THE

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1998 Open Championship

Todd Jarrett Repeats As National Champion

Kim Stroud Wins Her First National Open Division Championship

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Pistol Noise Spectra Database

By Erich Thalheimer, A-12934

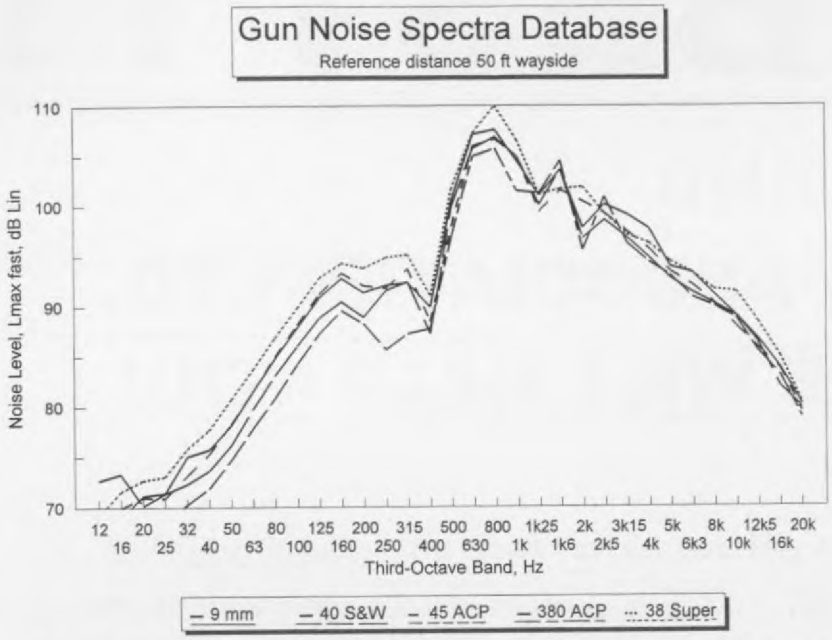
As an acoustical engineer and long-time USPSA member, I recently had the opportunity to combine my vocation with my avocation. After being disappointed several times in the past few years with fruitless searches for reference to spectral noise levels involving firearms, I decided to make my own database.

While the military does have an abundance of such data for interesting topics such as identifying "friend or foe" from acoustical signatures, those data are usually unavailable for unclassified purposes. Civilians may want to use this type of information for performing hearing conservation assessments for shooters, designing more acoustically comfortable indoor shooting ranges, isolating gun fire noise from adjacent living or office spaces, designing active noise control devices (muffs), or performing environmental noise impact assessments in which gun noise propagation is predicted at nearby noise-sensitive abutting land-uses. In all of these examples, appropriate noise-limiting criteria and guidelines do exist against which to evaluate the severity or acceptability of gun noise, and if warranted, noise control mitigation measures are available; however, that is a topic for a another article.

On May 20, 1998, during one of our usual Wednesday evening practices at Hopkinton Sportsmen Club, I brought out a state-of-the-art digital noise analyzer to measure acoustical spectra from a variety of available handguns. The noise analyzer was a CEL Instruments Model 593.C.1 which exceeded ANSI S1.4 Standards for Type 1 (scientific) accuracy. The meter was configured to measure and digitally store real-time 1/3-octave band noise levels over the entire audible frequency range of 20 Hz to 20 kHz. The meter was programmed to measure and hold maximum (Lmax) noise levels experienced in each 1/3-octave band using a detector speed of 0.125 ms ("fast"). The meter was calibrated beforehand and set to display noise levels in unweighted decibels referenced to 20 micro-pascals (dB re 20 uPa). All resulting acoustical spectra measurements were taken during live fire of an field course with the shooter approximately 50 feet away from the noise meter location.

In this manner, a variety of handguns were measured which were later sorted and averaged by caliber. Note that no attempt to disaggregate data based on bullet weights, speeds, models of guns, or any other variables was done at this time. All the sampled handguns were semi-automatics of various makes, and only the .38 Supers were compensated. The resulting averaged noise spectra for indicated calibers are shown in Figure 1. In general, maximum *broadband* noise levels for all calibers ranged from 110 to 115 dB at 50 feet. Note that if these noise levels are mathematically adjusted to predict the noise levels at say 3 feet, the shooter may be exposed to noise levels exceeding 140 dB.

To no one's surprise, the .38 Super produced the loudest noise levels, followed by the 9mm, the .45 ACP, the .40 S&W, and the .380 ACP, respectively. What was surprising was the similarity in the spectrum shapes of one caliber vs. any other. All five calibers tended to ramp up in low frequency noise levels at a rate of about 9 dB per octave, produce maximal noise energy in their mid-frequency 1/3-octave bands of say 500 Hz up to 2 kHz,



and generally roll off at higher frequencies at a similar rate of about 6 dB per octave. The only frequency regions which showed any clearly discernable variations between calibers were the loud mid-frequencies of 500 Hz to 2 kHz and also from about 160 Hz to about 400 Hz. The relative differences even in these frequency ranges were only about 3 to 5 dB for all calibers; but then again, such a difference is perceptible to most human listeners.

At this time, I offer no guaranteed explanation for the similarities in spectral signatures, so anyone wishing to use this data should do so carefully. The similar low frequency results could be due to inadequate response times for low frequency digital filters, and the similar spectral shapes in general could be an indication that the results show more the effects of the impulse response function of the digital meter, rather than real acoustical data. Given my understanding of the meter's design and something about digital frequency analysis, I believe portions of the data are reliable, particularly the mid-frequency ranges. I am again, however, amazed at how well the world's most advanced acoustical analyzer (the one between our ears) is able to distinguish differences in acoustic signatures when they appear seemingly so similar to an electronic noise measuring device.

So, as with buying a used handgun, *caveat emptor* to anyone wishing to use these results. They do, however, offer other acoustical and design engineers a reference of at least one database for handgun source strength noise emissions.