

Noise, Vibration and “Harshness??”

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Greg is an NVH Engineer and is meeting a business colleague, Susan, for the first time to discuss the details of a proposal for a new widget. They approach each other in the lobby of the engineering building, smile and shake hands.

Greg: Hi Susan, Glad you could make it today. I’m Greg from the NVH department.

Susan: Hi Greg, nice to meet you, too. I’m sorry . . . NVH?

Greg: Oh yes, of course, sorry. NVH means noise vibration and, um, harshness.

Susan: Oh, I see.

(The look on Susan’s face betrays her confusion. Greg shifts uneasily as he tries to explain.)

Greg: I bet you’re wondering about harshness, right? Well it’s a term that’s been around for a long time – I’m not sure how long actually. And most of us don’t really know exactly what it means, but most think that it has to do with the quality of the noise or vibration. Some say that it has to do with impacts, but I find that to be problematic as a complete definition. To be honest, I don’t really know what it means and I always struggle with it, and I’m not really sure how to respond when people ask about it so I tend to go on babbling since I have nothing really intelligent to say on the matter. Sorry, I wish I could give you a better answer.

Susan: I see. So then let’s talk about the quote, shall we?

This exchange has happened to me countless times in the last 20-some-odd years, and I’m sure I am not alone in this. It’s just really annoying and frustrating to me. Why do we tolerate this? Why have we done this to ourselves?

Most of us can clearly understand what the concepts “noise” and “vibration” are, but just what is “harshness?” Some have explained that harshness is a qualitative descriptor of noise and vibration. But isn’t that also known as “sound quality” or “psycho-acoustics?” Others have defined it as related to transient events, like tire impact harshness. The more “sharp” or impulsive the event, the harsher it is.

OK, that gets closer to something I can understand, but is it only limited to tire/road impacts? What about door slam? Or how about rattles? They are transients, aren’t they? Isn’t a diesel engine more “harsh” than a gasoline engine (most of the time, anyway)? How about music? Wouldn’t some say that metallic grunge is “harsher” than Chopin? Is metallic grunge more sharp or impulsive in some way than Chopin or Tchaikovsky?

So, just what the hell is harshness?

From a non-technical point of view, I think we can all agree that “harshness” is a very negative word. Here’s the standard definition:

Harshness (noun) – 1. Unpleasantly coarse and rough to the touch; 2. Disagreeable to the senses, especially to the sense of hearing; 3. Severe, cruel, or exacting; harsh punishment; a harsh overseer; 4. Unpleasant or uncomfortable: a harsh wilderness.

I am usually a positive person, and walking around talking about negative concepts like “harshness” all day doesn’t suit me. Yet, due to this rather cruel definition, this is exactly what I have been doing for the past 25 years. Is it any coincidence that being an “NVH engineer,” which has often been seen as a somewhat negative and confrontational occupation (“ . . . you want *what?*!!!”) is also linked to a negative mindset embodied by the very definition of the field in which we work? I think not. There is a special place in Hell for the person who came up with this term.

This has bothered me for a very long time, and I am finally going to do something about it, starting with this article. Rather than try to better define what harshness means, I am going to question the need for it in the first place. Ultimately I would like to see something else in its place. I’ll offer some alternatives here, and I would like to start a “grass-roots” effort with all of you to help us come up with a better word to replace harshness.

In doing this, I think we should try to keep the NVH acronym intact if possible since it has become deeply ingrained in the industry around the world (especially automotive), and changing that would be highly disruptive to a lot of people. I often see “NVH” on business cards of colleagues in different countries. This may prove too restrictive, but let’s start there and see where it goes.

Before I start with my proposal for a new definition, I thought it would be amusing to share with you some of the more “colorful” interpretations of NVH that have been floating about:

- Not very helpful
- Never very happy
- Nebulous, halfhearted and vague
- No vacation or holiday (my new favorite)

All kidding aside, I would offer a new definition of NVH, one that changes the emphasis from a passive listing of attributes, to an active, meaningful expression of our intent as noise and vibration profes-

sionals. In this new definition, I would replace the concept of harshness with that of “harmony.”

Harmony (noun) – 1. Agreement; accord; harmonious relations; 2. A consistent, orderly, or pleasing arrangement of parts; congruity; 3. Music: a) any simultaneous combination of tones; b) the simultaneous combination of tones, especially when blended into chords pleasing to the ear; chordal structure, as distinguished from melody and rhythm; c) the science of the structure, relations, and practical combination of chords.

Harmony is a positive word, and it has some technical as well as philosophical merit. The technical merit comes from the idea that most sounds (and vibrations) have harmonics, especially those from periodic signals or rotating machinery, and often our job is to ensure that the harmonic spectrum of these signals is, in fact “harmonious,” balanced and pleasing to the ear (or at least not damaging). It’s the other side of harshness, if you think about it.

On the philosophical side, our job as noise and vibration engineers is often to create harmony between various sound and vibration sources in a mixed-source environment. I would ask: Which would you rather spend your time doing: *preventing* harshness or *creating* harmony? To me, the answer is obvious.

In this definition of “H,” I would slightly alter the wording of the full NVH Term to *Noise and Vibration Harmony*. I like this much better than *Noise, Vibration and Harshness*. In this new definition, the words *noise* and *vibration* become subordinate; they are merely a means to an end – where the end is *harmony*. Harmony between the various noise and vibration sources in the product and harmony between the product’s NVH signature and the overall character of the product.

I like it. It’s also a lot easier to explain to people who have never heard the term before without the normal embarrassment that comes when trying to explain what harshness means. The one thing that I must admit to is that when you first hear the expression “noise and vibration harmony,” it sounds too, um . . . *milquetoasty*, if you know what I mean. That said, give it a try in your mind for a while. I’ve found that you really do adapt to it quite well. Whatever you may feel about it, I think it sure beats harshness.

OK, that’s one idea. Here are some others:

- NVH – Noise, vibration and harmonics. This is my second choice behind

harmony, and I suppose that the word *harmonics* has a little more scientific meaning to it.

- NVH – Noise and vibration holism; perhaps a little too “granola?”
- NVQ – Noise and vibration quality; violates the rule of maintaining the acronym.
- NVE – Noise and vibration engineering.
- NVH(f) – Noise and vibration human factors (awkward).
- NVH – Noise and vibration heuristics.

- N&V – Maybe we should just drop the H after all; some major organizations are already doing this.

- S&V – Sound and vibration; sure sounds familiar. If we expand the positive/negative argument a little more, one could suggest that noise is also a negative term and that sound is a much better way of expressing it. Maybe Jack Mowry has had it right all along!

I would like to hear your thoughts on this.

Any ideas for alternative definitions? Or perhaps you are a fan of the word harshness and think we should just define it better. Tell me what you think, and we can use *Sound & Vibration* magazine as our starting point. I'll also be attending the SAE Noise and Vibration (N&V!) Conference in Grand Rapids and we can all work together to make this happen.

Let's start something. Please e-mail your comments to me at ggoetchius@teslamotors.com. 