DEMYSTIFYING Acoustic Doors

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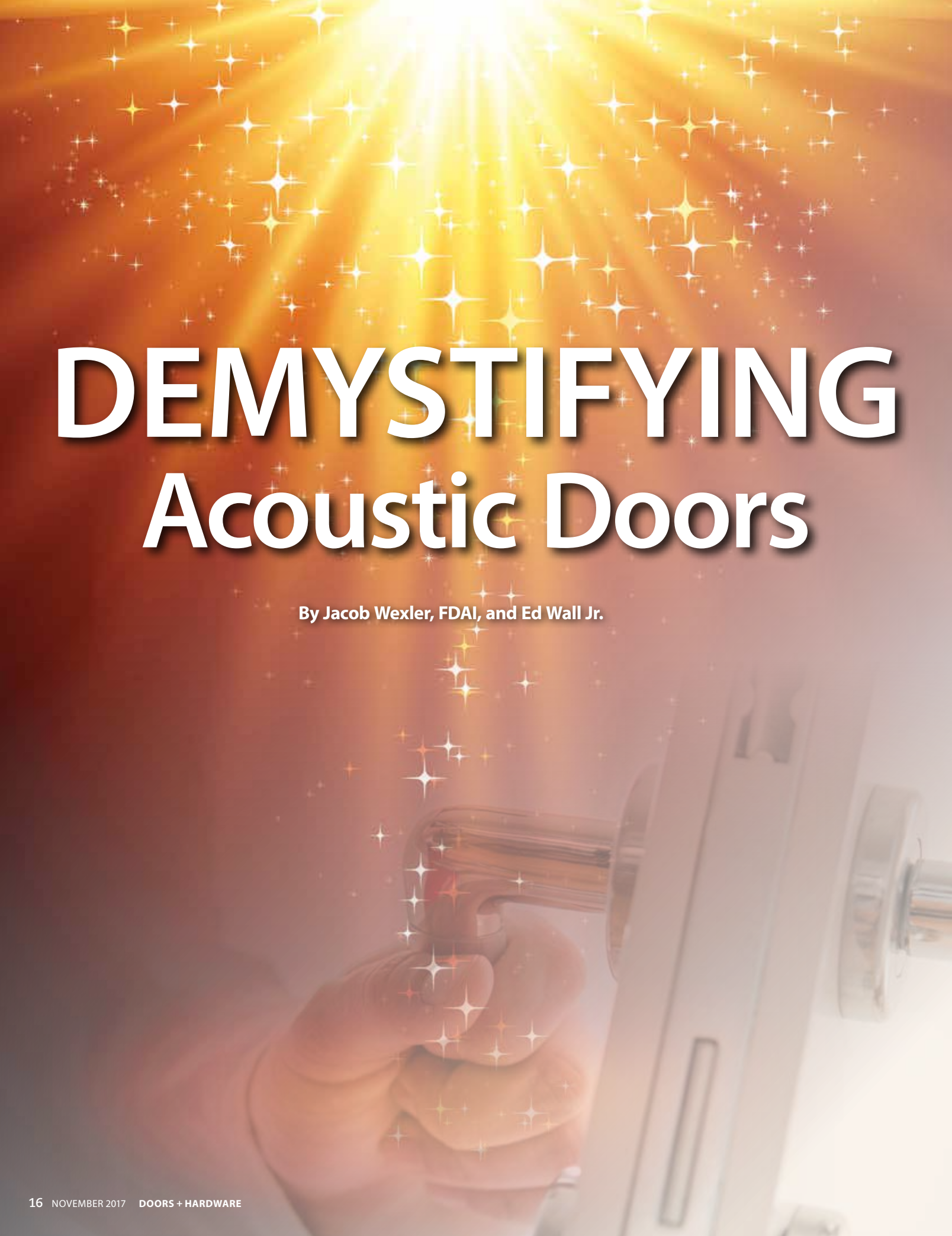

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From delayed recovery times in hospitals to decreased scholastic performance in schools, ineffective sound control can have measurable negative impacts on our lives. Our burgeoning understanding of these effects, combined with a growing need to protect privacy in almost every type of facility has resulted in considerable increases in both the demand and requirements surrounding acoustic control. Unfortunately, as these continue to grow, so do cost-cutting measures that over-promise and under-deliver.

Because the liability for ineffective sound control can fall on the contractors, distributors and specifiers involved in a project, it's vital to understand how acoustic doors function, how they are tested and rated, how crucial gasketing is to preventing sound transmission and why the growing trend of swapping out components in tested acoustical door assemblies is never a good idea. In this article, we will review some of the more common reasons for inefficient or ineffective sound control and offer advice on how to specify the products necessary to meet client needs and privacy requirements.

The Science of Sound

The complexity of sound is the reason why specifying acoustic doors is so difficult. Preventing the transfer of sound through door openings—specifically through clearances and gaps around doors—requires specialized expertise and quality materials to be successful.

Put simply, sound is vibrations in the air moving in waves. The rate of sound pulsations measured in cycles per second is called frequency—also known as hertz (Hz). The range of human hearing is considered to be 20 to 20,000 Hz. Sound pressure levels are measured in decibels—or dB. The scale of measurement used to simulate sound across the audible frequency range is denoted as dBA. It is important to understand the human ear perceives changes in loudness caused by even small changes in those levels. Each 10-dB increase doubles the sound reception. In other words, a noise registering at 60-dB is twice as loud as a noise at 50-dB, but only half as loud as it would be at 70-dB.

When sound comes in contact with a door, some of the energy from the vibrations transfers to the door. The resulting vibrations in the door itself set the air in motion on the other side of the door, creating more sound vibrations.

A door's ability to resist the passage of sound waves is determined by its mass, damping and stiffness. The greater the mass, the less sound is transmitted through the barrier. Sound vibrations can be reduced using damping materials, which are typically limp-mass materials. Damping material is sometimes used as core material in doors designed to provide the highest levels of sound control.

The stiffness of the barrier is also a factor in sound transmission. Although more flexible barriers transmit less sound, for practical reasons, acoustic doors are generally manufactured from very dense, stiff materials such as wood or steel with stiffness and barrier batts added to any hollow cavity inside the door. The resulting effectiveness of sound-control doors varies with different combinations of materials.

Understanding the STC Rating

Because so many different types of materials are used in acoustic doors, effective comparisons of different styles require the use of a rating system. When evaluating the performance of acoustical doors, the degree of effectiveness is measured in sound transmission loss or TL. TL is determined by measuring sound pressure levels at a given frequency in the source and receiving rooms. The adjusted difference between the two levels is the TL of the door. The higher the TL, the better the result.

The TL of a door is measured over 16 different frequencies, and the average of those values is used to determine the sound transmission class (STC) rating of the door. The higher the STC value, the better the rating with 30 considered to be the industry minimum for an acoustical door.

Specifying an STC rating sounds pretty straightforward, in the same way a one-, two-, or three-hour fire door is selected. But the appearance of simplicity is precisely why so many acoustic installations are inefficient, being either over-specified and unnecessarily expensive, or underspecified and ineffective. This is because STC values are not proportionate units of measurement. To continue reducing sound transmission—that is, to achieve increasingly higher levels of sound control—each 10-dB increment requires 10 times as much improvement as the one before. While door openings rated in the range from STC 30 to STC 40 are common, achieving STC 50 and higher ratings is extraordinarily difficult.

It is also important to understand the process of determining a door's STC rating. Acoustic doors are tested under optimal conditions, and field performance will vary. They are first tested in a fixed condition—i.e., sealed in place when sound is applied and recorded. This step determines the STC value of the door itself. The second phase of testing requires the door to be operable.

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All sealants are removed before sound is applied, so the resulting operable STC rating indicates a more accurate measure of the door's performance in an installed environment.

A reputable acoustic door manufacturer will always quote STC ratings as operable or clearly indicate which condition applies, but some manufacturers are still furnishing their STC ratings only as sealed-in place, which is misleading. When decisions are made based on those practices, disappointments are inevitable. Because "operable doors" means dealing with gaps, acoustical gasketing is the critical element to ensure that performance in the real world comes as close as possible to the theoretical STC value of the sound door.

Gasketing is Crucial to Success

When acoustic doors fail to deliver the appropriate amount of sound control, the first instinct is often to install a door with a higher STC rating. One of the primary reasons controlling noise leakage is so challenging is because of how easily sound waves travel through any opening with very little loss. No matter how small the gap may be, it will allow almost as much sound to travel through as though the door were open.

The more effective way to address this problem is not to install a more expensive door with a higher STC rating, but to eliminate any unsealed gaps or clearances in the existing door assembly using high-quality acoustical gasketing. Without proper gasketing, even the most highly rated STC door will be largely ineffective at blocking sound.

Of course, on the other side of this problem are those who would attempt to save money by installing high-quality acoustical gasketing on a door that is not STC-rated. While this method will yield nominal improvement in the amount of sound traveling through the opening, it will be insignificant compared to the results of pairing the proper gasketing with the appropriate STC rated door.

It's important to remember that, as with any products, there are significant variations in quality materials and designs. Lower-quality gaskets will deliver lower-quality results that will be measured in disappointing STC performance. Designers and consultants should ensure that only high-quality gaskets are used with their sound control systems. Compression seals extruded from high-quality neoprene are essential for basic gasketing integrity, and supplemental seals can be invaluable in helping compensate for the effects of commonplace variances in installed clearances.

In assessing gasketing quality and design for optimum durability and service life, as well as STC performance, look for:

- Good-quality neoprene with consistent density and solid footing in gasket housings.
- Consistent quality in the housings themselves and any moving mechanisms.
- Adjustable features to offset alignment problems and help compensate for less than perfect frame installation are important. Available adjustable solutions range from high-end special profile door frames with kerfs for uninterrupted C-fold type gasketing, or cased open profile using built-in gasketing as stops, to lower-end designs with standard hollow metal profiles.
- Mounting brackets and other options designed to eliminate the need to cut into gasketing when installing closers or other hardware items. In all cases, providing precise guidelines for required components will minimize the potential for errors due to inferior materials or mismatched components.

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Avoid Alterations

The most effective way to ensure proper performance of acoustical assemblies in the field is to minimize the variables that can impact the functionality of the door. Engineered door assemblies with acoustical gasketing, tested as a unit, provide full accountability through a single manufacturer and its installers because all components are engineered and tested as one system. This can be particularly useful for high-demand sound control, as well as all applications where performance to precise STC levels is needed.

However, as competition and demand for these products continue to increase, there have been a growing number of reports of alterations and actions that are extremely likely to compromise the performance of acoustical door assemblies. Components are increasingly being substituted, and distributors are quoting rated acoustical doors with components that have not been tested with that assembly. In some extreme cases, STC ratings are based on testing with inoperable assemblies or outdated test reports.

Acoustical professionals recognize that mix and match is bad business practice when applied to engineered sound solutions. Accepting substitutes for any component in a rated acoustical assembly could easily lead to unacceptable noise levels. The ongoing costs of occupant and owner dissatisfaction will far exceed any short-term savings from misapplied "value engineering" during building construction or remodeling.

To avoid these potentially costly compromises and substitutions that can jeopardize performance, specifiers should follow these five rules:

1. Doors must be supplied as complete, integrated assemblies, along with certified test reports – no substitutions.
2. To be of practical value, STC ratings must be based on testing with assemblies that are operable – not sealed in place.
3. View test results older than five years with caution, because even tested products change.
4. Require installation by a certified professional installer.
5. Include requirements for field sound tests in project specifications.

Conclusion

Controlling and eliminating noise from traveling into or out of a room remains one of the most difficult challenges in this industry. Utilizing quality products and partnering with a professional sound engineer on highly sensitive projects can ensure the end result is successful and avoid costly repairs. ■

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