

TALK

SOUND

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

Bulletin No. 27

December, 1953

HEAD ALIGNMENT AND WEAR PROBLEMS

In magnetic recording machines, the high frequency response is extremely sensitive to the alignment of the recording head and also to the intimacy of contact between the head and tape. These facts are certainly well known in the recording art, but their practical manifestations are not always fully appreciated. Therefore, these few brief comments are offered covering some practical head problems which may be encountered in the operation of a recorder.

Asimuth Alignment and Tape Skewing

If the reproducing gap is not parallel to the recorded poles on the tape, serious loss of high frequencies may result (see Fig. 1). For rea-

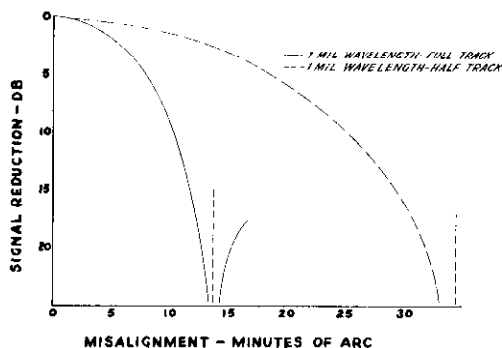


FIG. 1-HIGH FREQUENCY SIGNAL REDUCTION DUE TO MISALIGNMENT

sons of interchangeability, an attempt is made to align the head gaps on all recording machines exactly perpendicular to the tape. This alignment is accomplished by rotating the head for maximum output from an alignment tape upon which a steady high frequency signal has been recorded using a carefully aligned head. In making such an adjustment, the extreme sensitivity of these high frequency signals to alignment becomes immediately apparent. For example, in a full width (1/4") recording of 1 mil wavelength, a misalignment of only 8 minutes of arc will reduce the output by about 6 db.

However, even after carefully adjusting the head in this manner, one cannot write off completely the effects of alignment. A wandering motion of only a few thousandths of an inch may cause skewing as the tape passes over the head with attendant high frequency fluctuations. Fortunately the tape tends to "seat" itself and to follow the same path through the recorder on successive playings, thus minimizing the effects of clearance between the tape and guides. However, small disturbances such as reel wobble or tension

MINNESOTA MINING AND MANUFACTURING COMPANY

... WHERE RESEARCH IS THE KEY TO TOMORROW



"SCOTCH" is a registered trademark of the 3M Co., St. Paul 6, Minn.

changes may disturb this equilibrium and cause serious skewing.

A very frequent cause of tape skewing is the obvious one of sloppy guiding in the region of the recording heads. However, skewing may also be aggravated by misalignment of the head so that it does not meet the tape squarely, or by misaligned pressure pads or pressure rollers. It is a good idea to check for stability by noting the effect on the tape path of increasing the tension on the supply reel or flicking the tape with the finger. If the tape assumes a new path after this disturbance has passed, the guiding is not positive enough and high frequency troubles may be expected.

While the above skewing discussion is concerned with the problem of playing back a perfectly recorded tape, an analogous problem exists in recording. Since the alignment in question is that existing between the recorded pattern and the reproduce gap, the effect of recording and reproducing misalignments may well be additive.

Head Contact

An equally acute problem in obtaining good frequency response is that of maintaining intimate contact between the tape and the head gap. The effect of spacing between head and tape on high frequency playback level has been treated previously in Sound Talk Bulletin No. 6, but it might be well to review this data. In playing a low frequency signal, a separation of one or two mils does not appreciably affect the level, but at a high frequency, of say, 1 mil wavelength, even a half mil spacing results in a drop of over 20 db. It is readily apparent, then, that any loss of contact between head and tape, however slight, has a profound effect on the high frequency output.

This loss of contact may be due to any of several common causes such

as specks of dust or adhesive (from a poorly made splice, perhaps) lodged on the head, scratches or nicks in the head surface or foreign matter adhered to the tape itself.

Another source of trouble is misalignment of the head with respect to the tape path so that the tape tension is high along one edge but low along the other. Changes in total tape tension then may cause variations in the contact along the loose edge, with attendant fluctuation in output.

A partial solution to these problems is afforded by a resilient pressure pad bearing against the tape backing opposite the recording head. This frees the contact problem from the effects of tape tension which depends upon the braking action of the supply reel. However, the pressure pad is a mixed blessing, and if not properly aligned, can have an adverse effect upon both contact and skewing.

Wear Effects

The high frequency output of a new recording head will usually improve slightly as it becomes "worn in" by the polishing action of the tape. In a carefully constructed head, the frequency response then remains almost constant throughout its useful life. However, at some time, the wearing action will "break through" the relatively thin surface which is maintained with parallel gap faces and the gap will then open up very rapidly. This is because of the flare in the airgap in this region which greatly reduces the leakage flux. Of course, once this "break through" occurs, the frequency response becomes very poor and the head should be replaced.

In recorders having pressure pads, localized head wear under the pressure pads can be expected. Unfortunately, this wear may not be uniform even over the small area of the pad, but may form craters or ripples in

the head surface. As long as these are small enough to allow the pressure pad to deform the tape and maintain intimate contact with the head they cause no trouble. However, as the ripples become more severe the tape will tend to "bridge" over these irregularities and may lose contact with the head gap. In such cases readjustment of the pressure pad may result in some improvement but usually replacement of the head is necessary.

Testing For Alignment

In playing a tape recording which was made on a different machine, head misalignment may be suspected, but one may not wish to disturb the head adjustment to verify this. In this case, the skew effect mentioned earlier can be used to advantage, because deflection of the tape from its normal path across the head has the same effect as rotating the head. If, after carefully deflecting the tape a small amount in each direction, it is found that the greatest high frequency output corresponds to the normal tape path, the head is correctly aligned. This test may be made on almost any kind of a recording, since the ear can readily distinguish the presence of highs in program material.

In case the highs can be improved by deflection of the tape, (indicating misalignment), either the head used to make the recording, or the one on the playback machine may be at fault. Regardless of the origin of the misalignment, optimum reproduction of this particular tape may be obtained by readjusting the playback head. However, after playing this tape, the machine should be rechecked with an alignment tape, and readjusted, if necessary.

In summarizing these points, the following check list is suggested for locating poor high frequency response due to head problems:

- 1 - Check azimuth alignment with an alignment tape.
- 2 - Check for tape skewing which seems to occur simultaneously with amplitude fluctuations.
- 3 - Check to be sure the head meets the tape squarely.
- 4 - Check for stability of the tape path in its guides.
- 5 - Check for foreign deposits, nicks or gouges on the head surface.
- 6 - Check for "break through" in the head gap. A magnifying glass or microscope is helpful.
- 7 - Check for uneven wear.
- 8 - Replace the head if necessary.