

# Handling

When tape is handled, as during splicing, the operator's hands should be thoroughly clean to prevent contamination of the tape by body oils and salts, which will pick up foreign particles. Some operators, in addition, find it helpful to wear clean white gloves to prevent contamination when handling tape.

Heads and guides of the machine should be cleaned to remove accumulations of foreign matter each time a tape is placed on the recorder. The machine manufacturer's recommended cleaning procedure should be followed.

# Cleaning

If you have difficulty with signal dropouts arising from dust, carefully wipe the surface and backing of the tape with a lint-free cloth, such as a very soft chamois, before and after using. To get rid of contamination that does not brush off easily, use a cloth lightly moistened with Freon TF.* Aliphatic hydrocarbon-type solvents (heptane, gasoline, naphtha, etc.) can also be used; care should be exercised, however, since they are flammable. Freon TF is non-toxic and non-flammable. Do not use carbon tetrachloride, ethyl alcohol, trichlorethylene or other unknown cleaning agents because they may soften the oxide, deform the backing, or both.

# Storing

Tapes, when not in use, should be placed on a precision reel for uniform winding at moderate tension and then given protected storage. Recommended take up tension for most instrumentation recorders is 4 to 5 ounces for each ¼ inch of tape width. The best method of protected storage is to place the reel of tape in a self-sealing plastic case (the "SCOTCH" BRAND "Seal-Tite" plastic case, shown in Figure 2, is an example) and store it on end in a storage bin equipped with partitions between each reel. The plastic case protects tape from dust and sharp humidity and temperature changes. It also guards both tape and reel against handling damage when being transported between storage and work areas. Rewinding the tape once or twice a year during storage is recommended because this releases expansion-contraction stresses and lessens the possibility of blocking. This is particularly true of acetate base tapes.

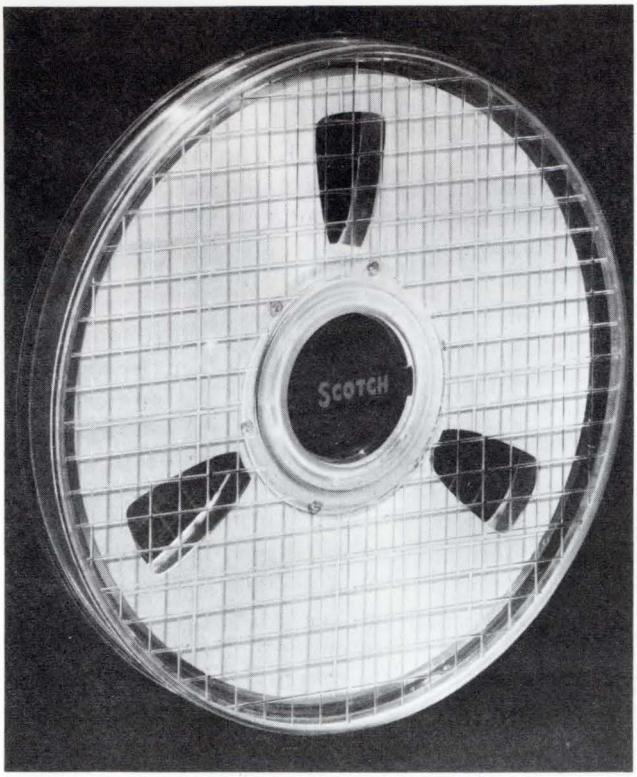
Extremes of temperature and humidity should be avoided. In general, recommended storage condition for acetate and polyester base tapes are:

Humidity . . . . . 40-60% R. H.
Temperature . . . . . 60-80°F.

If extremes of temperature are encountered during storage or transit, tape should be brought to equilibrium before it is used. Assuming, for

**Freon TF, a Dupont product, is available in quart, gallon and 5 gallon quantities from John B. Moore Corporation, Peerless Building, P. O. Box 3, Nutley, N. J.*

Figure 2.



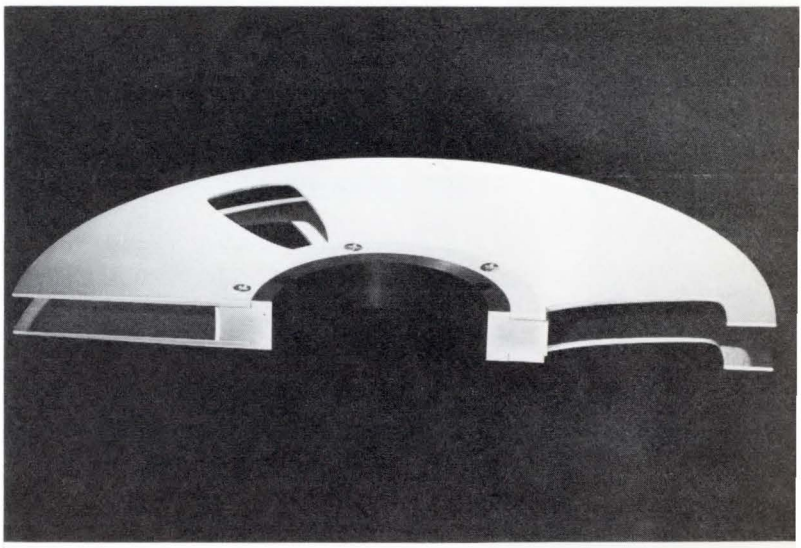

instance, that a tape has been in storage or transit at sub-zero temperatures, it should be stored a minimum of 4 to 8 hours at room temperature before it is used. Actually, it will not regain complete equilibrium for 16 hours. This time can be shortened by accelerating temperatures, but these temperatures should not be over 100°F; otherwise, condensation, which may or may not prove to be a problem, will form on the tape. Avoid using direct heat, such as lamps or other spot heat, to "warm up" a tape.

# Distortion

While the majority of dropouts in instrumentation recording are caused by specks of dust and other contaminants lifting the tape away from the head, the next most significant causes are dents and creases in the base material. Dents can be caused either by foreign particles becoming wound up tightly in the roll, or by roughness in the surface of the hub on which the tape is wound. These may cause a permanent set in many layers of the tape which cannot be stretched out flat as the tape passes over the head. Stresses in the roll sufficient to stretch the backing 5% will generally leave a permanent impression. Stresses below the 5% point are not normally permanent. Creases usually are caused by handling the tape (i.e., threading, making splices, removing the tape from the guides, etc.) or by damage to the edges of the tape because of uneven winding.

Most causes of distortion of the base material can be eliminated by the use of the precision reel, shown in the cutaway view of Figure 3. The tapered flanges are closely spaced to minimize scattering of turns during winding, and the flange design affords greatly increased protection against dust and crushing of the tape edges. The hub has no threading slots which cause distortion of the inner turns; it is covered instead by a neoprene friction ring to aid in threading. This ring also acts as a cushion for the innermost tape layers and minimizes distortion from winding pressure and expansion-contraction stresses.

Figure 3.



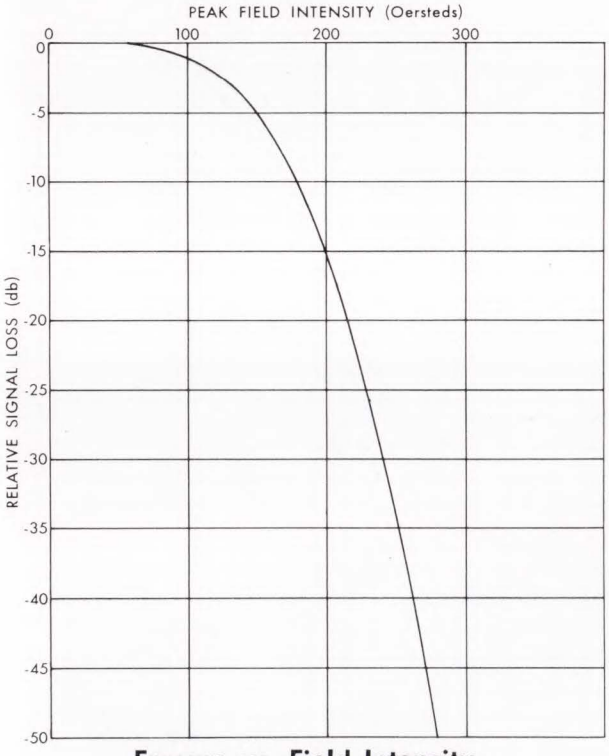
# Accidental Erasure or Saturation

Magnetic properties of instrumentation tapes are stable indefinitely. Magnetic retentivity is permanent unless altered by magnetic means. It may be altered, for example, by magnetic fields from permanent magnets or electro-magnets. These very likely will cause erasure if placed within a few inches of the tape.

This is the principle utilized in the bulk erasing process, in which a whole reel of tape is demagnetized without unwinding. The fields necessary to produce complete erasure, however, are so intense that it is not likely that this would occur accidentally, as in the case of proximity to current required for conventional electronic telemetry equipment. Complete erasure (considered, for purposes of this discussion, to be reduction of signal to a point below the noise level of the system) does not usually take place unless the field is strong enough to exert a noticeable attraction for the tape. Slight erasure can occur, however, without any noticeable attraction or vibration.

Figure 4 illustrates the relationship between field intensity and erasure as shown in experiments conducted with a typical A.C. bulk eraser. Some erasure is noticeable at a field intensity of only 100 oersteds, and a 6 db drop occurs at a field strength of 155 oersteds. A 6 db loss is generally considered critical because it represents a 50% reduction in signal strength. In some applications a loss of 1 db might be critical.

Figure 4.




**Erasure vs. Field Intensity**

Notes: Field intensity measured at center of recorded track. Track width = 0.090 inches. $\lambda$ = 0.015 in. (500 cps at 7.5 ips). 0 db = 8 db below level for 3% harmonic distortion.

Both unrecorded and recorded tapes should be kept away from electromagnetic bulk erasers and storage cabinets with magnetic latches. Unrecorded tapes should not be placed near D.C. magnetic fields because they may become saturated and suffer signal degradation (i.e., their signal to noise ratio may be reduced).

Parts of the recorder may become magnetized, and this can cause tape erasure or possible tape saturation and signal degradation. As a preventive measure, periodic demagnetization of critical recorder parts, particularly heads, is recommended.

# Accidental Erasure During Shipment

To guard against accidental erasure of recorded tape during shipping, tape can be packed with bulk spacing (such as wood) between it and its shipping carton. Bulk spacing is effective in reducing the possibility of accidental erasure by fields encountered during transit because field strength varies inversely with the square of the distance. Assuming no field greater than 1000 oersteds would be encountered during shipment (this is an unvarifiable but reasonable assumption), 3 inches of bulk spacing would give adequate protection.