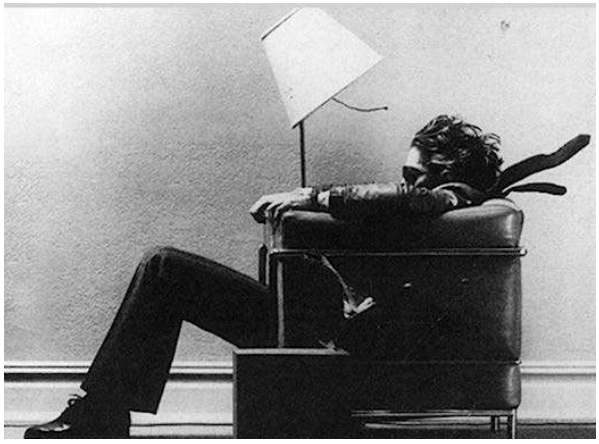
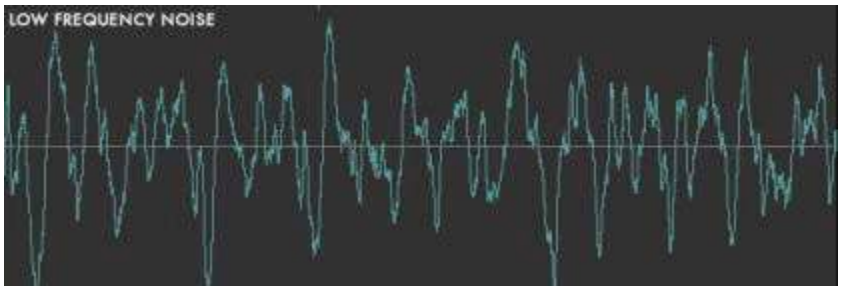
Steve Morgan on: Low Frequency Noise Identification and Mitigation



Low frequency noise (LFN) is generally defined on the Common Octave Bands as 250 hertz (Hz) or less. You might know it better as that chest-rattling thump of the bass from a car driving past with its music cranked. You can't really make out the song, but you can feel the beat in your chest. Or even as the pulse of the speakers at a concert that make you worry you're having heart palpitations. In short, LFN is *felt* more than it is heard.

LFN is to the noise world what the marathon runner is to athletics; it has long wavelengths (31.5 Hz, for example, is almost 35 feet long), high endurance, and will travel long distances. Compared to the high-frequency sprinter, a sound wave at 8000 Hz is only 1.65 inches long. The higher the energy, the quicker it dissipates.



In many ways, this makes LFN even more important to address. The vibration of LFN can get into nearby houses as the sound wave itself develops through the enclosure, having an adverse effect on the residents. For a community in close proximity to industry, LFN can pose a detrimental health risk while also increasing the likelihood of community complaints.

Though noise-induced hearing loss is a common concern relating to higher frequencies of noise, LFN is known to produce a number of negative physiological reactions (e.g.,

changes to blood pressure and heart rate, headaches, vertigo, sleep disturbance, difficulty breathing, anxiety) and subjective complaints (e.g., feelings of vibration, pressure, and annoyance), as well as mental and physical performance impairment (e.g., fatigue, irritability, lack of concentration).[1][2][3][4] LFN has even been found to physiologically affect both hearing and deaf participants in studies comparing the two, demonstrating that it is the cochlear stimulation of LFN that adversely affects those exposed to it in a manner unique from high frequency noise (HFN).[1]

Even if a site is equipped with noise control or meets regulations at its property line, the operator's risk of complaints may remain high due to the presence of LFN.

Unfortunately, LFN is often overlooked in newer noise regulations, for a number of intriguing reasons. Chief of these is the simple fact that, at the noise source itself, the LFN tends to be discounted in favor of the more obvious HFN. In auditory terms, the high-pitched 4000 Hz tone may be perceived as a squeak, while the lower-pitched 200 Hz tone would be perceived by the listener as closer to a hum. [1] LFN may not have the same high-pitched shriek of a fan that demands attention upfront, but it can be felt from far away and it is equally, if not more, annoying to those exposed to it, particularly over long periods of time. [2]

If standing in a compressor station, trying to identify by ear the loudest noise sources, more than likely it is the HFN that will garner the most attention, such as the pitch of a fan. Even though HFN stands out on site, these noise sources tend to have minimal effect on residents farther away, as it is the LFN—the marathon runner—that travels farthest and retains the most energy at a distance. When a complaint comes in from a resident that should have been marginally or not at all affected by a facility, more times than not this is symptomatic of a LFN issue.

As the noise regulations of jurisdictions mature, and industrial facilities come into compliance based on those regulations, LFN often becomes a greater concern. In those cases where there seems to be a continuous flow of residential complaints prompting regulators to dig deeper into the source of those complaints, LFN is frequently the common factor. Through continuous assessment of noise complaints, LFN is eventually addressed by environmental policies, as seen with such regulations as the Colorado Oil and Gas Conservation Commission's (COGCC) Aesthetic and Noise Control Regulations of the US[5] (i.e., requires a low

frequency Noise Impact Assessment when readings exceed 65 dBC) and the Alberta Energy Regulator's (AER) Directive 038 in Canada[6] (i.e., there is a potential 5 dBA penalty added onto the facility noise level when there is a LFN component). Both regulatory bodies identify LFN as an important consideration.

Noise Impact Assessments

Assessment of noise is the first step to attenuating it. This is one of many reasons why Noise Impact Assessments (NIAs) are integral to the implementation of effective noise control measures, especially in cases where LFN is a potential concern. NIAs assess dBA levels (standard A-weighting sound measurement) concurrently with dBC levels (LFN-specific C-weighted sound measurement) and help to identify all noises and their sources, including LFN. In this manner, the rumble of that generator that didn't seem like a big problem while standing next to it can be identified as a significant noise source at a nearby residence where the sound is spurring complaints. NIAs are extremely valuable in ranking noise sources, not just in regard to sound power levels, but also in identifying contributing frequencies at certain distances or receiver points.

The nature and behavior of low frequency wavelengths also make it more difficult to attenuate than its high-frequency counterparts. Low frequency sound waves take longer to develop and so can travel greater distances than HFN. In order to effectively attenuate LFN, the sound needs to be allowed to develop as fully as possible while enclosed. Because of size of the wavelength, it needs space to develop before it can be attenuated. Therefore, LFN requires large mufflers and cooler silencers to grant those wavelengths the space necessary to develop and then be attenuated—it is volume that is most imperative when attenuating LFN.

In conclusion, low frequency noise poses health risks for communities as well as complaint risks for industry. This is increasingly being addressed by noise regulations, and should be factored in when considering noise control measures on new or existing facilities. Identifying low frequency noise through a Noise Impact Assessment is the first step to successful mitigation. Noise control measures must also take into account the need for space and volume of machinery in order to most effectively attenuate low frequency noise—because when it comes to low frequency noise, size matters.

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About Steve Morgan

Steve Morgan is Executive Vice President at Noise Solutions, after serving as the company's Vice President Business Development since 2004. Steve has been part of the speaker rotation at Olds College in Alberta since 2012, specializing in business development and social media. He has written and facilitated a variety of leadership-training courses, and has been a keynote speaker at events for the Canadian Institute of Management and the Lone Star College's Continuing Education of Engineers Program. Steve lives in Alberta, Canada with his wife of 17 years.

Resources and Citations

[1] Passchier-Vermeer, W., Passchier, W.F. (March 2000). Noise Exposure and Public Health. *Environmental Health Perspectives, Vol. 108,* Supplement 1, 123-131. The Netherlands.

[2] Ising, H., Kruppa, B. (2004). Health Effects Caused by Noise: Evidence in Literature From the Past 25 Years. *Noise and Health: A Bimonthly Inter-Disciplinary International Journal, Vol. 6,* Issue 22, 5-13. Federal Environmental Agency, Berlin, Germany.

[3] Schust, M. (2004). Effects of Low Frequency Noise up to 100 Hz. *Noise and Health: A Bimonthly Inter-Disciplinary International Journal, Vol. 6,* Issue 23, 73-85. Federal Institute for Occupational Safety and Health, Berlin, Germany.

[4] Stansfeld, S., Matheson, M. (2003). Noise Pollution: Non-Auditory Effects on Health. *British Medical Bulletin, Vol. 68,* 243-257. The British Council, London, UK. doi: 10.1093/bmb/ldg033

[5] Colorado Oil and Gas Conservation Commission (COGCC) Aesthetic and Noise Control Regulations, 802.d (August 1, 2013). http://cogcc.state.co.us/RR_Docs_new/rules/800series.pdf

[6] Alberta Energy Regulator (AER) Directive 038: Noise Control, 3.5.2 and 4.1.1 (February 16, 2007). http://www.aer.ca/documents/directives/Directive038.pdf

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