

# Analog Audio Mastering Tape Print-Through

## Technical Bulletin A011194

### Situation:

Print-through is the undesired low level transfer of magnetic fields from one layer of analog tape to another layer on the tape reel. Preprint, also known as pre-echo, is the print through signal that is on the outer layer of tape wind, thereby preceding the recorded signal. Postprint, or post-echo, is when the print-through signal follows the recorded signal.

There isn't an analog recording tape made that doesn't suffer from print through. Until 3M introduced the 900 Series of tapes, the rule was the better the tape is in terms of high signal-to noise ratios, the more potential there is for print-through.

Actually, the potential for print through has a ratio of its own called signal-to-print. This ratio for a given tape is a constant, and it remains constant regardless of the strength of your recorded signal.

Signal-to-print is a function of the recorded wavelength and the thickness of the tape. Wavelength is determined by the following equation:

$$\lambda = \frac{\text{tape speed (ips)}}{\text{frequency (kHz)}}$$

The worst print-through occurs at a wavelength equal to  $27 \cdot C$ . C is the total tape caliper in mils. For a typical 2 mil mastering tape, the worst wavelength for print-through would be about 12.6 mils. When running at 15 ips, this would be a frequency of about 1200 Hz.

### Possible Cause:

Signal-to-print may be the constant that measures print-through potential, but the real print-through that makes you cringe is measured by the print-to-noise ratio. A tape with a poor signal-to-noise ratio will actually make you cringe less, because the noise on that tape will mask the print through you would otherwise hear.

In other words if the signal-to-noise ratio is lower than the signal-to-print ratio, you would not hear the print through. However, you will definitely hear the noise.

Multitrack recording will also help you mask print-through, because mixing tracks will add noise to your recording. Mixing even four tracks can increase your noise level by 6 dB. (See Figure 1.)

### Recommendation:

There are a few steps you can take to minimize print-through. The most common is to store your tape tails out. Normally, the outer layers of tape from the printing signal will receive more print-through than the inner layers, since the signal must reach the top of the oxide coating to be noticeable. To reach the top surface of an outer layer of tape, that signal's magnetic field needs only to pass through the base material. To reach the top surface of an inner layer of tape, it must pass through both the base material and the oxide. So by storing tape tails out, the strongest print-through will be postprint. This is less offensive than preprint, because post-print will be masked by the recorded signal on playback. (See Figure 2.)

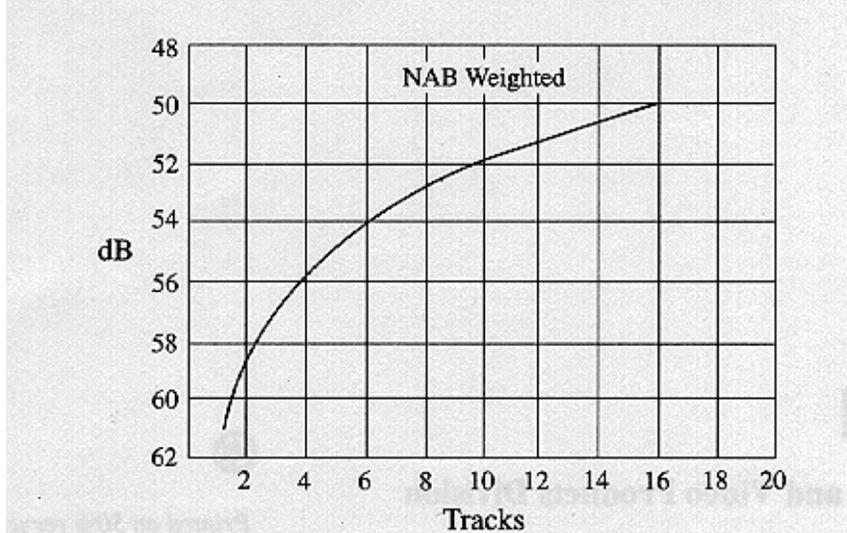
### Storing and archiving your tape.

Storing tape tails out will also serve another purpose. It will require you to rewind before playback. Most of the strength of a printed signal is accumulated during the first few minutes of storage. And much of this strength is lost within seconds after being removed from the printing signal. So the simple act of rewinding can cut the strength of your print through signal by as much as 6 dB. (See Figure 3.)

Temperature will also affect print through. Storage temperatures of 70°-80° F will help minimize print through. Even the extra heat from motors and erase heads can be enough to cause more print-through.

**Figure 1**

**Overall Noise vs. Number of Tracks Mixed**



Stray magnetic fields will also increase print-through by several dB. This is one more reason why you should be sure tape heads and guides aren't magnetized. Also no symmetrical bias waveforms (those which produce even order harmonics) can be the cause of problems. These problems will leave DC magnetic fields on the tape and greatly increase print-through. The DC field in effect helps "bias" the oxide to enhance the print-through effect.

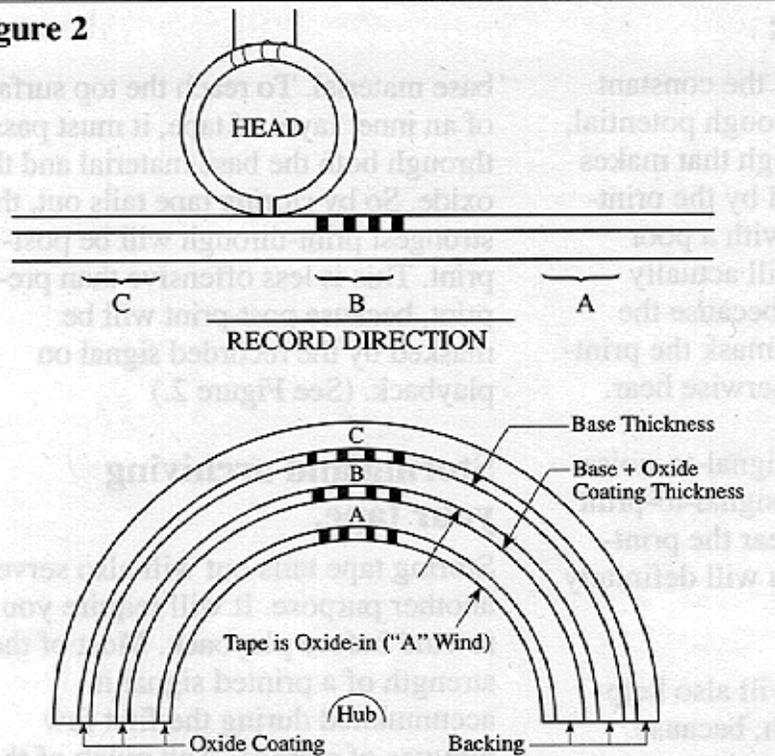
And, of course low-print tapes will reduce print-through. 3M has recently introduced a new series of mastering tapes with 3 to 8 dB better signal-to-print than comparable mastering tapes. It may be the answer to your print-through problems.

**Other things you can do.**

You'll probably find some inferior tapes that have spectacularly poor signal-to-print ratios. This may be a result of tape thickness using thin base tapes. Whatever the reason for this lack of print-through, beware. Print through should be judged in context

with the other tape attributes you value. The classic trade-off within a product line is signal to noise, S/N vs. signal to print, S/P. With 3M's new 900 Series products, the S/P trade-off is much less than any other mastering tapes available today.

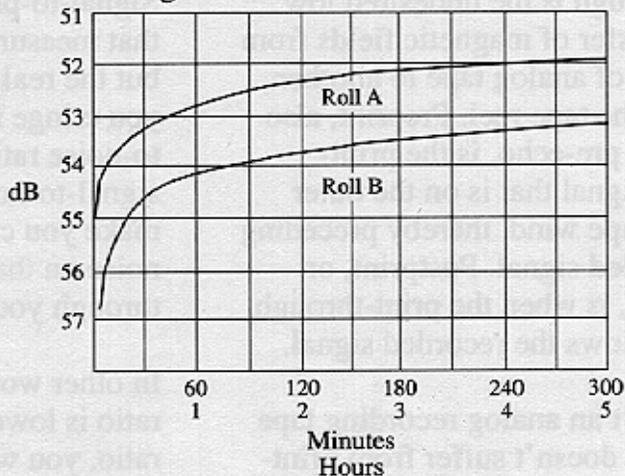
**Figure 2**



Tape stored on take-up reel. Section C receives most signal transfer, which appears as post-print on playback. This method of storage is recommended for master tapes.

**Figure 3**

**Signal-To-Print Ratio vs. Time**



Audio and Video Products Division

**3M Center, Building 223-5N-OI St. Paul, MN 55144-1000**

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