the clearance on guides is limited to minimum figures to obtain extremely accurate guiding. If the width of the tape then exceeds tolerances, the guides will bow the tape, and it will again be lifted from contact with the heads. Slitting the tape must, therefore, be rigidly controlled.

The binder material must be wear resistant. This is not primarily a matter of ensuring the durability of the recording, but rather is to minimize oxide deposits on components in the tape threading path (see Cleaning). Of course, if the binder breaks down sufficiently to cause signal drop-outs it would affect the durability, but this will be encountered normally only after prolonged use at high tape speeds not usually employed in audio work.

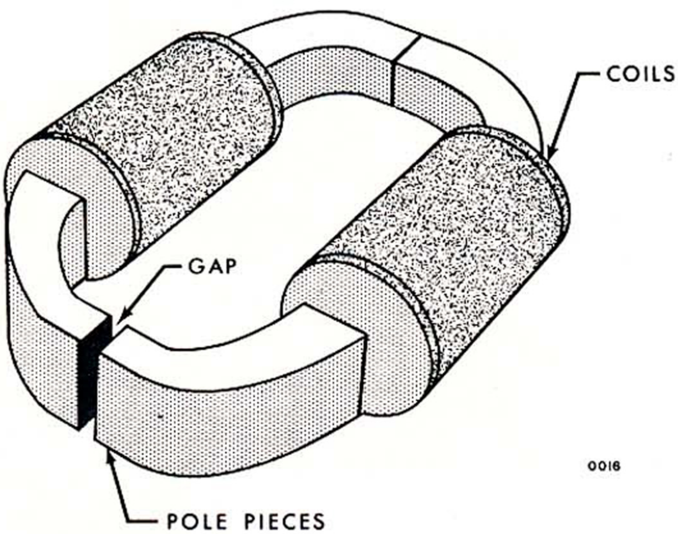
There are several considerations concerning the iron oxide particles which affect tape characteristics. These include the size and shape of the particles, and their physical orientation so that the axes of easy magnetization are longitudinal to the direction of recording.

In addition to all the above, tape must be strong enough to withstand the stresses it will undergo in normal operation, and pliable enough to follow the required turns in the tape threading path.

Recognizing that the quality of magnetic recording is today limited by the properties of the tape, not the equipment, Ampex recently entered the tape manufacturing field. It is felt that the association of Ampex and its subsidiary — Orr Industries Co. — will result in definite improvements in the art of magnetic recording.

Heads

No assembly in a magnetic recording system is more important than the heads, which convert the electrical current to a magnetizing force during the recording operation, then reconvert that magnetism to an electrical current during the reproduce mode. Professional quality equipment employs three separate heads — erase, record, and reproduce — each especially designed to perform its specific function.



Construction of a typical magnetic head.

Recording

The operation of the record head is essentially the same as that of an electro-magnet. If we insert a core of permeable material within a coil of wire, then run a direct current through that wire, we can set up an intense magnetic field that will attract any nearby material that is capable of being magnetized. If instead of the direct current, we use an alternating current, we would first attract then repel that material (at a rate controlled by the frequency of our a-c) until it assumed a position that was neutral in respect to the alternating field.

In a magnetic recording head the core is shaped like an incomplete ring — the discontinuity forms the head "gap" — which is inserted within a coil of wire. When the signal to be recorded is converted to an electric current and passed through the coil, a strong magnetic field is created across the gap. If we now pass our magnetic tape across the gap, the iron oxide particles in the tape will be magnetized in a pattern which is a function of the instantaneous magnitude and polarity of the original signal. Understand here that these particles do not physically move, but are simply magnetized by the flux at the head gap so that each individual particle contributes to an overall magnetic pattern.

The wavelength of the signal recorded on the tape depends upon how far the tape moves during each complete alternation of the signal current. For example, if we were recording 60 cycles at 15 inches per second, each cycle would be recorded on a 0.25 inch segment of the tape; if our frequency were 6000 cycles and our tape speed 7½ inches per second, each cycle would be recorded on a 0.00125 inch segment of the tape. Such computations may be continued for any frequency at any tape speed by simply dividing the tape speed (in inches per second) by the frequency (in cycles per second).

This brings up a point that sometimes confuses individuals accustomed to considering wavelength and frequency as being practically synonomous terms — that a certain wavelength can denote only one frequency or vice versa. This cannot hold true on any device which employs a moving medium to store the information. For example, say we record a frequency of 10,000 cycles at a tape speed of 15 ips. If we reproduce that tape at the same speed we will re-create our original signal; but if we reproduce the tape at 7½ ips the same wavelength on the tape will result in a signal of only 5,000 cps, if our reproduce speed is 3¾ ips our signal will be 2,500 cps. Similarly, if we record 10,000 cps at 15 ips the wavelength is 1.5 mils, if we record the same signal at 7½ ips the wavelength is .75 mil, at 3¾ ips the wavelength is .375 mil. Thus, wavelength may vary for a constant frequency and frequency may vary for a constant wavelength, dependent on the speed of our medium.