Fan Noise Reduction

Selecting the Most Cost-Effective Solution

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Maintaining acceptable noise levels can be a challenging balancing act for any facility, and reducing fan noise is often a key part of the solution. While there are multiple proven options for minimizing fan noise, each involves trade-offs among cost, convenience, efficiency and other factors. This paper will review some of the most effective strategies with the goal of optimizing all of these considerations.

For the purpose of this paper, “noise” is defined as sound that is loud, unpleasant or distracting. At low decibel (dB) levels, noise is merely a nuisance, but at higher levels it becomes a hazard that can make worker communication difficult, reduce productivity and cause permanent hearing loss.

Multiple factors contribute to fan noise. One source is aerodynamic noise, created by blades churning the air and moving it through housings and ductwork. All the mechanical bits spinning inside the fan also create a lot of sound vibration; these include bearings, motors, drive belts and other air system components.

Environmental factors

Fans create noise-reduction challenges, whether they are located indoors or outside. In enclosed spaces like buildings or pits, sound waves bounce off walls and other obstructions, resulting in higher decibel levels than in open environments. Yet, while sound dissipates more outdoors, it also travels further, creating a potential nuisance for neighboring buildings or communities. Everything from the elevation of the installation to the number of walls, the materials sound waves encounter and the foundations under some fans must be taken into account.

The challenge of measuring noise

These and other factors make it nearly impossible to make field measurements of exactly how much noise is coming from any individual fan. The total sound level can be influenced by building architecture, other equipment and nearby sounds in the ambient air, such as highway traffic, other local buildings and even wildlife. Changes in temperature, humidity and atmospheric pressure cause measurements to vary significantly, especially if they are taken days apart.

For this reason, each fan's dB rating is best determined by its manufacturer under controlled conditions prior to installation. The Air Movement and Control Association (AMCA) sets the industry standard for noise testing and ratings. AMCA certification provides a benchmark for fans to be compared equally.

Remember: Decibels are measured on a logarithmic scale, so a drop in 10 dB will be perceived as half as loud.

How much noise is acceptable?

To prevent worker hearing loss, Occupational Safety and Health Administration (OSHA) regulations set the maximum acceptable noise level for work environments at 80 dB. That said, some facilities need to meet much more stringent standards. Noise targets as low as 50 dB are not unusual, especially on sites located near residential areas or other businesses. Lower noise levels may also be desirable if workers regularly need to communicate freely in areas near equipment.

In some cases, fans come directly from a manufacturer with a sound-reducing fiberglass housing that offers a first line of defense. In such cases, the fan's published sound rating already takes this reduction into account. If lower sound levels are still necessary, they will likely involve one or more of the solutions detailed in the next section.

Sound-reduction strategies

ENCLOSURES

Full sound enclosures are insulated structures — almost miniature buildings — that fit over the fan itself. A well-built enclosure will reduce the noise level by 50 percent or more, even to the point that the fan may not even be audible on the outside.

Some enclosures are also equipped with silencers on the fan's inlet, outlet or both. A silencer works much like the muffler of a car to lower the sound of airflow in and out of a fan. Depending on the level you need to achieve, silencers can reduce the noise of an enclosed fan even further if necessary. Silencers are not needed in every case, e.g., if both the inlet and outlet are connected to shielded ductwork, or if an acceptable level can be achieved with the enclosure alone.

With or without silencers, enclosures offer the maximum level of achievable sound reduction. While this is a significant advantage, it also comes with trade-offs that must be weighed on a case-by-case basis.

Cost is a major consideration; it's not uncommon for an enclosure to cost more than the fan itself. As a result, enclosures are typically used only when no other solution can provide the level of sound reduction required.

Enclosures also require a lot more space. Those designed to be removed for maintenance can easily double the footprint of smaller fans. Larger enclosures typically aren't removed, so a minimum of two to three feet of clearance must be left around the fan for maintenance access. This can easily increase the footprint of larger fans by 30 percent or more. In some cases, enclosures aren't an option if the extra space needed isn't available.

Some enclosures are also inconvenient for maintenance workers, requiring them to work in confined spaces or remove a heavy enclosure entirely. If the fan is still running during maintenance, some other form of ear protection will be required while working inside an enclosure.

Pro

- Maximum achievable sound reduction — up to 50 percent or more

Cons

- Most expensive sound reduction solution
- Larger footprint
- Can create maintenance challenges

Business Case

If you need to reduce fan noise by more than 15 dB, an enclosure may be the only viable solution. In such cases, it's worth the extra cost and other trade-offs to achieve your target sound level.

SOUND BLANKETS

One level down from full enclosures are insulated fabric covers known as "sound blankets". Custom-formed for each individual fan and held in place with VELCRO® strips, they can typically lower sound levels by 10 to 15 dB.

While this level of reduction is more limited than enclosures can offer, sound blankets are less expensive and take up far less space. They can also be used on ductwork for additional reduction.

The primary disadvantage of sound blankets is that they must be removed and replaced whenever maintenance is performed. This can involve removing many pieces of heavy fabric just to get access to the fan. Replacing the sound blanket can also be a challenge, since all of the fabric pieces must be precisely aligned in order to reduce the sound properly.

SOUND BLANKETS *continued*

Pros

- Less expensive than full enclosures
- Minimal footprint

Cons

- Offer less sound reduction than enclosures
- Cumbersome to remove and replace
- Must fit the fan precisely to be effective

Business Case

Sound blankets offer an excellent compromise if you only need sound reduction of 10 to 15 dB, or don't have enough space for an enclosure.

SOUND-REDUCTION WRAPS

Gluing plastic foam to the housing of a fan can provide additional reduction of around 10 dB. This foam is only one-quarter to one-third of an inch thick and can be cut into whatever shapes are necessary to preserve access to panels, screws and other housing parts.

While sound-reduction wraps aren't attractive, they're cheap and efficient. They create few challenges for maintenance workers without significantly increasing the footprint of the fan. Sound-reduction wraps can also be combined with other solutions to provide further reduction if an extra 10 dB or so are needed to achieve your sound target.

One drawback of sound-reduction wraps is motor noise, because the foam can only be glued to the housing, not to the motor itself. As a result, sound-reduction wraps can't block motor noise as well as other solutions can.

Pros

- One of the least expensive sound solutions
- Allows easier access to fan components
- Minimal footprint
- Can be combined with other solutions

Cons

- Minimal sound reduction
- Won't shield motor noise

Business Case

When limited sound reduction is needed (about 10 dB), sound-reduction wraps offer a cost-effective and hassle-free solution.

Other strategies

In addition to the three major solutions discussed herein, the following strategies can also be useful in limited situations.

EAR PROTECTION

Earplugs and earmuffs provide personal hearing protection that moves with the worker. While this can be effective when other solutions are impractical, no form of ear protection can completely eliminate sound. Ear protection also makes communication between workers challenging.

The biggest drawback, however, is compliance. People simply don't like wearing them, and will even work without them in areas that are loud enough to cause permanent hearing loss. For this reason, ear protection is best used as a last resort when no other solution is practical, or as a backup method, e.g., when workers perform maintenance inside an enclosure.

FAN SIZE OPTIMIZATION

Fan noise is frequently associated with the number of revolutions per minute (RPM) a unit makes. Since smaller fans must usually spin faster to move the same amount of air, a larger fan requiring fewer RPMs may produce less noise. Air density may also be a factor when selecting fan sizes, e.g., a site in Denver may require less fan power than one in Houston.

The obvious trade-offs are that larger fans need more space and are likely to be more expensive. Depending on the situation, the amount of reduction may also be minimal, but may be worth considering if you're just a few dBs away from the desired level.

LIMITED ACCESS

Sites that have some flexibility can choose to locate fans in areas where they will not be in close proximity to workers or may be shielded from surrounding buildings by walls or natural features. Using limited access as a form of engineering control may allow fans to operate with less reduction or none at all, apart from ear protection when maintenance workers enter the area.

This solution is not always practical because fans must frequently be located in a particular place. It may also be impractical in situations where fans require frequent maintenance.

INNOVATIVE BLADE DESIGN

Most fan manufacturers use blades with a backward curve. Hartzell's airfoil blade, available in fiberglass centrifugal fans, provides more efficient airflow using less energy. While this design offers only incremental improvement to sound levels, every potential source of noise reduction can help you reach your goal.

Find the right solution for your site

We understand that you have many factors to consider and selecting the right solution for your site can be challenging. Hartzell noise-reduction experts are available to advise you on the most cost-effective solution for your facility. Hartzell offers all of the major proven sound-minimizing solutions detailed in this paper, including sound-reducing fan housings, enclosures, blankets, wraps, and more. Contact your local Hartzell representative for additional information.

Hartzell-FLOW® Fan Configurator

Calculating noise levels when trying to spec the right fan can be complicated. The Hartzell-FLOW fan configurator can help you identify and design the right fan for your site, while also factoring in noise level requirements. You'll get an exact drawing plus data and details to drop directly into your blueprints.

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