



Andy Pearson

This article was published in ASHRAE Journal, November 2013. Copyright 2013 ASHRAE. Reprinted here by permission from ASHRAE at www.star-ref.co.uk. This article may not be copied nor distributed in either paper or digital form by other parties without ASHRAE's permission. For more information about ASHRAE, visit www.ashrae.org.

When is a Sound a Noise?

BY ANDY PEARSON, PH.D., C.ENG., MEMBER ASHRAE

Neil Diamond famously sang about “a beautiful noise” and the Psalms exhort us to “make a joyful noise to the Lord,” but in most cases involving fridge plants the noise is neither beautiful nor joyful.

Noise and vibration (next month's topic) are caused by movement. Strictly speaking, the former is movement of molecules in air (or sometimes some other fluid), and vibration is movement in solids. I like to think of the general audible movement of molecules as “sound;” it only becomes “noise” when someone objects to it. To support this, I note that we talk about “sound attenuation,” but refer to “noise pollution.” However, I fully accept that the terms are subjective and are often used interchangeably.

Good management of sound, to prevent it turning into noise, is as much about psychology as it is about physics. If the sound of a refrigeration system blends in with other background sounds then it is less likely to be noticed. However, if the plant suddenly switches on and makes an audible difference, it might attract complaints even if the sound levels are below the specified level—and in some cases even if they are below the general background level. This is particularly true if the sound is very “tonal”; in other words, if it is a pure note rather than a general wash.

The noise from road vehicles, trains or other random movements, even speech and music, tends to cover a wide range of pitch, but the noise from refrigeration plant is often close to a single note, and is typically right in the most sensitive part of our hearing. A tone against a broad range of background noise is likely to be noticed even if the background is up to four times louder, and an intermittent noise can be even more irritating.

The pitch of a noise—is it a high soprano or a low bass note—also has an effect on how it is perceived. Low pitched noises will travel far through the air without being scattered, but high pitches are more readily lost among the background. This is why you hear the tubas

and trombones of the marching band from the other side of the park, but not the trumpets, although they may be just as loud to the audience at the bandstand.

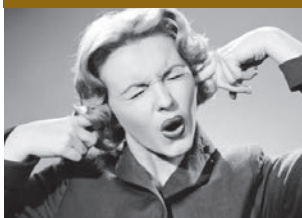
High-pitched noise escapes more readily through small openings in walls. It has a shorter wavelength than the low notes, so passes through smaller openings without so much distortion. Leaving a small window open can be as bad as leaving the whole door open if the noise pitch is high. We are most sensitive to noises at and slightly above the pitch of normal speech. Higher notes can be very annoying; lower notes are generally more tolerable even if they carry more energy than the high squeal.

There are many things that fridge plant designers can do to minimize the risk that the sound of their machinery becomes a noise. If the equipment is hidden from view it is less likely to attract complaints—and making the sound travel a longer path to the listener by erecting a screen has an additional benefit. If a screen is used it should preferably be close to the source of the noise; it will be

much less effective if it is halfway between source and listener. It should also be as tall as it can be; the further the noise has to travel (compared with “line of sight”) the better. If noise is tonal then pay special attention to the treatment of the tone, even if it is officially within specification. If variable speed equipment is used and switches to a different mode at a set time, then make the change gradually rather than in a single step.

In one case a neighbor complained because of noise at 11 p.m. It turned out that this was condenser fans stepping down from full speed to a lower “night-time” setting to reduce the noise, in compliance with the local regulations. It was the sudden change that made the fans noticeable, although they were quieter (and within specification) after the change. Once the variable speed controller was set to reduce speed gradually from 10:45 p.m. onwards, the neighbor was happy again. However, that was lucky because once a sound has been noticed it is usually treated as a noise, and it is difficult to get it unnoticed again. The answer to the title's question is “When it annoys!” ■

Not everyone appreciates Neil's latest CD.



Andy Pearson, Ph.D., C.Eng., is group engineering director at Star Refrigeration in Glasgow, U.K.