Why You Need Bolt Cutters to Measure Ambient Noise

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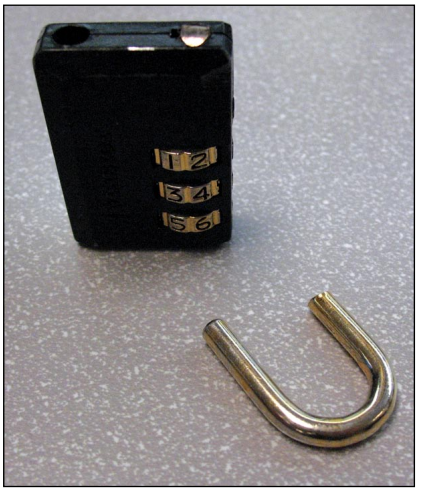

The plan was relatively straightforward – at least as far as ambient noise surveys were concerned. The only twist was that we were charged with capturing the extant acoustical environment over a 24-hour period at, not one, but a total of *three* sites. The sites in question were separated by a grand total of about 15 miles. Thankfully, these sites were located along a rather becoming stretch of rural highway in the American Southwest. Other than the fact that three sites was two more than what we might consider typical for a field noise survey, nothing we were doing was overly complicated for two experienced acoustical engineers. We had the proper, calibrated equipment. We had maps and aerials of the three sites and their surroundings (and we even purchased an additional regional atlas during the survey). Employing the skills we'd honed over our combined 39 years of acoustical engineering experience (including a combined 11 years of engineering college), we made sure we had good TV shows downloaded to our video-ready portable entertainment devices, as well as a good idea of the location of some decent Thai restaurants near our hotel.

The three sites were located in semirural areas with some single-family dwellings and subdivisions located nearby. Via diligent reconnaissance, we determined that we could overlap the placement of our 24-hour noise monitors to maximize data collection and minimize time in the field – always good news for the project accountant.

On the first day, noise monitors were placed at locations near two of the three sites. For 24 hours, they would measure and log "the usual" hourly average and statistical sound level data. We also made periodic, short-term, octave-band measurements. For the most part, my colleague and I were enjoying the clear, spacious skies and warm weather while being sure to make note of anything we heard. During our first middle-of-the-night visit, inspections of the noise monitors reassured us that the sound levels resulting from every cow's moo and train's horn were being logged. In addition, we discovered that, not only does it get cold in the desert at night; it also gets quiet. *Really* quiet. Quiet enough, in fact, that we found ourselves doing something extremely engineer-like: looking up the noise-floor of our equipment!

The second day was crucial – a pivotal day for the survey. For our time-condensed plan to work, we had to collect the noise monitor from Site No. 1 at the appropriate time, download the data, replace the battery, set it to record another 24 hours of sound level data, and place it at a new location near Site No. 3. Again, nothing too complex. But you know how stressful it can get when you've set a rigid schedule – the devil is in the details. Much to our chagrin, we encountered just such a devil; the noise monitor battery had only lasted 17 hours. While disappointing, this was not unexpected. We'd been having trouble getting some of our aging NiMH batteries to make it through a full 24-hour period. We'd also determined through frequent use that the noise monitor's battery-life indicator, displayed in the corner of the LCD, has a unique feature. Often, these sorts of indicators are a set of bars indicating the amount of remaining battery life. Logically, the number of lit bars should be related to the remaining battery life in a linear fashion. For example, if five out of five bars are lit, this should indicate 80-100% of battery life remaining. Likewise, four out of five bars lit should indicate 60-80% of battery life remaining, and so on. Not so for expensive sound monitoring equipment adhering to the highest level of ANSI (*et al.*) standards. Instead of utilizing this sort of common-sense approach, the battery-life indicator on our noise monitors had more of a variable, possibly even logarithmic relationship to the actual remaining battery life. Of course, if you think about it, it makes perfect sense; we *are* acoustical engineers. We *think* logarithmic scaling all the time. Why not when it comes to battery life, too? Five lit bars should indicate 48.7-100% life remaining; four bars should indicate 17.5-48.7%; and so on.

Battery replaced, the noise monitor was placed at the appropriate location near Site No. 3. The location was fairly decent, not too close to a nearby four-lane highway, chained to a fencepost on client property, which, aside from the fence, largely consisted of cacti, tumbleweeds, scrub grass, and other assorted desert flora. The location was also close enough to a wide highway shoulder that we were confident we'd be able to find it again in the middle of the night without: (a) being run over; or (b) falling into a ditch. The proper selection of a noise monitoring location is itself a topic for an entire article. Suffice it to say, ample engineering training is a must. For example, never choose a noise monitor location that is near, say, a beehive. At the very least, this could cause some mild annoyance – not to mention the noise from all that buzzing. At the worst, there could be unwelcome discomfort or death . . . and the latter of which could delay delivery of the final report.

The middle of the night fast approached, and the temperature dropped once again. For the second straight night, my colleague and I roused ourselves and made our way to the noise monitoring locations. This being the second night of interrupted slumber, I think it's safe to say we were a bit giddy. To this day, the content of at least one enthusiastic conversation has been completely forgotten by both of us. The only recollection we have is that of having developed some fantastically brilliant idea about something – or, at least, what seemed like a brilliant idea to a couple of sleep-deprived acoustical engineers driving through the desert at 2 a.m. (I wonder if any of the Roswell faithful have full-time careers in noise?)

We arrived at the last monitor location – the monitor near Site No. 3 – ready to be finished. Part of our ritual when we inspect the noise monitors is to (very quietly) unlock the case and (gently) open it to verify that all systems are 'go.' But the padlock on this particular case on this particular night, errrr, morning had other ideas. The locks we use are inexpensive, three-digit-combination padlocks. For the lock in question, the three-digit combination failed to release the lock mechanism, preventing us from inspecting the innards of the noise monitor case. The combination was entered several more times. The padlock was jiggled using several different jiggling techniques learned and mastered in engineering school. Whacking (quietly) was implemented as was a combination of jiggling *and* whacking (the latter as a last resort, of course). All to no avail. My colleague requested that I step aside so that he might try his hand at jiggling and whacking. After several more minutes, the case remained closed.

Seeing no reason to perpetuate the misery any longer, we decided to take it on faith that the monitor continued to function properly. It was after 3 a.m., and sleep was definitely a higher priority than trying to unlock the un-unlockable padlock. We decided to take our chances and return in the morning with some bolt cutters.

The sun rose but we didn't. Breakfast was eaten at lunchtime. We were looking for-

ward to concluding our noise survey, hopeful that we'd collected ample information about the extant acoustical environment around the three sites. After a quick side-trip to the local home-improvement store to purchase the bolt cutters, we returned to our problem-child, the un-unlockable padlock. I am happy to report that cheap bolt cutters are, in fact, perfectly well suited for cutting through cheap padlocks. The case was opened, where we discovered that the acoustical gods had delivered us a hat trick. No, the battery had not died. (Indeed, the indicator still indicated 'full' – which we estimated as being between 0 and 100% of battery life remaining.) This time, we were greeted by an LCD showing an unchanging sound level of 10.4 dBA. Cars and trucks passing by several hundred feet away – 10.4 dBA. Two experienced acoustical engineers yelling and, admittedly, cursing loudly – 10.4 dBA. Jiggling (but not whacking) the microphone pole – 10.4 dBA. Recalling the quiet desert measurement from the other night, this number seemed vaguely familiar. Of course, it was very close to the noise floor of the monitor. Realizing this, we inspected the microphone; it looked fine. But the microphone cable did not look fine. Some small, toothed creature, presumably a variety of desert rodent, had chewed almost completely through it. To add insult to injury, a review of the sound level data showed that the chewing had occurred around 7 p.m. – or roughly 8 hours *before* we discovered the un-unlockable padlock.

For those of you that lack any sort of strong religious convictions, let me tell you, the acoustical gods are a vengeful bunch. At some point, they got irritated with us and, to exact their revenge, they heaped a load of bad *juju* on an innocent noise monitor in the southwestern desert. You might think this is crazy talk, but I swear that monitor hasn't been right since.

In the end, there were enough data collected from other monitors and measurements to fulfill the needs of the project. The lesson we learned (I'm sure many of you have learned the same on noise surveys of your own) is that no matter how much they prepare you for this stuff in engineering college or how much experience you have, you can *never* be fully prepared. The bolt cutters are now part of the ever-growing list of standard gear that goes with us on field noise surveys. They occupy a well-deserved space beside extra flashlights, zip-ties and pens of assorted colors, the first-aid kit, the roll of electrical tape, and various other pieces of flotsam that have nothing to do with measuring noise – but without which we'd record nary a decibel.

We haven't quite figured out what to do to prevent future encounters with cable-hungry desert rats, but we *will* figure it out. Finally, we are still in the market for a good acoustical exorcist. If you know of one,

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