The Tape Guide

Checking Other Aspects of Performance

Correct recording bias is a key to maximum treble response at minimum distortion. Equally, a key to achieving the best performance of your tape machine is an understanding of the how and what-to-do of tape speed variation. This article covers these topics—and much more.

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THE PRECEDING ARTICLE discussed techniques of measuring frequency response, equalization, and azimuth. The present article is devoted to techniques of measuring other important aspects of tape machine performance.

Bias Current

It is vital that bias current be set at the correct value in order to achieve the best practical compromise between extended treble response and low distortion, a compromise that varies with tape speed.

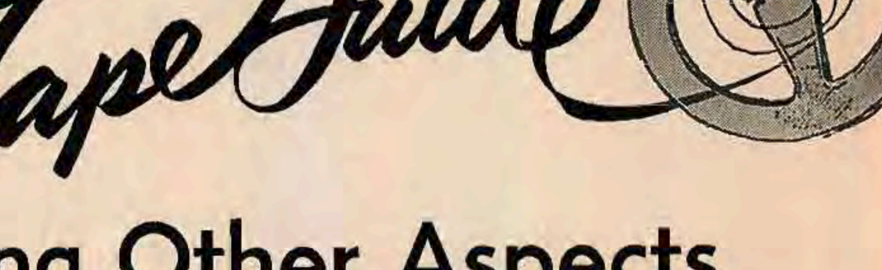

Fig. 1. Setup for measuring bias current.

The method employed to check record equalization, shown in *Fig.* 1, is also frequently used to measure bias current. A 100-ohm resistor inserted in the ground lead of the record head is generally a suitable value for the purpose. If the meter has insufficient sensitivity, it is often feasible to use a 1000-ohm resistor instead. The problem is to ensure that the resistor in series with the head offers negligible resistance to current compared with the impedance of the head. A typical record-playback head, with an inductance of about 0.5 H, has an impedance exceeding 150,000 ohms at the bias frequency, so that the additional impedance presented by a 1000-ohm resistor is then negligible. On the other hand, a head designed only for recording may have an inductance of but a few millihenries, so that an additional impedance of 1000 ohms becomes significant.

The resistor in question should of course be accurate, preferably to 1 per cent. Similarly, the meter should be accurate. Current is calculated by means of Ohm's Law, namely $I = E/R$, where I is current in amperes, E is voltage in volts, and R is resistance in ohms. For example, if one measures 70 millivolts (.07 volt) across a 100-ohm resistor, then $I = .07/100 = 0.7$ ma (milliamperes). It happens that a bias current of 0.7 ma is typical of a number of machines in home use. However, the required value, depending upon the head, can deviate a good deal from this. Hence the optimum value should be obtained from the manufacturer of the tape recorder, or possibly from the manufacturer of the head if the two are not the same. Moreover, one should obtain the optimum value for the speed at which one plans to do the most recording, inasmuch as the optimum value is different at the various machine speeds. To illustrate, at 7.5 ips the optimum value may be 0.7 ma, whereas it may be 0.6 ma at 3.75 ips.

As components in the bias oscillator circuit warm up, they tend to change value somewhat, and the frequency and magnitude of the bias current tend to change accordingly. Thus it is desirable to measure and adjust bias current only after the tape recorder has warmed up for a period, say for 15 or 20 minutes. (In use, it is similarly desirable to provide a warmup period before making a recording.)

Another technique for adjusting bias current involves measuring the change in recorded signal amplitude as the bias is varied. While this method can be used with machines having a combination record-playback head, it is such a tedious procedure that it is primarily recommended for machines with separate re-

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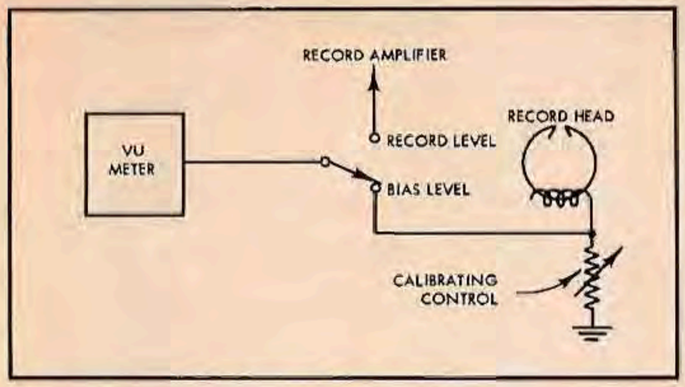


Fig. 2. Checking bias current with a VU meter.

cord and playback heads. At a given frequency, usually 1000 cps, bias current is adjusted until maximum signal amplitude is recorded on the tape. This is determined by measuring the playback signal. The gain controls of the record and playback tape amplifiers are not varied during this procedure.

It is often recommended that instead of adjusting bias current for peak output, one should set it at about "0.5 db above peak." This means *increasing* bias current until the signal amplitude (1000 cps) drops 0.5 db. Note carefully that it is the signal amplitude which is to drop 0.5 db, not the bias current. At this point slight changes in bias current, upward or downward, have a minimum effect on distortion and frequency response. An authority has stated: "For optimum results in recorders with wide frequency range at low tape speeds, it seems desirable to set bias at not under 0.5 db above peak. . . . This offers close to optimum distortion characteristics, while producing minimum change of relative response with bias change."[1]

Still another technique for gauging and adjusting bias current relies upon an instrument for measuring distortion, either intermodulation or harmonic distortion. First record at a relatively high level so that variations in distortion due to bias current changes may be readily perceived. Next adjust bias for minimum distortion. Then high-frequency record-playback response is checked at a much lower recording level, at least 20 db below maximum permissible level. Bias is reduced until treble response is considered adequate. Satisfactory treble response also entails adjustment of the amount of treble boost used in recording, assuming that the record amplifier contains a control for varying the treble boost. It is not advisable to go much above 20 db treble boost at 15,000 cps, for this raises the danger of overloading the tape at high frequencies on program material.

At a tape speed of 15 ips, it will probably be found that the bias corresponding to minimum distortion also permits response substantially flat to 15,000 cps without undue treble boost in recording. But at 7.5 ips and lower speeds, it will be found that, in order to obtain satisfactory high-frequency response, it is necessary to reduce bias current below the quantity corresponding to minimum distortion. It is then necessary to ask oneself whether and to what extent it is worth achieving extended treble response at a cost of increased distortion. Through trial and error, one can arrive at the point which carries flat response a fairly long way, say to 10,000 or 12,000 cps at 7.5 ips, without an undue increase in distortion. But trying to reach "all the way out," namely to 15,000 cps, may cause an increase in distortion disproportionate to the added realism of reproduction achieved by extending flat response from 12,000 cps out to 15,000 cps.

It is necessary to take into account that the amount of bias current suitable for one brand of tape may not be the optimum for another brand. To illustrate the point, following are the results of a test conducted to determine the amounts of bias current producing minimum distortion for four brands of conventional tape. Using Tape A as a reference, bias current for minimum distortion was 0 db for Tape A, +0.75 db for Tape B, −0.50 db for Tape C, and 0 db for Tape D. While the differences in bias current, expressed in decibels, appear small, nevertheless they are great enough to have appreciable effect upon distortion and upon frequency response above 10,000 cps. Accordingly, it is desirable to adjust bias current on the basis of the brand of tape one plans to use for most recording purposes.

The individual seeking maximum performance from his tape machine will wish to check bias current periodically because its magnitude may change as the result of aging of the oscillator tube and of other components in the oscillator circuit. Relatively slight changes in bias current can produce relatively large changes in distortion and frequency response. In tape recorders of professional and semi-professional quality, it is usually the practice to incorporate a switching arrangement that permits the VU meter to check the bias current. The meter does not provide an absolute reading but does indicate in relative terms whether bias current is at correct level. As shown in *Fig.* 2, a calibrating control is incorporated to cause the meter to read 0 VU (or some other designated figure) when bias is correct.

Bias Waveform

It is important to check not only the magnitude of the bias current but also its waveform. Obvious distortion can readily be detected by connecting an oscilloscope across the record head. Harmonic distortion in excess of 5 per cent is apparent to the eye. Ideally, the bias waveform should be a perfect sine wave. If harmonics of the bias frequency are also present, they will produce noise in recording. Therefore some tape machines include a control for balancing the oscillator tube to achieve minimum distortion, as shown in *Fig.* 3. This adjustment can be performed by ear on a machine having separate record and playback heads. With no audio signal fed in, one simultaneously "records" and plays back a blank tape, meanwhile adjusting the balance control for minimum noise. It is advisable to use a test tape that has been thoroughly erased by means of a bulk eraser, so that noise due to the bias current waveform will be readily apparent and not masked by tape noises.

Bias Frequency

If for any reason the bias frequency should change radically, there will tend to be the following deleterious effects: (1) If the frequency is too low, there

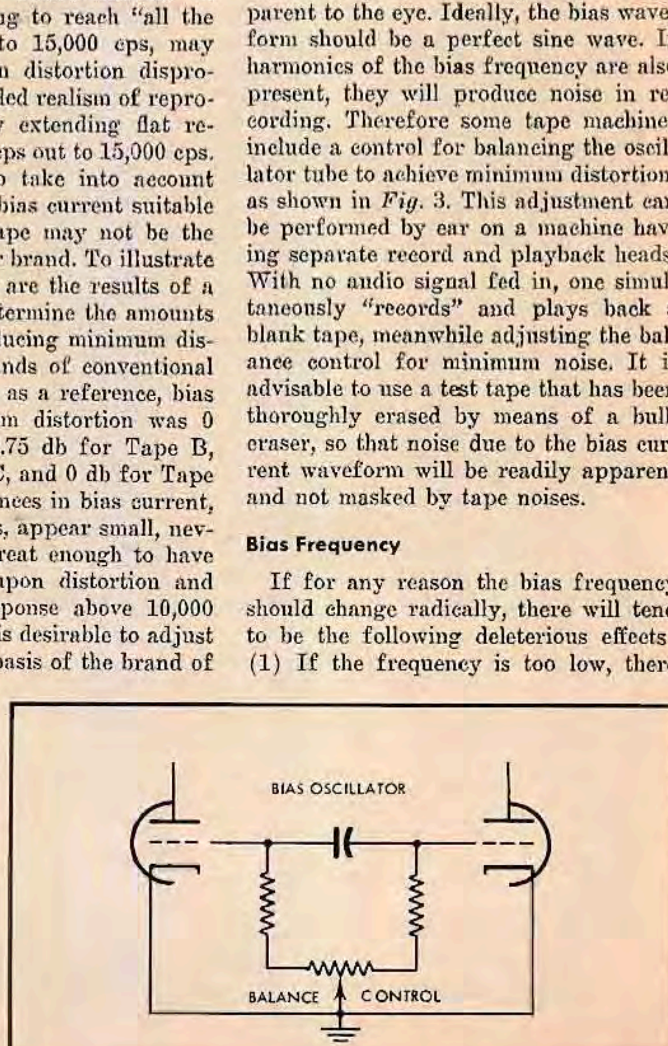


Fig. 3. Oscillator circuit incorporating a balance control for minimizing noise.

[1] C. J. LeBel, "More on recorder bias," *Audio Record,* March–April 1956, p. 7 (formerly published by Audio Devices, Inc., New York City).

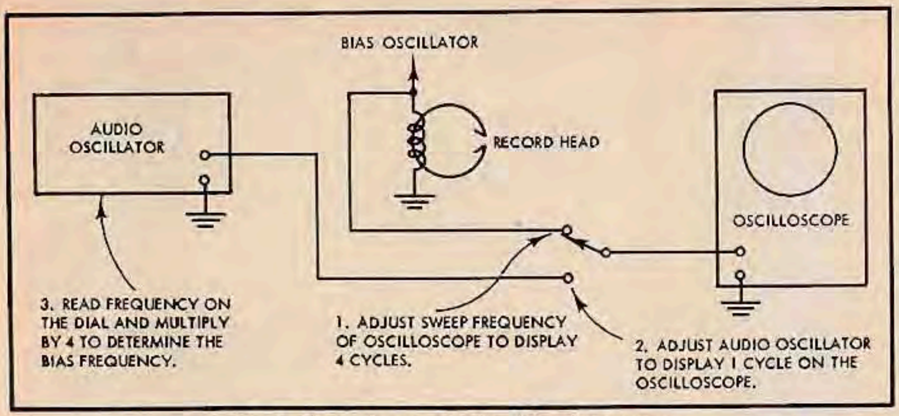


Fig. 4. Setup for measuring bias frequency.

will tend to be audible beat notes between the bias frequency and the harmonics of the higher audio frequencies; the bias frequency should be at least four to five times the fundamental of the highest audio frequency to be reproduced. (2) If the bias frequency is too high, the effectiveness of the erase head (which is supplied current by the same oscillator that feeds the record head) is usually diminished. Thus in rerecording a tape, one may hear some of the first recording, particularly the lower frequencies, coming through the second recording. (3) With a change in frequency, there may be a change in the amount of bias current reaching the record head; an increase in current will reduce distortion and restrict high-frequency response; a decrease in current will increase distortion and extend high-frequency response, possibly producing an undesirable peak.

An audio oscillator and an oscilloscope may be used to check the bias frequency, as illustrated in *Fig.* 4. Connect the oscilloscope to the record head and obtain a display of four cycles. Then connect the oscilloscope to the audio oscillator and adjust the latter's frequency until one cycle appears on the oscilloscope. The frequency indicated by the dial of the oscillator is one-fourth of the bias frequency. If the audio oscillator goes to 100,000 cps, then one may adjust the oscilloscope for a reading of one cycle when connected to either the record head or the oscillator. The accuracy of the method described depends upon how precisely the oscillator is calibrated. However, a slight error is unimportant, and almost any audio oscillator will be sufficiently accurate for the purpose.

Distortion

Whereas such audio components as control amplifiers, power amplifiers, and tuners are commonly checked for intermodulation distortion as well as harmonic distortion, the general practice is to test tape recorders only for harmonic distortion, although an IM test is usually quite revealing.

Figure 5 shows the setup for checking total harmonic distortion (THD) of a tape machine having separate record and playback heads. A signal from an audio oscillator is fed into the tape recorder, and the output of the latter is measured by a harmonic distortion meter. The procedure is essentially the same in the case of a machine that uses a single head for both record and playback, except for the fact that the recording of the test signal and its measurement take place at different points of time; after recording the test signal it is necessary to rewind the tape and play back the signal into the distortion meter.

The test frequency is usually 400 cps or thereabout for a variety of reasons. (1) Peak audio energy of most sound sources occurs in the neighborhood of 400 cps. Hence, at a given recording level, a test in this region is indicative of the maximum distortion likely to occur. (2) It is desirable to use a relatively low frequency in order to be able to record on the tape a large number of the harmonics due to distortion. Thus if the test frequency were, say, 5000 cps, and if the tape machine had a range extending to 15,000 cps, only the second and third harmonics could appear.

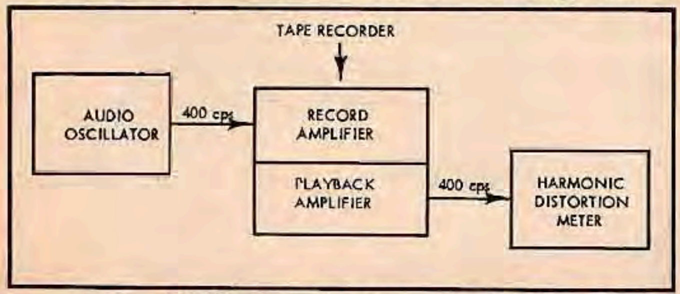
Testing harmonic distortion at the higher frequencies—above 5000 cps or so—is not apt to be very meaningful. On the one hand, the pronounced treble boost in the record amplifier tends to exaggerate high-frequency distortion. In recording natural sound sources, this high-frequency emphasis tends to be offset by a decline in audio energy of the source; but there is no such offset when dealing with a test signal. On the other hand, to the extent that the tape recorder has limited high-frequency response, say to 15,000 cps with a very sharp decline thereafter, harmonic distortion shows up only to a slight extent if at all. One can easily establish this fact by recording a high frequency such as 10,000 cps at a very high level at 7.5 ips and viewing the playback waveform on an oscilloscope. Since the harmonics are beyond the reproducing ability of the tape recorder, the playback waveform will appear as an undistorted sine wave no matter how high the recording level.

The fact that distortion in the high frequency range fails to show up on a harmonic distortion test does not mean there is no problem here. Overloading at high frequencies can create havoc in terms of intermodulation distortion. To illustrate, a 10,000-cps note and a 12,000-cps one, if over-recorded, may intermodulate to produce spurious distortion products that are audible.

Measurement of intermodulation distortion offers a much more sensitive test of the performance of a tape recorder. At a recording level where a harmonic distortion test may reveal only 2 or 3 per cent THD, the IM test may reveal 10 per cent, 20 per cent, or even more IM distortion. *Figure* 6 shows the setup for checking IM distortion, requiring only the use of an IM analyzer; this assumes that the IM analyzer supplies the frequencies, usually about 60 cps and 6000 cps, needed for the test.

Record Level Indicator

The test of distortion must have reference to the recording level as indicated by the record-level indicator. If the indicator is of the magic eye type, maximum permissible recording level corresponds (or should correspond) to eye closure, that is, minimum fluorescent shadow. If the indicator is of the neon lamp type, maximum level is denoted by ignition of the lamp. If the indicator is a VU meter,



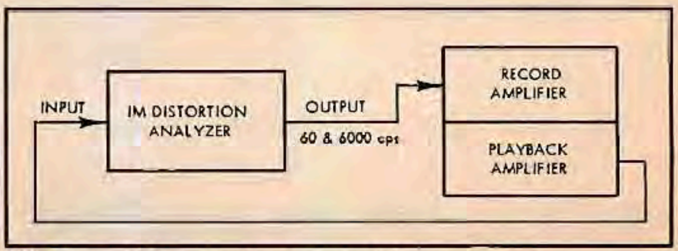


Fig. 5 (left). Measuring harmonic distortion. Fig. 6 (right). Setup for measuring intermodulation distortion.

maximum recording level is generally 6 to 8 db above the 0-VU reading. For example, in the case of a number of professional tape recorders, when the meter reads 0 VU on a steady signal this is intended to correspond to a recording level that produces 1 per cent total harmonic distortion. The level that produces 3 per cent THD is about 6 db above 0 VU. If the recording level that produces 3 per cent THD is considered to be the maximum permissible amount, then there is a 6 db allowance for the mechanical lag of the VU meter. Thus to measure distortion at maximum permissible recording level, the input signal should be 6 db higher than that required to drive the meter to 0 VU.

One can obtain test tapes containing a signal recorded at a level producing a stated amount of harmonic distortion. Thus Ampex produces a test tape with a 250-cps tone recorded at a level resulting in 1 per cent harmonic distortion. Dubbings Sales Corp. in the past produced a tape with a 400-cps tone recorded at a 2 per cent harmonic distortion level; although not presently in production, it may still be available from some mail order houses and other distributors of audio supplies.

Such tapes can be used to check the calibration of the record-level indicator with reasonable accuracy. To illustrate, assume the use of the Ampex test tape. Play the tape and measure the level of the output signal. Using an audio oscillator or test record, record the same frequency (250 cps) or a nearby one on another tape and adjust the recording level until the same playback level is obtained as with the test tape. Then one is recording at a level producing approximately 1 per cent harmonic distortion, assuming bias current is at "normal" value.

If the tape recorder is rated on the basis of 3 per cent harmonic distortion, the input signal can be raised about 6 db to obtain an increase from 1 to 3 per cent harmonic distortion. At this point the magic eye indicator should close or the neon lamp should ignite. In the case of the VU meter, the 0 VU indication should have been reached at the 1 per cent harmonic distortion level or earlier.

If the tape recorder is rated on the basis of 2 per cent harmonic distortion, the input signal can be raised about 3 db to obtain an increase from 1 to 3 per cent harmonic distortion.

Of course, the more direct method of checking calibration of the record level indicator is to measure distortion at the point where the magic eye closes or the neon lamp ignites or the VU meter reads 0 VU.

Signal-To-Noise Ratio

Signal-to-noise ratio is measured on the basis of maximum permissible recording level, namely that which produces 1, 2, or 3 per cent harmonic distortion. Assuming that 3 per cent harmonic distortion is considered acceptable, as is commonly done, and that the record-level indicator is correspondingly calibrated, the procedure for measuring signal-to-noise ratio is as follows: A frequency between 250 and 1000 cps —usually 400 cps—is recorded at maximum permissible level. The playback signal level is measured. The tape is rewound and the process repeated, except that this time no audio signal is recorded. Again the playback signal is measured. Now the output is due to noise and hum of the record amplifier and of the playback amplifier (largely the latter in most cases), noise produced on the tape as the result of distortion in the bias-current waveform, tape hiss, and imperfect erasure by the erase head. The ratio of the first playback signal (with an audio input signal) to the second playback signal (without an audio input signal) constitutes the signal-to-noise ratio of the tape recorder. In a high quality machine, the predominant contribution to noise will be tape hiss.

If one is measuring the signal-to-noise ratio of a tape machine designed only for playback and not for recording, the measurement has to be made on the basis of a test tape. As stated before, test tapes are available carrying frequencies recorded at a given level of harmonic distortion. Comparison of the output level when playing the test tape and when playing a blank virgin tape yields the signal-to-noise ratio. If the test signal is at a level corresponding to 1 per cent harmonic distortion, the signal-to-noise ratio at the 2 per cent distortion level can be approximated by adding 3 db; at the 3 per cent distortion level, by adding 6 db.

In a high-quality tape machine the signal-to-noise ratio will range upwards of 50 db, or a voltage ratio exceeding 300:1. Therefore the measuring instrument has to be a vacuum-tube voltmeter of high sensitivity. Typically, the output of a tape machine (before the power output stage, if any) is about 1 volt. Hence if the noise is 50 db lower, the output voltage is only about 3 millivolts. If the machine has a signal-to-noise ratio as high as 55 db, as some do, then, based on a maximum signal output of 1 volt, the noise content will be less then 2 millivolts.

Wow and Flutter

A quantitative measurement of wow and flutter requires equipment unlikely to be in the possession of the home recordist and therefore will not be discussed here. However, a simple and effective test can be made by recording and playing back a tone in the vicinity of 3000 cycles, where the ear is highly sensitive to changes in pitch. The signal source can be an audio oscillator or a phonograph test record. However, inasmuch as the phonograph or the record or both may be a source of wow and flutter, an audio oscillator is the better source. Wow will be apparent as a quavering effect. Flutter will be apparent as graininess or coarseness of the tone.

In the case of tape machines designed for playback only, there are a number of test tapes which can be used for checking wow and flutter by ear. These tapes incorporate a frequency in the range of 2000 to 5000 cps.

Tape Speed

Tape speed may best be measured by means of a tape stroboscope, such as shown in *Fig. 7*, consisting of a wheel that is pressed against the moving tape and therefore moves at the same speed as the tape. The wheel contains a number of bars along its circumference, and these bars are viewed under a 60-cycle light source; for greatest clarity, a neon or fluorescent lamp is desirable, although the ordinary incandescent lamp will do. If tape speed is exactly correct, the bars on the stroboscopic wheel will appear to be standing still. If speed is slow, the

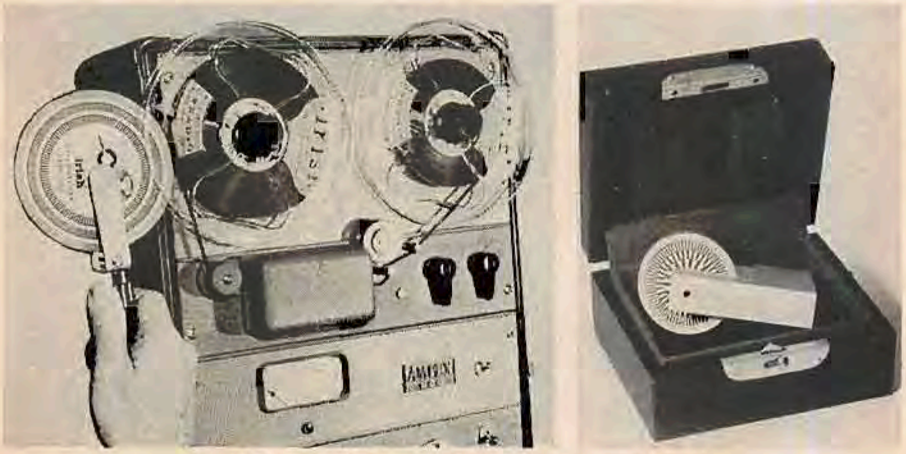


Fig. 7. Two stroboscopes for measuring tape speed.

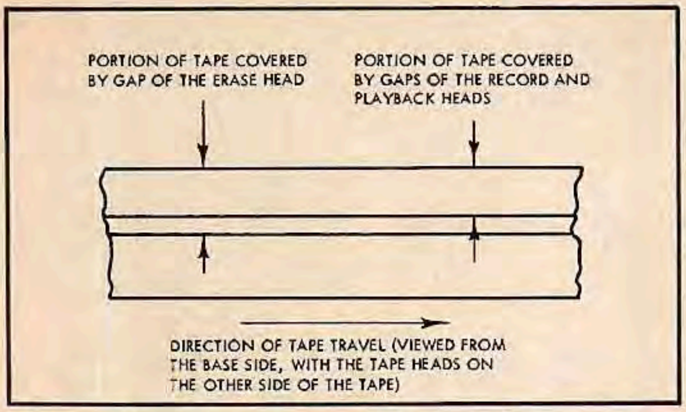


Fig. 8. Portion of the tape spanned by the gaps of half-track heads.

bars will appear to be moving backward, that is, in the direction opposite to tape motion. If speed is fast, the bars will appear to be moving forward, or in the same direction as the tape.

Apparent motion of 72 bars per minute past a given point, say the tip of a pencil, corresponds to a speed error of 1 per cent. Fair to good home machines may be expected to have speed errors not exceeding 2 per cent, namely 144 bars per minute. Good to excellent home machines should have speed errors not exceeding 1 per cent. Machines of semi-professional quality will have speed errors under 0.5 per cent, while professional ones will have speed errors not exceeding 0.2 per cent.

Erasure

The ability of the erase head to perform effectively may be tested by recording program material at a level great enough to produce maximum *permissible* indication on the record-level indicator, putting this tape through the recording process once more but without a signal input, and then playing the tape. A properly operating erase head will leave none of the first signal, at least not enough to be heard even at a high playback level.

However, if the tape has been recorded at excessively high level, one that produces a great deal of distortion, even a very good erase head may not achieve adequate erasure. It may then be necessary to put the tape through the erase procedure twice, or else use a bulk eraser.

Inability of the head to erase a normally recorded tape may be due to the following factors:

1. *Insufficient erase current.* High-frequency current through the erase head can be measured by the same technique that is used to measure bias current through the record head. As was illustrated in *Fig.* 1, a low-value resistor, say 100 ohms, is inserted between the ground lead of the head and ground. Voltage across the resistor is measured, and current is computed by Ohm's Law. The measured voltage divided by the resistor equals the current. Thus if one volt is measured across 100 ohms, current is 1/100 ampere, or 10 millamperes. Erase heads in many home machines typically use between 10 and 15 milliamperes of current. Some, however, use a good deal more.

2. *Improper vertical positioning of the erase head.* If the gap of the erase head does not fully span the recorded area, because the head is positioned too low or too high, complete erasure cannot take place. One can tell if this is the cause because the signal remaining on the tape will then have full frequency content. But if incomplete erasure is due to other causes, the remaining signal will consist mostly of low frequencies, which are the most difficult to erase.

3. *Improper azimuth alignment of the head.* If the gap departs considerably from correct azimuth, which is a position at right angle to the length of the tape, erasure may be affected. A slight azimuth error, however, will usually have little, if any, effect.

4. *Frequency of the erase current.* As pointed out earlier, the erase head tends to become less effective as the erase current increases in frequency. Means of checking this frequency have already been described.

5. *A defective head.* An erase head with shorted turns will not function properly. The test here consists of head substitution. A head of poor design will give inadequate performance. Here one may try using a different brand of head, assuming it can be mounted on the tape deck. Some manufacturers produce two kinds of erase heads, one with a single gap and the other with two gaps side by side so that the tape is twice exposed to an erasing field in a single pass. Substitution of the two-gap head may achieve the desired improvement.

Head Height

The erase, record, and playback heads must be vertically positioned so that their gaps all span the same portion of the tape, that is, the same track. This is illustrated in *Fig.* 8 for half-track (mono) recording. The same principle applies to two-track and four-track stereo heads.

As pointed out in the preceding section, if the erase head is out of vertical alignment, incomplete erasure results. If the machine has separate record and playback heads, there are two additional problems should these heads be out of vertical alignment with each other: (1) Playback signal will be less than maximum, with consequent deterioration of the signal-to-noise ratio, if the playback gap does not span as much of the recorded track as possible. (2) There may be crosstalk—signal pickup from an adjacent track—because the playback head partially spans or comes too close to an adjacent track.

In the case of half-track heads, visual alignment can often suffice. This means aligning by eye the edge of the tape with the edge of the gap. To maximize the chances of accurate alignment, the position of the tape relative to the head should be that which occurs in the normal "dynamic" state—that is, when the tape is moving past the head. To obtain the dynamic position, place the transport in motion, then shut off the power (if necessary, by removing the power plug from the wall outlet) so that the tape is stationary against the head. If pressure pads are employed, remove the pressure pad holder after shutting off the power. Then visually align the gaps to the tape.

To check the height adjustment of the playback head, one can play back a commercial prerecorded tape and move the head up and down. When the output is maximum, as measured by a VTVM, playback-head vertical alignment is correct. It is advisable to use a test tape with a low-frequency signal, such as 400 cps or less, so that slight changes in azimuth as one moves the head do not appreciably affect the playback level.

If the tape machine uses a separate record head, the latter can be aligned to the playback head by adjusting the record head's height for maximum signal output while simultaneously recording and playing a low-frequency signal. Then the erase head height can be adjusted for maximum erasure.

In the case of stereo heads, involving two gaps one above the other, as shown in *Fig.* 9, vertical positioning is more critical than for half-track heads. Visual alignment is probably a preliminary step, with further steps more or less mandatory. The checks already described can be used. One can further check on the basis of crosstalk. When playing a commercial prerecorded two- or four-track tape containing program material, if the playback head is improperly positioned to the extent that it impinges on an adjacent track, the signal of the adjacent track will come through with full frequency content. If the playback head is incorrectly positioned so that it does not actually span

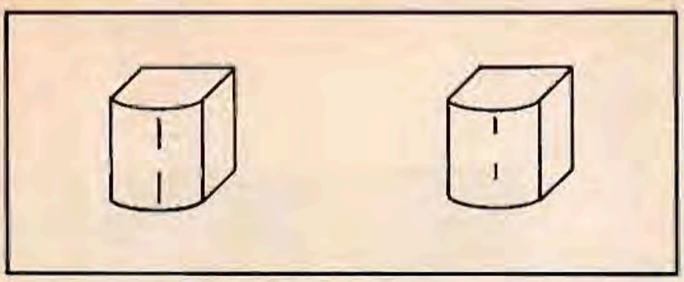


Fig. 9. Gaps of two- and four-track stereo tape heads.

part of an adjacent track but comes very close, then the crosstalk will consist predominantly of low frequencies, which extend beyond the track to a greater extent than the high frequencies. On the other hand, if the crosstalk consists predominantly of high frequencies it results in a tinny sound coming through from the adjacent track. This is indicative of crosstalk within the head, which has nothing to do with vertical position. Such crosstalk is in the nature of transfer of the signal from one section of the stereo head to the other because of magnetic coupling.

More precise and more direct methods of checking and adjusting head height are available, as follows:

1. *Test Tape.* RCA test tape No. 12-5-64T is illustrative of a tape containing a section—Part 1—specifically designed for height alignment of four-track heads. As shown in *Fig.* 10, the entire width of Part 1 of this tape is recorded except for a .043-inch band erased at the location of track 3, which is called A-2. The recorded signal is 1000 cps at 3.75 ips and 2000 cps at 7.5 ips. The instructions state: "In order to adjust the head assembly height, move the head up or down until the audible tone or the output meter reading on the A-2 track is at a null or minimum. Note that a head height either up or down from this proper position will cause an increase in signal level."

2. *Visual Indication.* Reeves Soundcraft Corp. makes a product called Magna-See that enables one to view the signal recorded on the tape. This has a number of uses, including checking head height, azimuth, and head wear. To use Magna-See, the tape is recorded at slightly higher volume than normal, the tape is immersed in a bath of Magna-See solution, and the tape is allowed to dry out, whereupon the recorded track becomes visible.

Fig. 11 shows how a two-track stereo recording would appear after exposure to Magna-See. One would first adjust the height of the record head on the basis of several trials with the aid of Magna-See. If the tape recorder has separate record and playback heads, then the playback head would be aligned on the basis of maximum output when simultaneously recording and playing a low-frequency signal. Or, one could perhaps temporarily connect the playback head to the record amplifier and make a recording through this head; then view the results by means of Magna-See. To align the erase head, one could erase a tape that has been recorded with an aligned head, and check the results with Magna-See to determine whether the recorded sections have been erased excessively or insufficiently.

Test Tapes

As indicated in this article and the preceding one, various test tapes are available to facilitate checking and adjusting tape machines. Some test tapes have but a single purpose, while others have several. Typically, the single-purpose tapes are for azimuth alignment. Thus Audio Devices produces an "audio alignment tape," containing tones of 1000, 5000, and 7500 cps when played at 7.5 ips. The two lower tones are of 30 seconds duration, while the highest lasts 60 seconds. The purpose of the lowest tone is to set level. A preliminary adjustment of azimuth is made with the 5000 cps tone, and a final adjustment with the 7500 cps tone.

Ampex's No. 5563 test tape is an example of a multi-purpose tape, to be used at 7.5 ips. It contains a 10,000 cps frequency for azimuth alignment, a 250-cps tone for setting playback level (adjusting the VU meter in playback), another 250-cps tone at a lower level to be used as a reference for a frequency response check, and a series of tones for checking frequency response at 10,000, 7500, 5000, 2500, 1000, 400, 200, 100, and 50 cps. Similar tapes are produced by Ampex for the 3.75 and 15 ips speeds.

One of the most comprehensive test tapes that has been made, intended specifically for use by the audiofan, is the one put out several years ago by Dubbings. Although no longer manufactured, it may still be available from some audio supply houses. This tape contains a series of beeps five minutes apart for checking tape speed; a 400-cps tone recorded at a level corresponding to 2 per cent harmonic distortion; a high-frequency tone for azimuth alignment; a series of tones for checking frequency response; a tone for checking wow and flutter by ear; and a series of progressively quieter signals for checking signal-to-noise ratio (when the signal on the tape is no greater than system noise, this indicates the signal-to-noise ratio, identified by a voiced announcement).

A number of tapes have appeared for testing stereo machines. For example, RCA Victor's 12-5-64T is a quarter-track tape, with recordings on two of the four tracks. Among the tests is one for adjusting the height of the head (as previously described); another is a tone that permits one to phase the

Fig. 11. Appearance of two-track stereo tape after exposure to Magna-See.

speakers—the tone appearing midway between the speakers when phasing is proper. Another stereo test tape is the Audiotester 30-208, which includes the sound of a metronome for stereo balancing. The Sonotape Stereophonic Alignment Tape includes a test for correct track placement; that is, namely sound from the left coming from the upper track and sound from the right coming from the lower track when the tape moves from left to right; tests for frequency and loudness balance between tracks; tests for proper speaker location based on degree of separation and mixing of sounds from each track.

A word of caution is in order with respect to test tapes, particularly those bearing on azimuth alignment and frequency response. The heads of a tape machine tend to become magnetized gradually, causing partial or complete erasure of high frequencies on a tape passing over the head. Therefore it is recommended that the tape heads be demagnetized before a test tape is placed on the machine. Æ

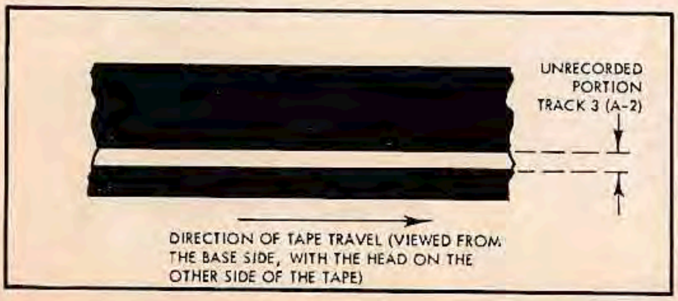


Fig. 10. Portion of RCA test tape No. 12-5-64T used for height alignment of four-track stereo tape heads.