TECHNICAL TALK

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

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EFFECTS OF FRICTIONAL HEAT ON TAPE WEAR ABILITY

In the manufacture of magnetic tape, the consideration of operating temperature is important to the design of tape binder formulations. One of the factors contributing to oxide wear (or more commonly, oxide rub-off) occurs when a recording system's operating temperature exceeds the designed temperature limits of the formulation used to bind the oxide to the base material.

These critical temperatures have long been accepted as the ambient temperatures of the recording system... seldom exceeding 130° to 150° F. It was therefore puzzling to note that in studies of oxide coatings designed to withstand temperatures exceeding 150° F., tape binders continued to break down; manifesting as oxide deposits on recorder heads and tape guides.

It was theorized that heat resulting from friction, occurring at points of contact such as recorder heads and tape guides, greatly exceed the established "operating temperature" of the equipment. It was also found that heads and guides having plastic surfaces in their construction caused tape to wear faster than heads and guides with all metal surfaces. The suspected cause of this was the low thermal conductivity of plastic materials. However, because heat penetration at these points of contact is perhaps just a few micro-inches, and because exposure to such heat is momentary with the heat itself quickly dissipated, difficulty was experienced in obtaining accurate readings of the tape's temperature as it passed the head.

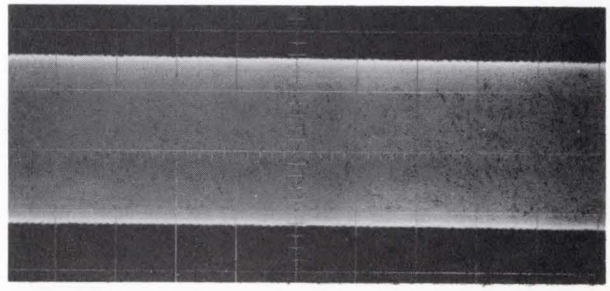

Fig. 1

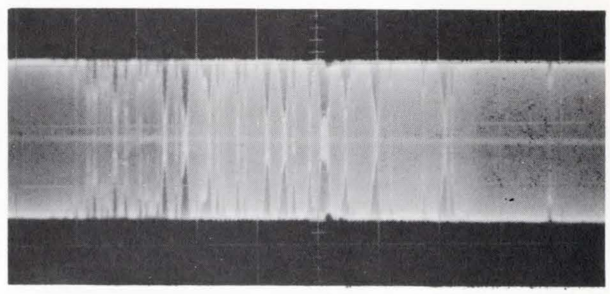

Fig. 2

Figure 1 shows the waveform envelope on playback after 200 passes across the head. The tape used in the test is a typical instrumentation or computer tape, standard to the industry, recorded at 550 bits-per-inch. Figure 2 is a photograph of the same tape and the same waveform envelope after 2000 passes through the recorder.

By substituting various plastic materials for the oxide coated tape, and passing them through a recorder at common tape speeds, their plasticizing (or melting) temperatures were observed. The use of several such materials, each having different temperature properties, permitted a process of elimination to establish that friction-generated head temperatures were between 200° and 250° F. on some types of instrumentation and computer equipment.

Initial experiments with common binder systems advanced the development of coatings capable of resisting the higher temperatures, but not without sacrificing a portion of the coating's magnetic capabilities. And the reverse was also found to be true: It was possible to produce a coating with superb magnetic properties, but which was subject to acute deterioration of its binder system.

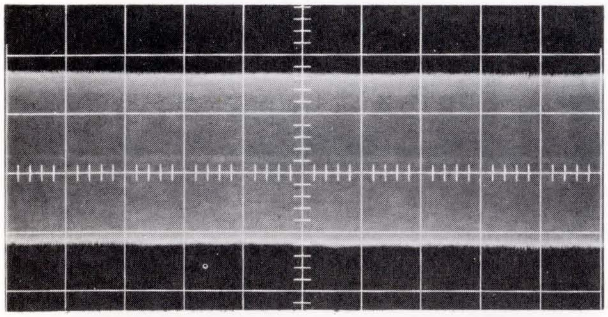

Fig. 3

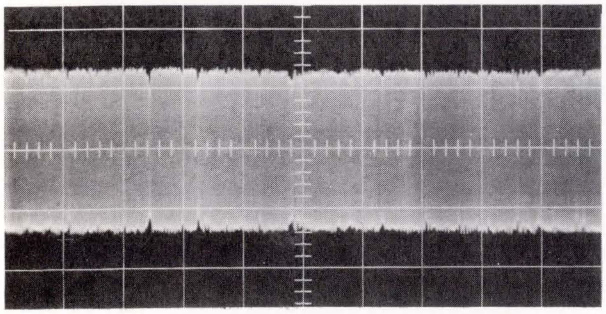

Fig. 4

From various studies of the physical and magnetic demands on tape in instrumentation and computer applications, a special high temperature binder was developed which possessed both the necessary heat resistance and excellent magnetic efficiency demanded in short wavelength recording applications. Presently used in coatings for Video Tape, heavy duty oxide coating is also available in some instrumentation and computer tapes.

Figure 3 shows the waveform envelope on playback of a tape coated with heavy duty oxide after 2000 passes, recorded at 550 bits-per-inch. Figure 4 is a photograph of the same tape and the same waveform envelope after 30,000 passes through the recorder. A comparison of figures 1 and 2 to figures 3 and 4 (representations of the same test on the same equipment), illustrates the better wear characteristics of heavy duty oxide.

It was notable in this test that oxide wear which did occur with heavy duty tape, took the form of a fine powdery deposit; as opposed to the often "gummy" agglomerates of oxide and binder which are typical of wear products from other coatings. This smaller wear product reduces the possibility of rub-off being wound into the reel to adhere to adjacent layers, thereby affecting head-to-tape contact; or to cause picking of oxide from adjacent layers. Also, the powdery particles would be less apt to collect in large enough deposits to create errors by shunting the gap of a record head.

While heavy duty oxide was developed primarily for those instrumentation and computer applications where high tape speeds and tensions contribute to recording errors, its low-dropout characteristic provides a more reliable tape for all applications demanding reliability. Since each pass of a tape through a recorder contributes to tape wear, the increased replay life of heavy duty oxide can also be interpreted as increased reliability on any single pass.