

How To Bake A Tape

- Mike Rivers

A lot of tape manufactured in the mid-to-late 1970's is starting to come out of storage now for remixing and re-issue, and engineers are finding that it won't play. The surface of the tape has become gummy and it sticks to the heads and fixed guides of the tape transport, squealing, jerking, and, in extreme cases, slowing down or stopping the tape transport. This problem has cropped up on all brands of tape, but is nearly always fixable, at least temporarily.

Tapes can exhibit two different problems as a result of long term storage; binder breakdown and lubricant breakdown. Lubricant breakdown, which is fairly rare, leaves a white residue when the tape is run over the heads. Binder breakdown, the more common failure mode, leaves a dark, gummy residue, and is fixable by gentle heating ("baking") of the tape. Fixing lubricant breakdown requires careful cleaning of the tape and possibly applying fresh lubricant. Baking will not solve the lubricant breakdown problem and may make it worse. Make sure you know which problem you have before you put a tape in the oven.

Here's where the stickiness comes from. The binder is the chemical compound that holds the oxide particles together and sticks them to the tape backing. Under humid conditions (which means anything but controlled low-humidity storage), the polyurethane used in the binder has a tendency to absorb water. The water reacts with the urethane molecules, causing them to migrate to the surface of the tape where they gum up the tape path during playback.

Short strings of urethane molecules are particularly prone to water absorption, while long strings make the coating mixture too viscous to produce good tape. Middle-length strings are the best, but the tape manufacturers didn't know this at the time, and didn't always know what they were getting. In the case of Ampex tape, tapes most likely at risk are 406 and 456 manufactured from approximately 1975 through 1984. During those years, Ampex tested the goop they got from their binder suppliers simply by measuring viscosity. Unfortunately, the long and short strings average out, viscosity-wise, to a viscosity about the same as the ideal medium strings, so some tape was inevitably manufactured with an overly great proportion of short urethane strings in the binder. In the worst cases, as little as 3 days' exposure to 70% relative humidity can cause a tape to become gummy, but typically, it takes 2 to 15 years under normal, people-friendly ambient conditions. In 1984, Ampex started doing it's

incoming inspection with a high pressure gas chromatograph (that's when it was invented), and was able to more accurately determine the molecular makeup of it's binder, and control production much more carefully. Better things for better living through chemistry.

The good news is that the "sticky shed syndrome" resulting from water absorption by the short urethane molecule chains is almost always fixable. The process for repair is commonly know as "baking a tape". The fix lasts about a month under normal storage conditions, and Ampex claims that a tape can be re-baked any number of times without ill effects. Best advice, though, is to make a copy of the tape on first playing, and work with the copy.

To bake a tape, you want to expose it to even heat, ideally at 130 degrees F, with a variation of less than plus or minus 10 degrees. Too cool and the process is ineffective, too hot and you're starting to risk increasing print-through.

There are several kinds of ovens you can use. One thing you DON'T want to do is stick it in your kitchen oven and turn the heat on "low". Most oven thermostats don't go low enough, don't provide good enough temperature control, and a gas flame generates quite a bit of water vapor, exactly what you're trying to get rid of.

It's important that the tape be packed smoothly before baking. Chances are it will be if it's been cared for as a master tape should, but if it needs to be re-packed, this should be done by winding the tape at play speed on to another reel using a tape deck on which the heads can be removed, and with the tape threaded so that it doesn't pass over any fixed (non-rotating) guides.

The hair-dryer-in-a-cardboard-box, a method attributed to George Horn of Fantasy Records, is a simple, inelegant home made tape baking oven that works well and can be made from things you're likely to have around the house.

Bill of Materials:

A cardboard box about 14" on a side (a tape carton is about right, but a wine carton will do) with the flaps cut off

A 1500 watt electric hair (blow) dryer

A wire shelf (I borrow one from the kitchen oven)

A couple of 2x4's to support the wire shelf

A meat thermometer, the kind with the round dial and pointed probe intended for sticking into roasts. If you have to buy one, I recommend the ones that Starbucks sells for measuring the

Baking time ranges from about 4 hours for 1/4" tape to 8 hours for 2" tape. It's not critical. You can't over-bake unless you leave it for a day or so (and your hair dryer will probably burn out before then), and if you under-bake and the tape is still gummy, you can bake it more. After you shut off the heat, leave the tape to cool down to room temperature before running it through the deck again.

If you want a more elegant solution, check your local appliance shop for a Farberware (or equivalent) convection oven, but make sure it's large enough to accommodate the size tape reels you use. These run about \$150 and might be a worth while investment if you have a large amount of tape to bake. Hair dryers aren't designed for continuous duty and you'll probably go through a few if you have a large project. Microwave ovens are totally inappropriate for the job, though I've read at least one report of success with one.

Lately, I've been doing tapes in my pilotless kitchen oven by replacing the 25 watt appliance lamp inside with a standard 100 watt light bulb, and putting in a muffin fan salvaged from a dead PC power supply to circulate the air. That gives me a nice stable 130 degrees, but it took some experimenting with the fan speed and placement. Without the fan, it never got beyond about 110 degrees, and I found that a 150 watt bulb (my first test) wouldn't allow me to get below 140 degrees. The friend who told me about this approach says he does it in his kitchen oven with the standard bulb that was in there when he bought the house. Go figure.

The technical jargon about the molecules comes from an article by Philip De Lancie in the May 1990 issue of Mix Magazine, where he quoted sources from Ampex. I'm no molecular chemist, just giving credit where it's due (and relieving myself of the responsibility for their errors).

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P.S.

It is really important to let the tape cool down SLOWLY to room temperature, or the stickiness will come right back. Turn off the heat, leave the oven/box closed, come back in 3 or 4 hours. When it's completely cool, then you can play it again.

For further information on this topic, read about Wendy Carlos' experiences at www.wendycarlos.com/news.html which also contains a link to a copy of Eddie Ciletti's article in EQ, which lists recommendations for using a readily available food dehydrator instead of a lab oven.