Ear Sense: The Proof Is In The Data

More evidence of level abuse and arguments against artist demands

By Fred Ampel

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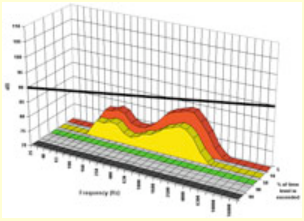
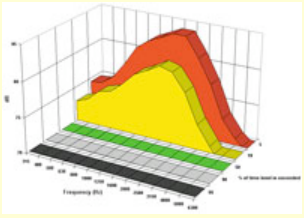
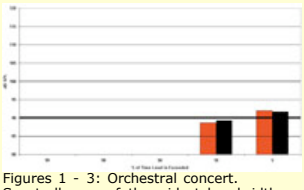






Figures 1 - 3: Orchestral concert. Spectrally one of the widest bandwidths of any data collected, and this large group reached 92 dBA only five percent of the time.

Immediately after my previous Ear Sense column (Live Sound February 2003) appeared, I received several phone calls. It seems that some of you are interested in fervently defending the need for high sound pressure levels, particularly for certain types of musical performance, including (but not limited to) rap, metal/thrash and similar genres.

Comments like "the nature of this music demands maximum levels to get real with the audience" or "the artist absolutely insists on having the PA at very high levels to make his/her statement" were characteristic of the remarks being made. However, none of the callers would speak for attribution or send an e-mail. I guess they only wanted to get "virtually real" with the topic in a one-on-one manner.

Well, if the nature of a particular musical genre demands excessive levels, I'd sure like to know why! Raw acoustic horsepower is NOT inherent in any musical performance style. Dynamic variation? Yes. Impact? Most definitely. Plenty of deep bass that can thump your chest (and other body parts)? Absolutely!

But I'm hard pressed to find a linear relationship between dynamic impact and levels that will damage human hearing. The two most certainly are not linked by heredity, and, further, it's easily feasible to produce "substantial impact" without sound levels that are continuously 20 to 30 dB above the point where irreversible damage takes place.

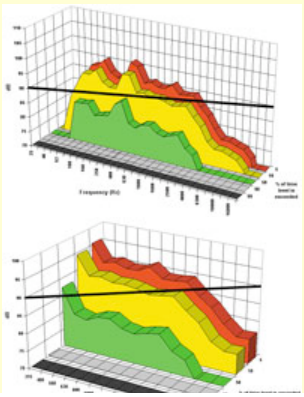
ABSURD DEMANDS

The other main argument - "the artist demands ultra-high SPL" - is a more complex scenario. Artist demands for everything from special water in the dressing room to certain colors of lighting on stage are one of the industry's most difficult facets. Just like client demands in any business, some artists are relatively easy to accommodate while others come up with demands that are simply absurd, impossible, in violation of the known laws of physics or require funding similar to the national debt of a small nation. And then there are those that place the vendor squarely on the sharp end of the stick.

But for your own sake, always consider SPL demands that you know to be dangerous (and should recognize as such) in that "not negotiable" category. When it comes to demands for levels that put you, your company, the venue and untold others at legal risk, the boundary between ego and common sense has been crossed.

The basic problem comes down to one of two things with artists and their management - ignorance or arrogance. Realistically, there are far more performers who would be concerned and willing to change if they (and their often sycophantic management) were tutored about this topic. Their current mindset regarding SPL is driven by a competitive streak and a serious lack of knowledge about what is happening from both audiological and regulatory standpoints.

Of course, when asked, they take a solemn vow that they would "never, ever" put their fans at risk. When the lawsuit comes, however, such ignorance is not a viable excuse. The opposite side of the coin hosts the far more problematic performers, thankfully in the minority, who simply don't know, don't want to know and don't care. They likely will soon be looking at fines as the cost of maintaining their "artistic integrity".

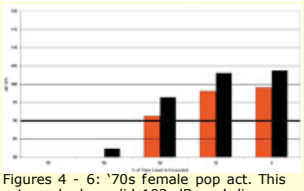


Unfortunately, they'll have no problem finding lawyers and suppliers who will gladly take their money. I call this the "Pinto" mindset, named after a certain automobile whose manufacturer had discovered it would be cheaper to settle claims by those who were immolated by its vehicles rather than taking appropriate steps to prevent the problem. There will also be those who claim discriminatory application of any rule or regulation, using polemics to try and circumvent the situation, such as, "they fined us because they don't like our music."

Fortunately for the rest of us, it's hard to believe any judge or health and safety authority would find for the defendant in such a case. The one absolute in all of this is that hearing damage is PERMANENT and quantifiable - at least sufficiently quantifiable to win the day in court. If you think it's not, just "Google" the topic on the web. You'll quickly find hundreds of hits detailing the costs incurred by employers and suppliers in the U.S., Canada and the European Union (EU), as well as non-EU Scandinavia, Japan and almost anyplace else where

there were people willing to sue or file a claim under existing regulations with a target to sue or a rule to use.

LET'S GO TO THE DATA



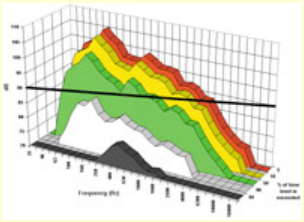
Figures 4 - 6: '70s female pop act. This act reached a solid 103 dB peak linear scale but only exceeded 90 dB for an average of 10 percent of the time.

The graphs presented with this text are from the same pool of measurements used in the February article, and the same parameters apply. Dan Foley, vice president of Listen Inc. acquired the data at several concerts during a recent summer season at an outdoor music venue where each act supplied its own sound system.

These measurements have been processed only to be presented in a compact graphical format.

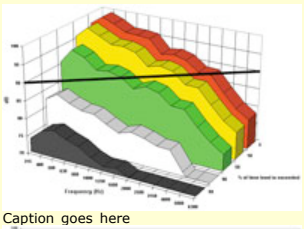
The only filtering used was applied to each full-range dataset, allowing us to show a narrowed spectrum from 315 to 6300 Hz, the area of the ear's maximum sensitivity and in which the majority of hearing related damage occurs and is most injurious. It's also the bandwidth that most closely matches the A-weighting scale used by regulatory agencies in SPL measurement systems.

As noted above, one of the defensive arguments used to validate excessive SPL is that a musical style or type "requires" higher levels. So it's instructive to look at a diverse group of musical styles and see the levels that were generated and measured.



Figures 1 - 3 were taken at a full-scale orchestral performance. Spectrally, this represents one of the widest bandwidths of any data collected, extending as it does from the extreme deep bass area (about 25 Hz) to the very high frequency range above 10 kHz. From an SPL standpoint, this large group reached 92 dBA only five percent of the time and was at or below 90 dB for the balance of the show (highlighted in **Figure 3**).

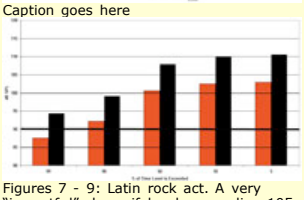
These particular performances were largely Baroque-era selections, and certainly different program choices (Mahler, Wagner or some 20th Century works) would like produce higher overall levels.



Caption goes here

A different conductor might have had the orchestra play at higher levels as well. Even so, SPL likely would have touched 97 dB or so, A-weighted peak, but the average likely still would have been at or below 90 dB overall (A- or linear-weighting), a very safe and sensible place.

Now let's move to the somewhat narrower bandwidth space occupied by the '70s female pop act, shown in **Figures 4 - 6**.



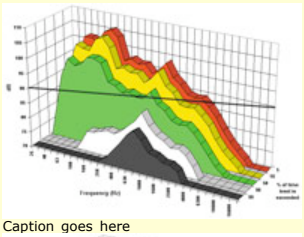
Figures 7 - 9: Latin rock act. A very "impactful" show, if levels exceeding 105 dB (and hitting 110 dB) at about 80 to 200 Hz are any indication.

The spectral world of this act occupies a 40 Hz to 4 kHz primary space with a rapid roll-off above 5 kHz, although some energy goes as far out as 12 kHz. Note, however, that this energy is 15 dB or more below the peaks around 100 Hz, 400 Hz and 1.6 kHz.

As **Figure 5** shows, this act reached a solid 103 dB peak linear scale but only exceeded 90 dB (barring a few spectral peaks) for an average of 10 percent of the performance time. Overall, this show, while a tad spiky on the spectrum, maintained reasonably sensible levels most of the time as seen in Figure 6. It also probably sounded edgy, given the spectrum, but not painfully so.

WE ARE THE CHAMPIONS

Moving along, let's look at our two SPL "champions" for this segment, depicted in **Figures 7 - 12**. These two, a Latin rock main act and a '70s mainstream rock band, join our heavy metal contestants from the last installment in hitting the highest raw number - sort of like those car stereo "pure loudness" contests.



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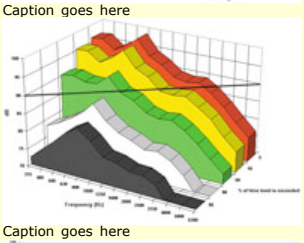
The Latin rock performers (data in Figures 7 - 9) had a very "impactful" show, if levels exceeding 105 dB (and hitting 110 dB) at about 80 to 200 Hz are any indication.

Although there's not much above 6.3 kHz (8 kHz is 20 dB or so down from the 2 kHz peak of 95-plus dB), you can see in **Figures 8 - 9** that this act stayed well above the 90 dB safety threshold essentially all the time when measured using a linear scale. Using an A-weighted scale, they exceeded 90 dB a good 90 percent of the time, and were well above 100 dB for at least 50 percent of the performance.



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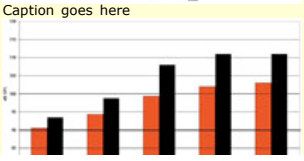
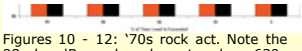
This was a LOUD show! It was also painfully loud, as shown in Figure 8 - the data centered on the 315 Hz to 6.3 kHz region. It also shows that the performance produced levels well above 90 dB across essentially the entire band, with large sharp spikes in the lower mids and again around 4 kHz.

It's a safe bet that this show left many in the audience with their ears ringing, and they were likely shouting at one another after the show to be heard while they looked for their cars, friends or the exit.



The senior citizens of our SPL derby - the boys from the '70s mainstream rock act - seemed extremely fond of 63 to 160 Hz and 630 Hz. (See **Figures 10 - 12**) Ladies and gentlemen, we have a new record! This band managed to get to 113 dB at least 10 percent of the time, and to 108 dB a good 50 percent of the time.



Figures 10 - 12: '70s rock act. Note the 98-plus dB vocal peak centered on 630 Hz. Figure 12 shows energy focused on the areas where it could do the most damage.

With a truly massive low-frequency mountain extending from 95 dB at 40 Hz (lots of subs in this rig!) to a chest-cracking 109 dB around 100 Hz, this performance was certainly felt by the audience. Note that there was a 98-plus dB vocal peak centered on 630 Hz to pound everyone's ears for at least half the show's duration.

If anyone could conduct a normal conversation after this show, I'd be amazed, unless, of course, hearing protection was worn.

Take another look at **Figure 12**. This was seriously and dangerously loud, and over a long period of time. The bell-curve-shaped primary spectrum shown in the graphs means that energy wasn't only high, it was focused on the areas where it could do the most damage. This show was a laser-guided cruse missile for hearing damage!

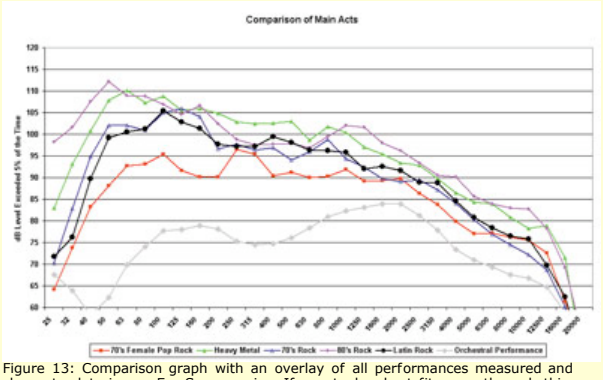


Figure 13: Comparison graph with an overlay of all performances measured and shown to date in our Ear Sense series. If you took a best-fit curve through this data, it would reveal a noise regulator's jackpot.

Finally, **Figure 13** offers a comparison graph with an overlay of all performances measured and shown to date in our Ear Sense series.

If you took a best-fit curve through this data, it would reveal a noise regulator's jackpot. Every show, except the orchestral performance, produced levels well beyond the action-inducing threshold we've set at 90 dB across the core bandwidth (315 Hz to 6.3 kHz).

We're not talking a dB or two - try 15 dB or more! If the current regulations in force under the EU (as well as those being implemented in the U.K.) were in place at this venue, each of these performances should have, and frankly would have, required health and safety authorities to take appropriate action.

Next time, we'll look at U.K./EU/ Global level standards and rules. Here's an appetizer: in the U.K., the Health and Safety Executive has cautioned those who own/operate pubs/clubs and similar facilities are at risk of harming employees, and potentially, patrons. More specifics are coming soon, and we'll be looking at how this current action may impact other global markets, such as North America.

Fred Ampel has been involved in the A/V industry for 33-plus years. His career has included work in sound reinforcement, broadcast, studio, A/V system design, installations and equipment development. He was also the founding editor/editorial director of S&VC magazine. Ampel heads up Technology Visions and can be reached at ***www.technologyvisions.com.***

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