EDITORIAL

Murphy's Laws of Noise and Vibration Sources

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Recently, I met with potential clients who expressed their frustration that any changes made in terms of design and packaging increased the noise of their products. I tried to explain the scientific causes of the increased noise, but they did not quite appreciate the complexities.

Finally, I said that Murphy's Law governs the relationship between noise and certain design changes. They said, "Ah-ha! Why didn't you tell us this before? Also, where do we find more information on these laws?" I said that these laws are well known and that they should be able to find them on the Internet. In case you have not heard of Murphy's Law and its history and impact on our culture, visit the Wikipedia site: http://en.wikipedia.org/wiki/murphy's_law.

After that discussion, I was curious and I decided to take my own advice. I searched the Murphy's Noise Laws myself, while neglecting less important (but paying) work like research, teaching, and consulting. But I could not find any clear documentation of Murphy's Laws and similar principles as they directly apply to noise and vibration sources and their control.

Of course, I found some stray comments like "The more sound an auto (scooter in Bangalore, India) makes, the slower it goes." Also, a key word search of the S&V site (http://www.sandv.com) resulted in only one paper (on violins) that talked of a "classic example of that subset of Murphy's Laws related to non-reproducible results." I tried to see if any of our national and international noise or vibration conferences ever held a session on this topic. Nothing! I should have recognized in advance that Murphy's Laws exist on all topics – except the one on which you are working.

Since my exhaustive search did not reveal any written laws that specifically apply to noise and vibration sources and their control, I was struck by this thought: *No wonder we have not made significant progress, since a lack of explicit laws is clearly hindering any advancement to the art and science of noise control (though there are thousands of technical papers).*

I have decided to initiate the process by formalizing a few of these laws, though I recognize such pearls of wisdom have been handed down from one generation of engineers to another by oral communication (in meetings, bars and camp fires) – and sometimes in frustration. This is finally my opportunity to make an impact on the S&V community and shape my legacy!

I have randomly highlighted 20 laws and principles under four categories (with focus on noise and vibration sources), without any proof or supporting experimental evidence, as Murphy would expect, based on my more than 30 years of experience and the wisdom of my colleagues. Note that I have lumped theorems, lemmas, axioms, hypotheses, postulates, corollaries, inferences and even observations under the "laws."

Acoustics and Vibration (A Primer)

First Law – No one (except Murphy of course) understands the science of acoustic or vibration sources. Noise investigations tend to involve cognitive, economical and political issues; therefore, we should call it as an interdisciplinary science or art.

Second Law – Never make the same sound or vibration measurement twice. Multiple measurements will always disagree, and then you'll have to explain why. Also, it is easy to theorize the cause-effect relations based on single measurements.

Third Law – Define the standard deviation of noise or vibration levels between 5 to 10 dB *without* any measurements.

Fourth Law – Noise and vibration sources seem rather simple before you study them, but they become more mysterious with detailed measurements and advanced simulation studies.

Fifth Law – Scaling laws of all kinds work for only one example case or known system.

Important Noise Sources

First Law – The most important noise source is 3 dB below the one you have addressed in your work.

Second Law – The dB algebra is a useful trick to razzle-dazzle non-experts, but the true noise control experts should not use it to promise any reduction.

Third Law – The only robust source is a loud one.

Fourth Law – The only quiet source is the one that makes a product or system dysfunctional.

Fifth Law – Conduct measurements with several concurrent design changes; this will allow you to rank sources in order of importance at will.

Noise Expectation/Product Design

First Law – If there are two or more ways to design a product, both or all will lead to more noise. Alternately, if there is a way to design a quieter product, it will never be implemented due to cost, weight or political considerations

Second Law – If a designer can find a way to degrade noise and vibration, he or she will be successful 99% of the time. Alternately, if there a 50-50 chance of increasing noise, it will go up 100% of the time.

Third Law – An effort to enhance the energy efficiency will also increase noise and vibration levels – but in a nonproportional manner.

Fourth Law – Any solutions to reduce noise and vibration that are offered by a manager will always fail – though after much testing. In the meantime, the manager will have been promoted.

Fifth Law – Strengths of noise and vibration sources can only be reduced by adding money and weight.

Noise Prediction

First Law – If the noise prediction is within 20 dB of the measured data, highlight the virtues of trends and the simulation methods you have used.

Second Law – If the noise prediction is within 3 to 4 dB of the measured data, take all the credit now, since you (or others) will never be able to repeat it.

Third Law – Judge the noise or vibration prediction software by its postprocessor and how colorful the results are.

Fourth Law – Blame all discrepancies between theory and experiments on nonlinearities, randomness and unmodeled dynamics.

Fifth Law – Do not try to validate the prediction for your example case. Instead, cite all of the trivial cases where computations match simple theories. Alternately, claim that the analogous experiments are either impossible or wrong.

We attribute all of the above to Murphy and pay homage to him and other great social scientists (Dr. Phils of the world) who have made our lives easier. I suspect that many reasonable (and seasoned) experts will see the void in the literature and contribute their laws and anecdotes. Collectively, we may create a "Bible" (more like a Wikipedia page) on Murphy's Laws that directly apply to noise and vibration control and explain the mysteries that surround us. I look forward to your contributions. SV

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