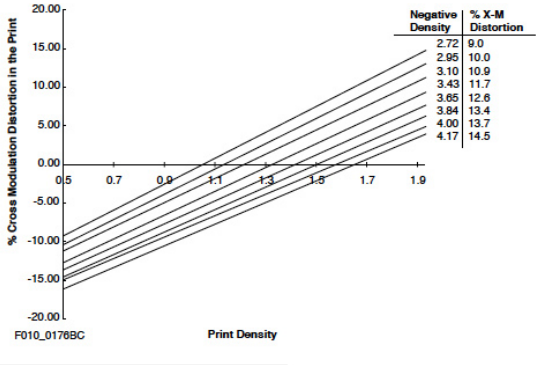
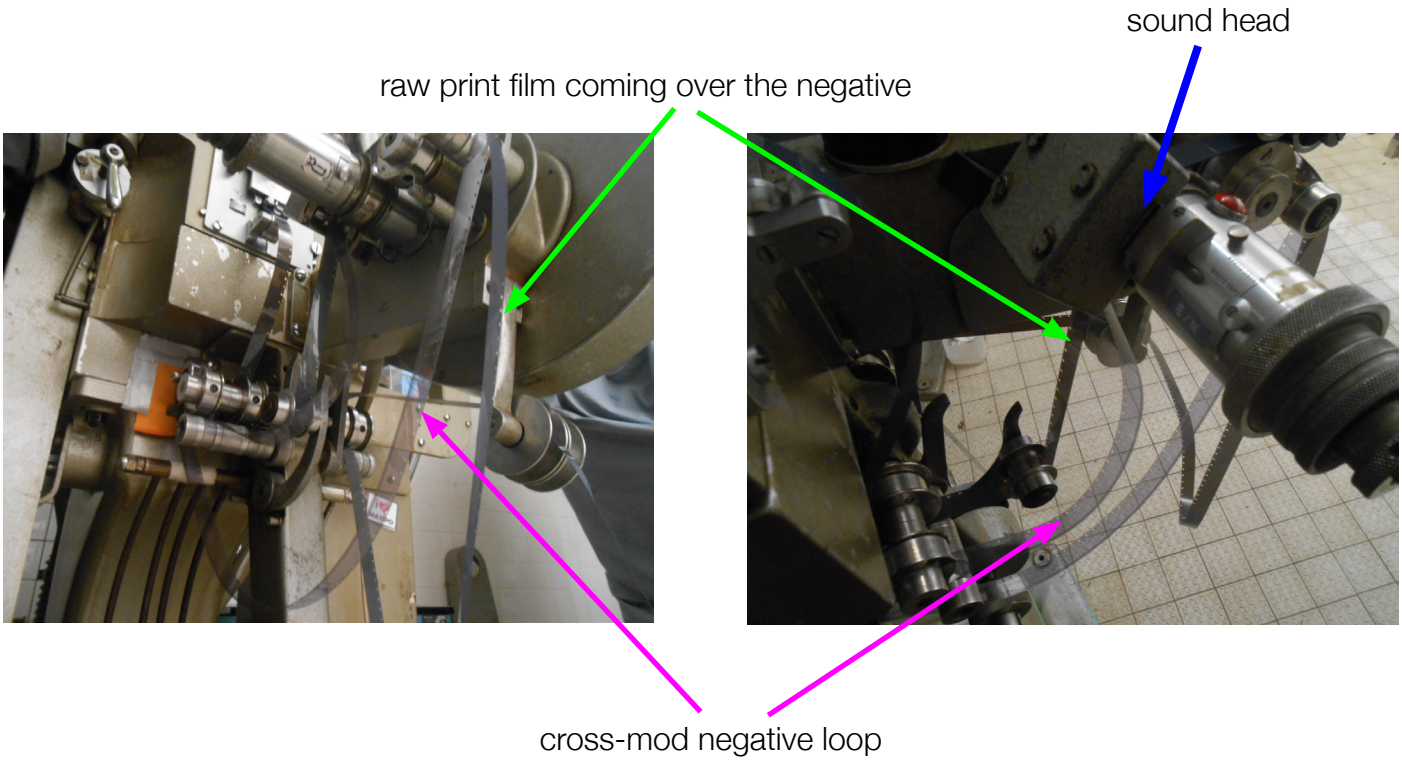
Using a cross-mod signal to expose an optical sound track

When making a sound print, the exact density of the sound negative is not important, the issue is finding the right combination of densities between the negative and the print. A cross-modulation signal is a 4000 Hz tone that is modulated by 400 Hz; it is used to determine the best density of the positive soundtrack for a particular sound negative. When there is no distorsion, no 400 Hz is heard.

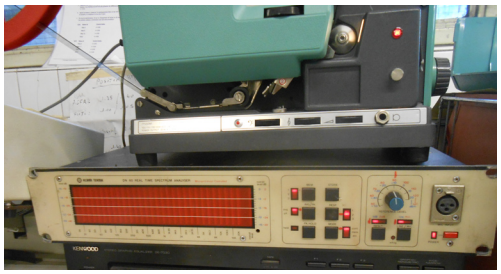


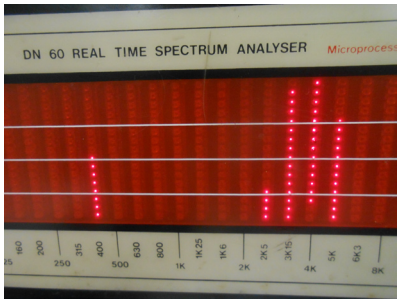
Once one knows he will be be making a sound negative of an admissible density (as a rule of thumb, sound negatives are made at around 3.0 density to yield approx. 1.5 density soundtracks on the print), one records a few seconds of cross-modulation signal right after the sound mix. Record the cross-mod signal at around – 4dB in relation to the maximum scale of the sound camera. This signal is then processed together with the mix so that the two are produced under the exact same conditions. Around ten seconds of cross-mod signal is usually enough to be separated from the mix after the sound negative is processed in order to make a loop in the printer.

That loop is placed in the contact printer and exposed at different lamp values, stopping in between each one to produce light marks. One has to cover a broad enough range, going from “not enough light” to “too much”.

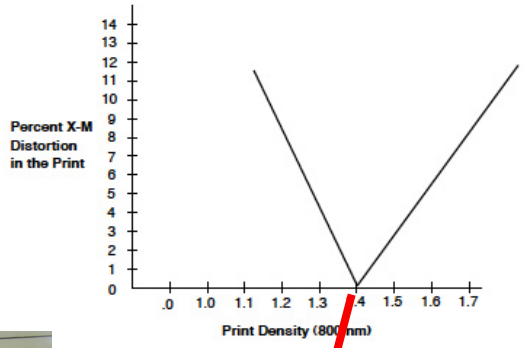


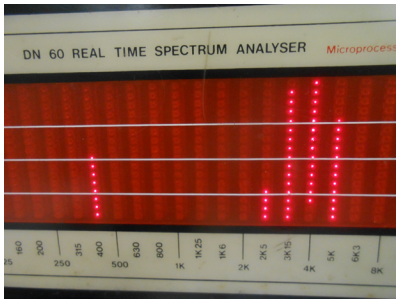
That test sound track is then read in a spectrum analyser. There are professional models like the Klark Teknik DN60 but a plain consumer “equalizer” that gives a a reading of the the different frequencies hooked up to a portable projector will do the trick. The 4000 Hz signal must be strong all the time, and the 400 Hz resulting from the distorsion produced when the density isn’t right will vary. Too much density brings 400 Hz, and not enough density does too. One looks for the density that brings no 400 Hz at all. This value corresponds to the ideal density for printing that specific track: one just has to make the print using this value.





no good





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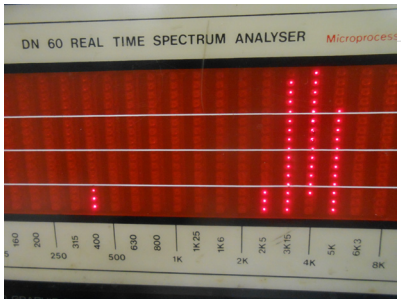
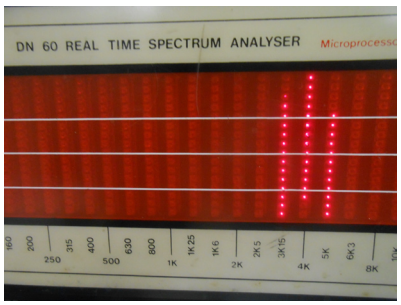
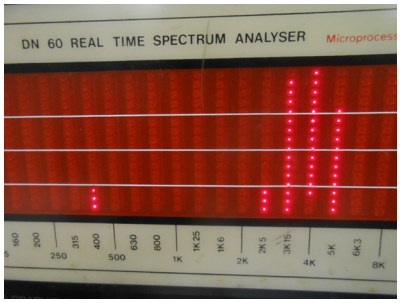


better



Bingo !



better

This is all very simple to implement for black & white film. For 16mm color film prints, however, the situation is more complex due to the fact that optical sound readers in 16mm projectors are mostly sensitive to infra-red light. As dyes that produce the colors in print film don’t block infra-red, it is therefore necessary in that format to develop specifically the soundtrack with a black & white developer so that the black parts of the track retain silver metal (that bleach eliminates in the other areas of the film) and block infra-red light, as in a black & white film. Otherwise, the dynamic of the sound would be severely affected by the fact that the reader would receive light even when light is supposed to be blocked. Also, density readings on a color print have to be made in the infra-red (800 nm), as with the BRUMAGIC MPST.

To know more, consult Kodak’s « Cross modulation Distorsion Testing for Motion Picture Laboratory » document.