Tests of ATR scrape flutter idlers
John Chester, 2018-07-17

Tests are being run on an ATR-102 with stock Ampex heads. Tape stock is NOS Quantegy 632.

The scrape flutter idler on this headblock was disassembled and examined under a stereo microscope. The shafts have some light scoring, as usual slightly worse on the bottom shaft. Looks better than many others I've seen which are still in service.

For real-time flutter measurement I use a Mincom 8300A-W flutter meter and SpectraPlus FFT analyzer software running on my computer. The 8300A-W was intended for measuring instrumentation machines, so it has wide range of test frequencies from 1.69 to 216 kHz. For 15 ips analog tape, I use 13.5 kHz. (All of these tests were done at 15 ips.) Originally the 8300A-W had a mechanical interlock between the test frequency switch and the flutter bandwidth switch which restricted maximum bandwidth to 2.5 kHz with 13.5 kHz test frequency. I have removed that interlock, so I can use 5 kHz bandwidth with this test frequency. Meter readings on the 8300A-W are less accurate because there's some carrier leakage, but it allows me to see 5 kHz bandwidth on the spectrum analyzer.

Testing is done with the ATR in record/playback. Thus, low frequency flutter readings are not very accurate, but for these tests that's not a problem – I'm only looking at flutter above a few hundred Hz.

For each test, I also recorded 1 minute of the test signal, and demodulated it using Plangent Process software. The graphs in this document were produced by viewing the demodulated file using the spectrum analyzer in Izotope RX6. I select a 40 second segment of the file, so the graph shows the average over those 40 seconds.

I ultrasonically cleaned the old flutter idler and jewel bearings, lubricated it with TufOil, and re-assembled it.

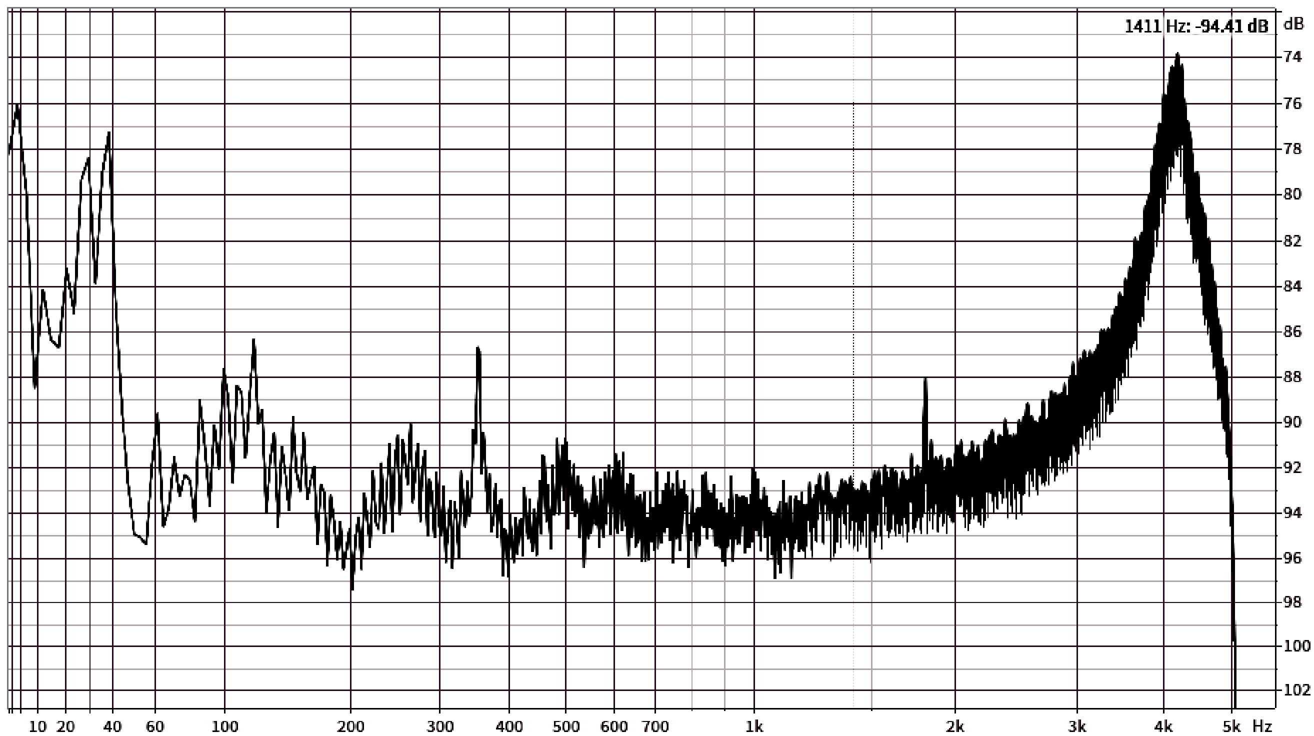
TufOil is marketed as an engine oil additive. It's a synthetic oil loaded with microscopic particles of Teflon (and it's very slippery). Before using it on scrape flutter idlers, I did a long-term aging test comparing it to two other Teflon lubricants: Tri-Flow and Dupont Multi-Use Lubricant with Teflon. I put a small drop of each on a horizontal piece of aluminum and let them sit for 6 months. Both the Tri-Flow and Dupont Multi-Use dried out and became significantly more viscous. The TufOil was unchanged, looked just the same as it did initially. TufOil is slightly more viscous than engine oil, so I was concerned that this viscosity might be too high – but the scrape flutter idler lubricated with pure TufOil, when spun with my finger, continues to spin for several seconds, and does a good job of removing scrape flutter with normal engagement with the tape.

I also have a new scrape flutter idler spool purchased from ATR Services. After testing my old one, I tested the new one using my old jewel bearings. I have now ordered new jewel bearings and will test them soon.

I tested 2 other lubricants: Dupont (now Chemours) Krytox GPL105 oil and GPL205 grease. These are also contain Teflon, and are supposed to be exceptionally stable.

The position of the scrape flutter idler on an ATR headblock can be adjusted over a small range. I tested 2 different conditions: 1) idler frame pushed fully forward toward the tape; and 2) idler position adjusted by looking at a real-time flutter display, and adjusting the position for the minimum engagement with the tape which still completely attenuated the scrape flutter. In the captions for the following graphs, I refer to this position as “optimum”, and the first condition as “full forward”. For the GPL205 grease, the optimum position was somewhat closer to “full forward”, presumably because of the higher viscosity.

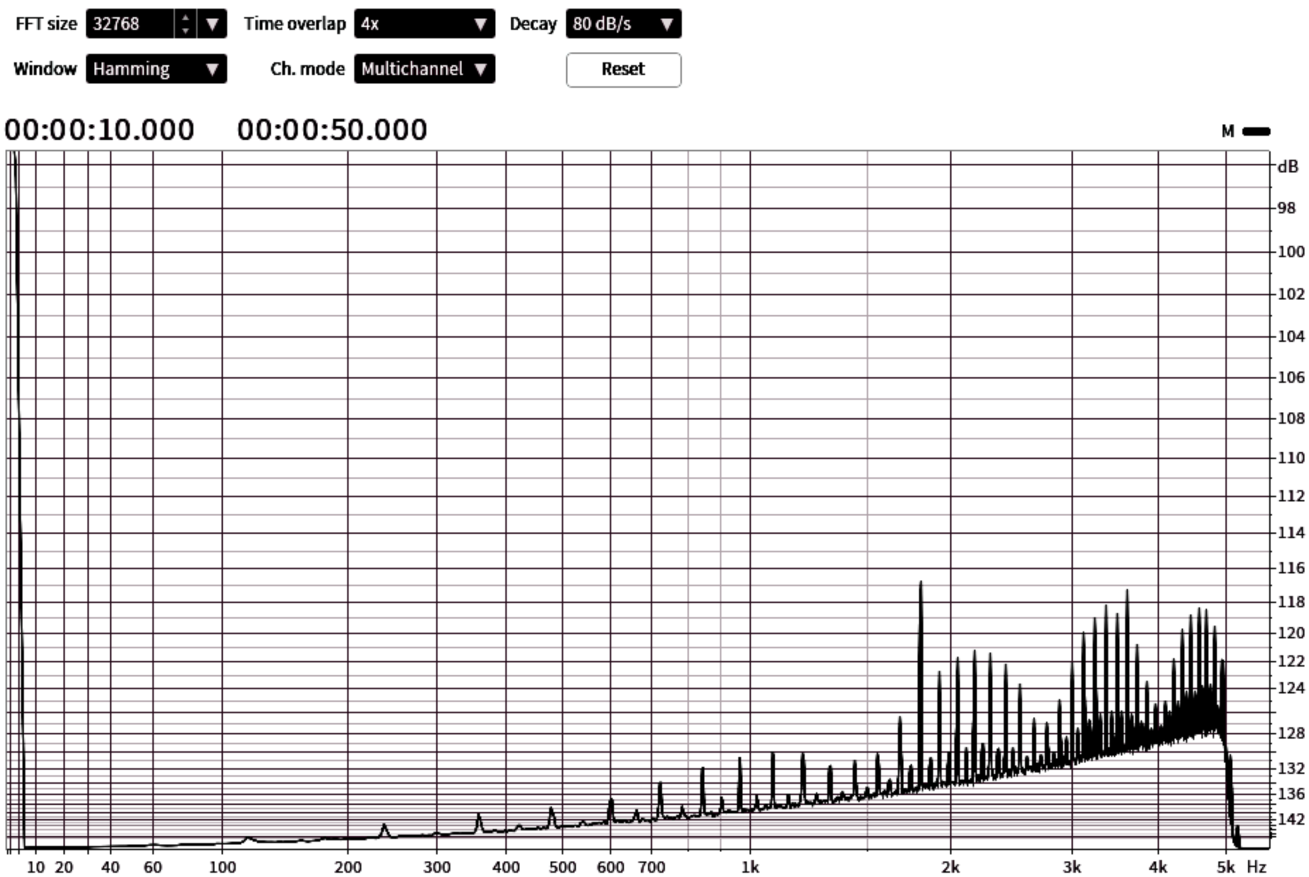
First, here's what the flutter looks like with no scrape flutter idler:



Yup, that's got some scrape flutter, all right……..

Note the low level of the flutter between about 400 Hz and 2 kHz. As you will see in the following pictures, this area gets a lot noisier when the scrape flutter idler is installed, and the noise level depends on condition of the shafts on the scrape flutter idler spool, lubricant type, and degree of engagement with tape. Pushing the idler further into the tape past the point required to fully attenuate the scrape flutter definitely increases the noise generated by the shafts & bearings.

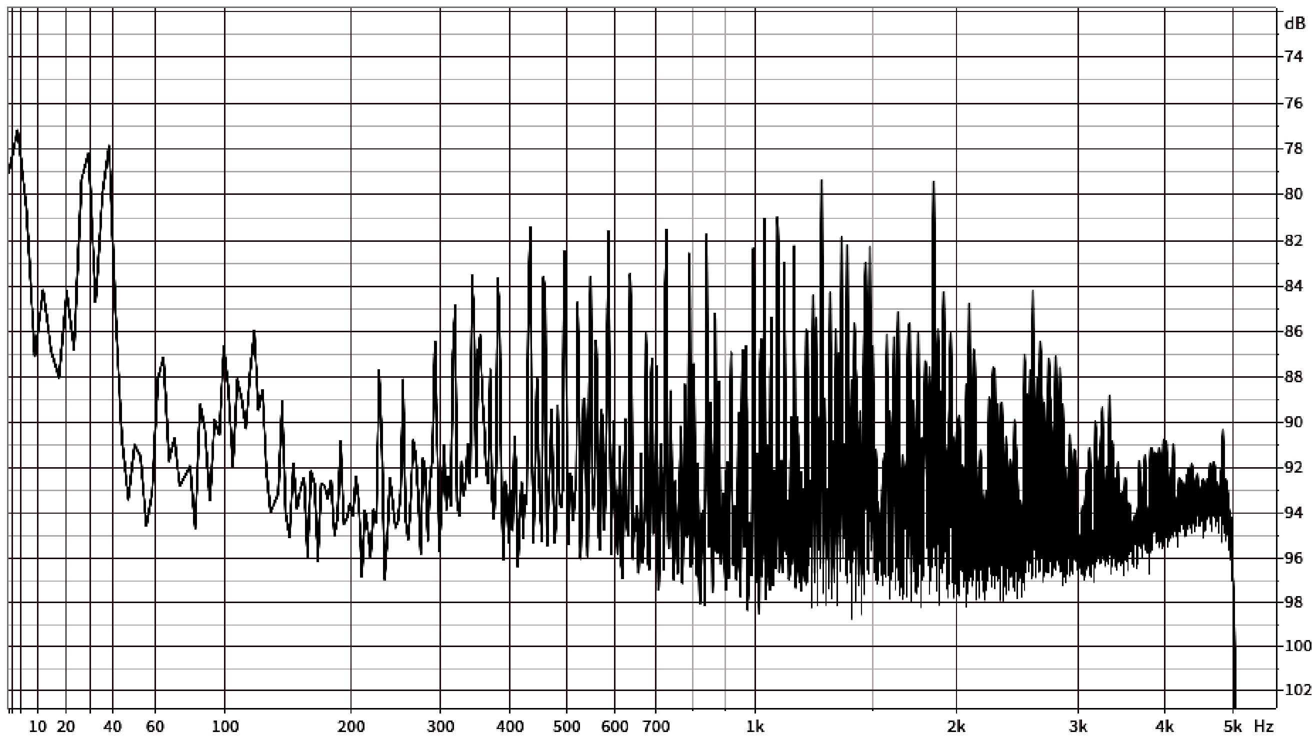
Next, let's check the phase noise of the 8300A-W's oscillator. This is a recording of the test signal, with the ATR audio selection set to INPUT.



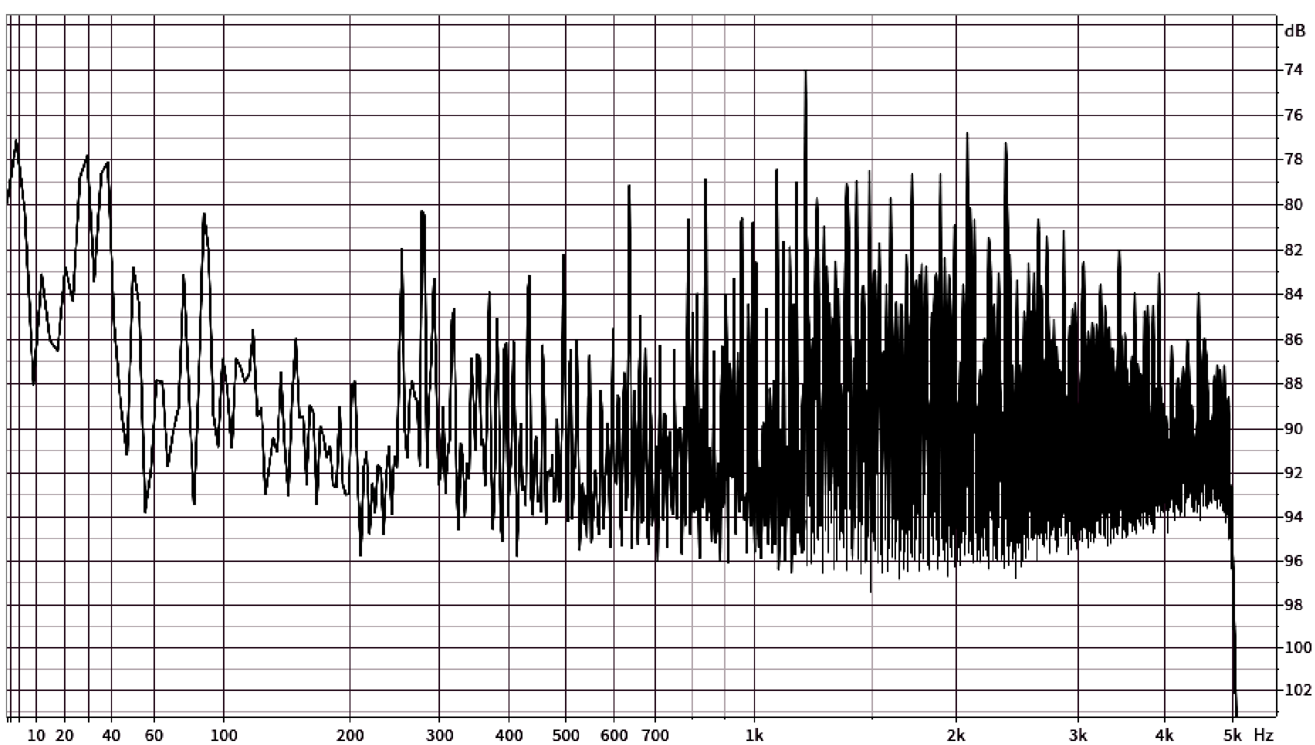
Note that the vertical scale is different from the previous picture. This shows that oscillator phase noise is well below the flutter on any audio tape machine.

This screen capture shows the FFT settings. All of the flutter pictures in this document were made with these settings.

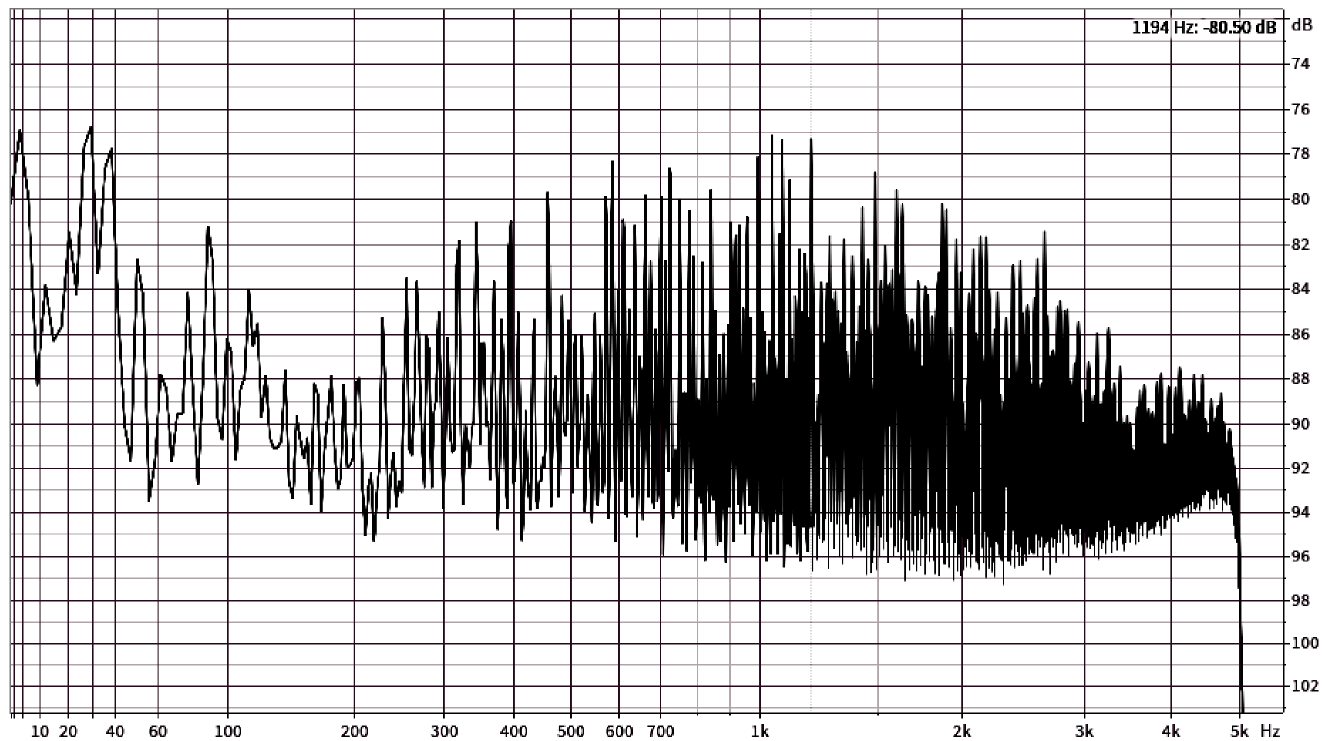
Now on to the pictures, with no further comments from me, for now.



Old scrape flutter idler, optimum adjustment. Lube: TufOil



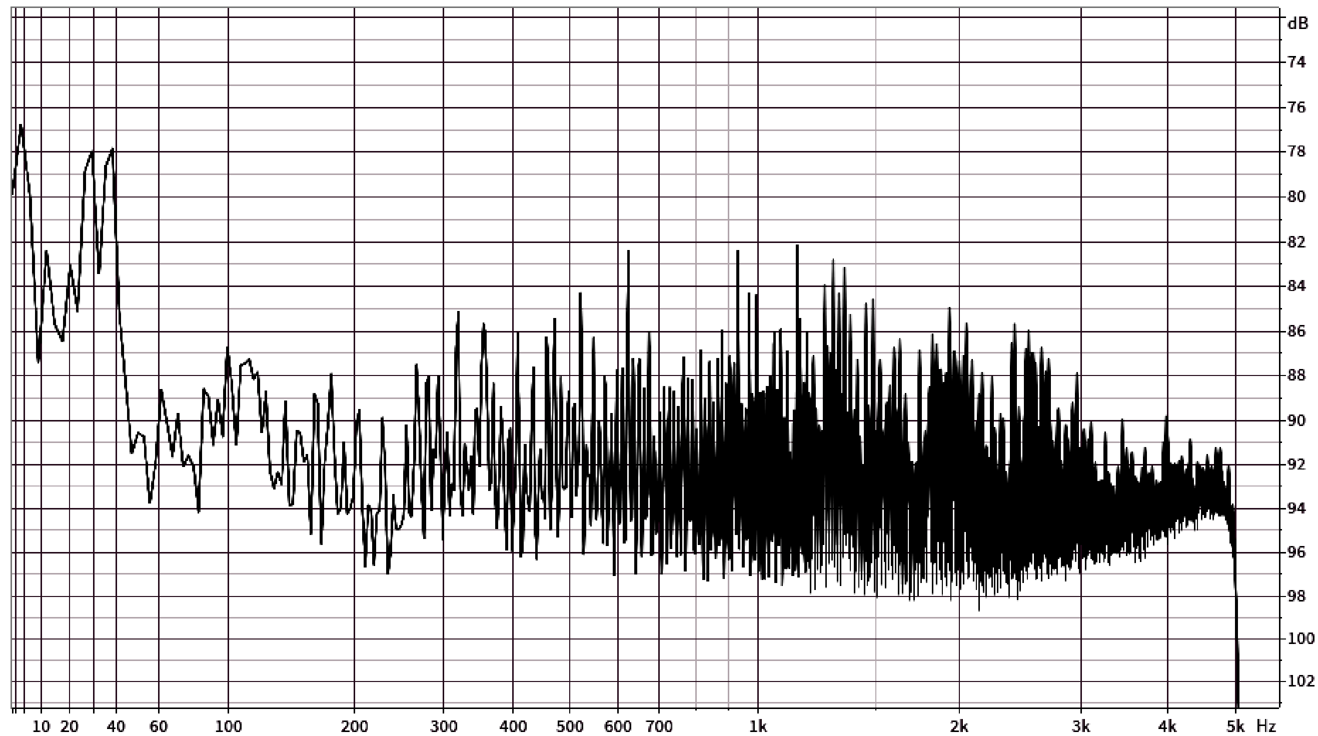
Old scrape flutter idler, set full forward. Lube: Krytox 205



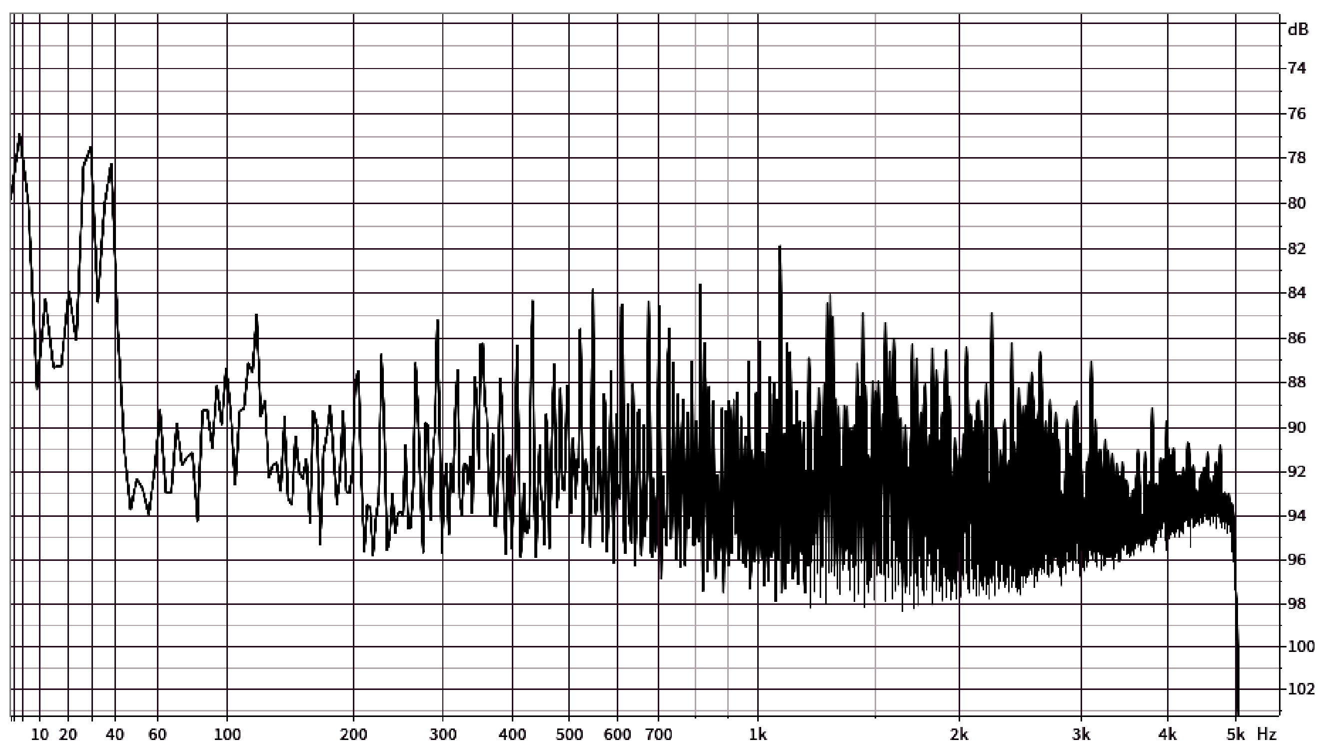
Old scrape flutter idler, optimum adjustment. Lube: Krytox 205

The next 2 pictures show the same test run twice, at different locations on the reel of tape. I was curious how repeatable this test was – and while there are visible differences between these 2 tests, they are (at least to my eyes) smaller than the differences between the different types of lubrication and different positions of the idler. They are certainly much smaller than the difference between the new and old scrape flutter spools.

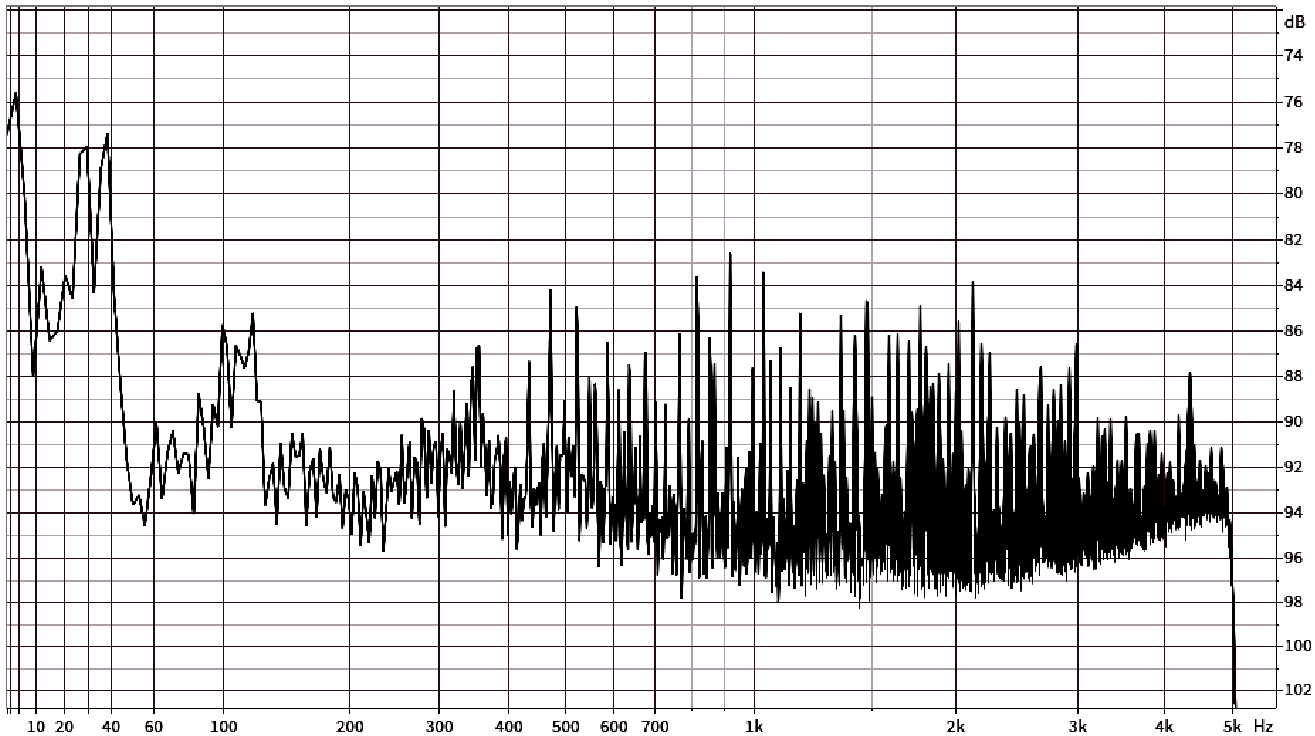
They also show a lubrication condition which may require some explanation. After testing with Krytox 205, I disassembled the idler, gently wiped off any excess grease on the shafts (but did not clean the jewel bearings). Then I put a tiny drop of Krytox 105 oil on the shafts and re-assembled it.



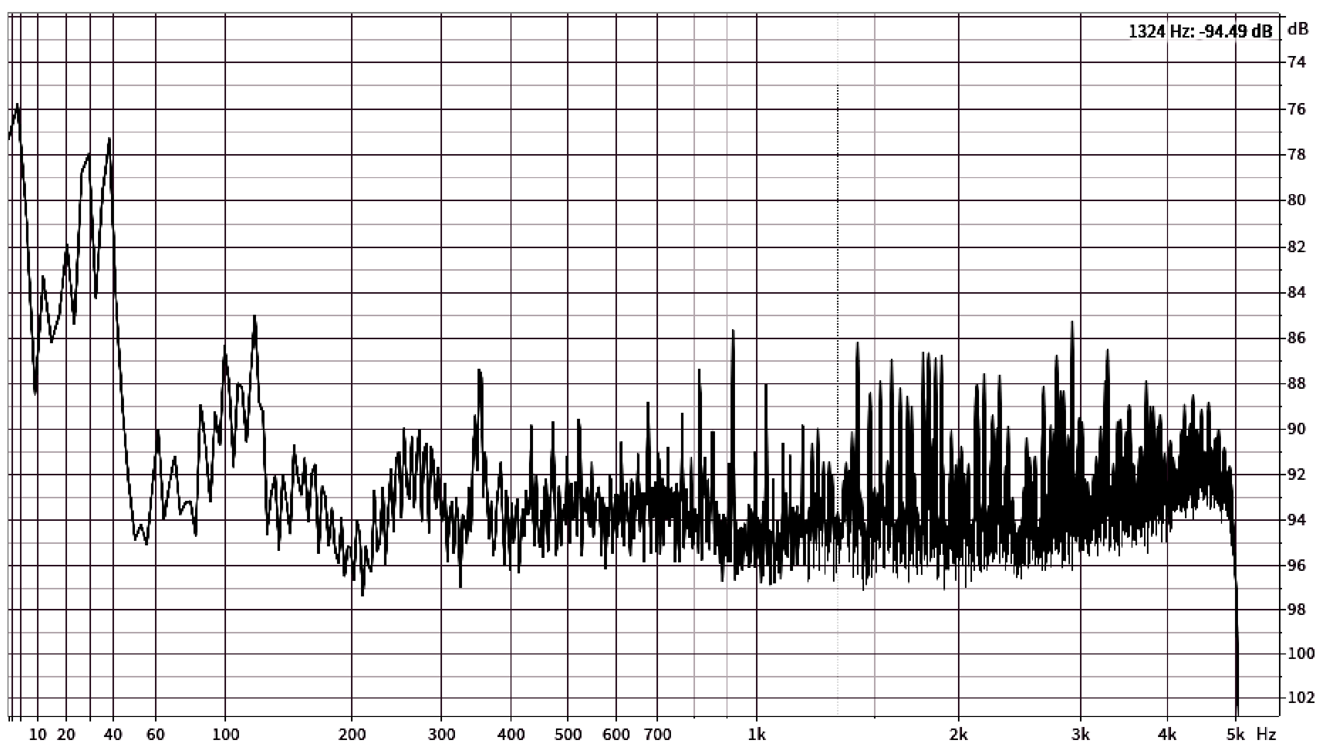
Old scrape flutter idler, optimum adjustment. Lube: Krytox 205+105. Near middle of tape.



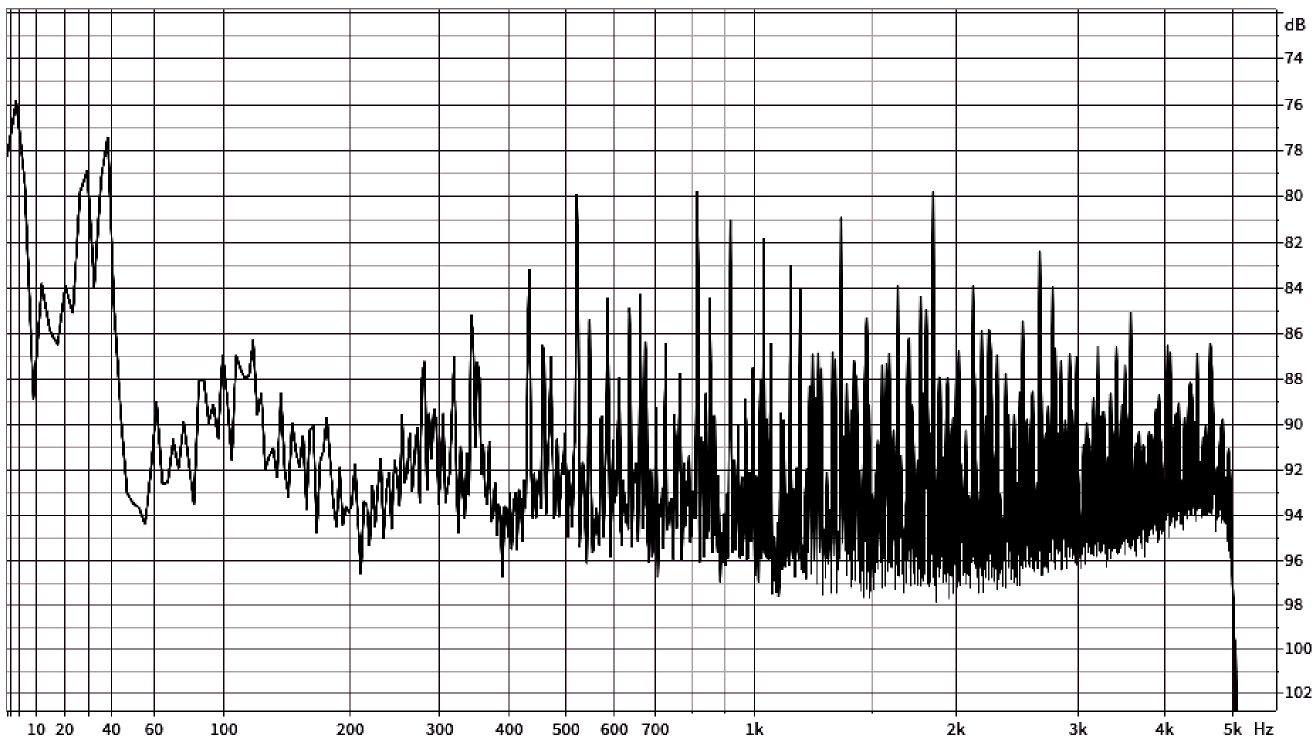
Old scrape flutter idler, optimum adjustment. Lube: Krytox 205+105. Near head of tape.



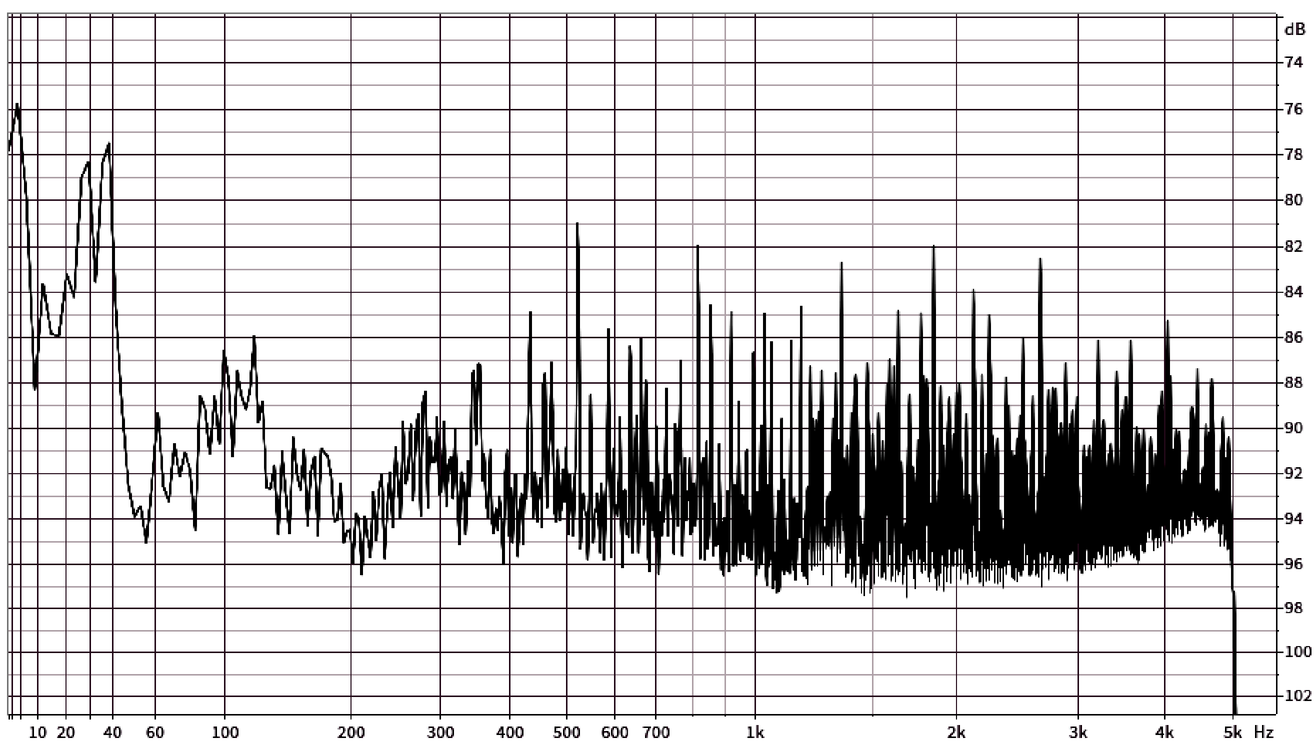
New scrape flutter idler, set full forward. Lube: TufOil



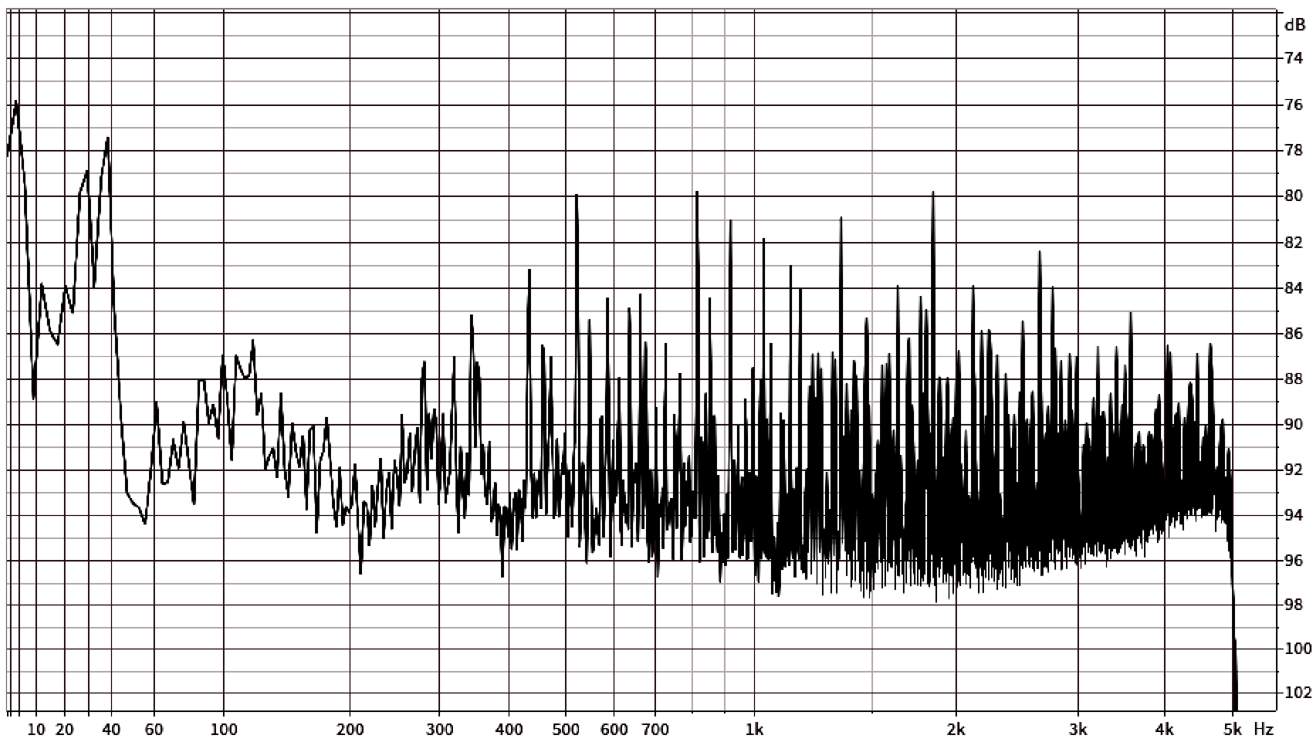
New scrape flutter idler, optimum adjustment. Lube: TufOil



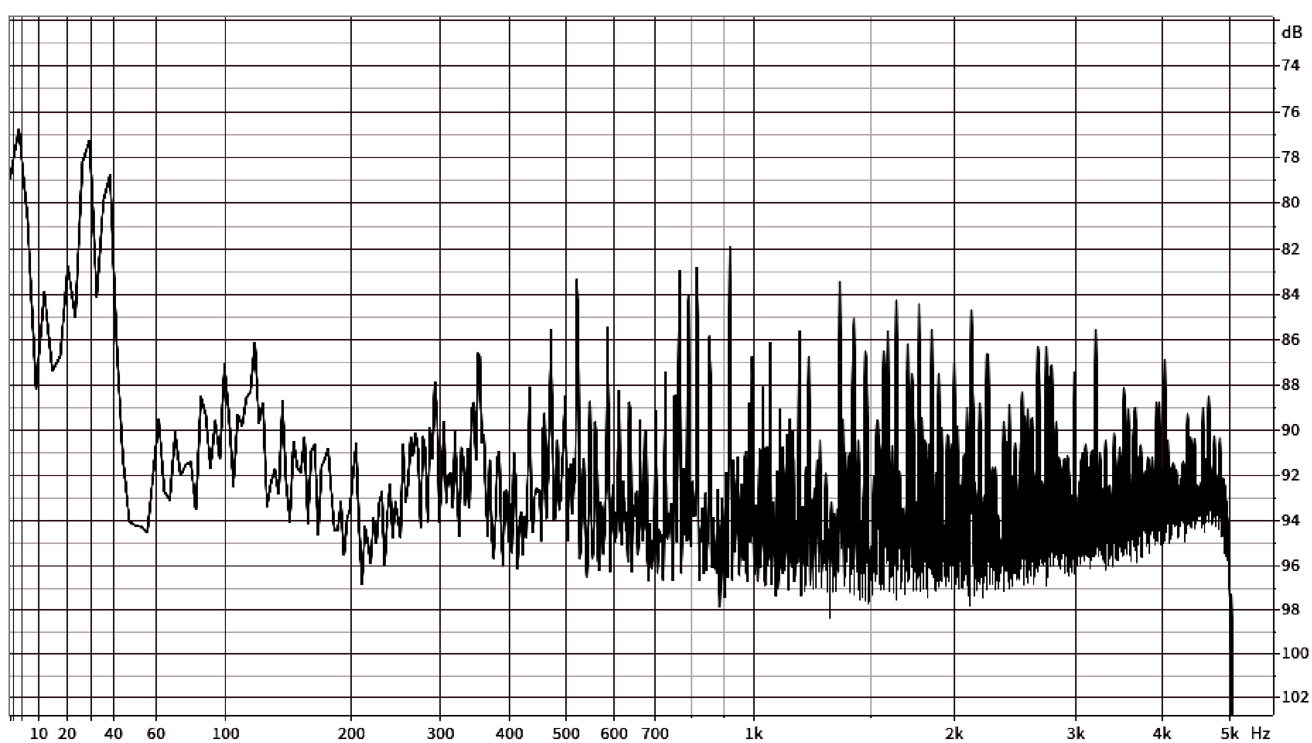
New scrape flutter idler, set full forward. Lube: Krytox 205



New scrape flutter idler, optimum adjustment. Lube: Krytox 205



New scrape flutter idler, set full forward. Lube: Krytox 105



New scrape flutter idler, optimum adjustment. Lube: Krytox 105