Addressing Sound Masking Requirements in the National Fire Alarm and Signaling Code® and UL Standards

Wayne D. Moore, P.E., CFPS, SET
Vice President
JENSEN HUGHES
117 Metro Center Boulevard, Suite 1002
Warwick, RI 02886
T. 401-736-8992
Email: wmoore@jensenhughes.com

About the Author

Wayne D. Moore, P.E., CFPS, SET, FSFPE, F. NSPE

Wayne Moore is a licensed professional fire protection engineer and is a Vice President with the fire protection engineering and code-consulting firm, JENSEN HUGHES. He is located in the firm's Warwick, Rhode Island office. He currently serves as a member and former Chairman of the NFPA 72-2016 *Emergency Communications Systems* (ECS) Technical Committee and is the Editor/Co-Editor of five editions of the *National Fire Alarm Code Handbook*®. In December of 2012, NFPA published his new book, "*Designing Mass Notification Systems – A Pathway to Effective Communications*". He is the 2009 recipient of the NFPA *Standards Medal* and the 2012 Recipient of the AFAA Lifetime Achievement Award.

Executive Summary

NFPA 72-2016, *National Fire Alarm and Signaling Code*® is the document that regulates the installation of fire alarm systems and all emergency communications systems (ECS), including mass notification systems (MNS). The scope as defined in the *Code* states "*NFPA 72* covers the application, installation, location, performance, inspection, testing, and maintenance of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment and emergency communications systems (ECS), and their components."

Additionally, the purpose of the Code is "to define the means of signal initiation, transmission, notification, and annunciation; the levels of performance; and the reliability of the various types of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment, emergency communications systems, and their components." NFPA 72 is silent on and has no requirements for sound masking systems. There is some confusion regarding the application of mass notification systems (MNS) and the interface between a sound masking system and an MNS. NFPA 72, *National Fire Alarm and Signaling Code*® does not regulate Sound Masking Systems.

This Tech Note will provide an awareness level of information about NFPA 72 as well as how the Code integrates with the UL requirements found in ANSI/UL 864, *Standard for Control Units and Accessories for Fire Alarm Systems*, 9th edition, 2003, revised 2012. (UL 864) and ANSI/UL 2572, *Mass Notification Systems*, 1st edition, 2011, revised 2012 (UL 2572). Additionally, it will be shown that sound masking systems are not required to comply with UL 2572 or UL 864 when a sound masking system is interfaced with an MNS or a fire alarm system. A summary of Code requirements as they apply to sound masking systems interface will also be presented.

NFPA 72-2016, *National Fire Alarm and Signaling Code*®

NFPA 72-2016, *National Fire Alarm and Signaling Code*® is the document that regulates the installation of fire alarm systems and all emergency communications systems (ECS), including mass notification systems (MNS).[1]

The scope as defined in the *Code* states "*NFPA 72* covers the application, installation, location, performance, inspection, testing, and maintenance of fire alarm systems, supervising station alarm systems, public emergency alarm reporting systems, fire warning equipment and emergency communications systems (ECS), and their components."

The Code has 15 chapters and 8 annexes covering all of the enforceable requirements in the chapters and the annexes contain guidelines or background information for the Code user, but this information is not to be confused with the chapter requirements and is unenforceable.

Users of NFPA 72-2016 should be aware that this Code is only enforced when a ECS is required by the building code in force in the jurisdiction. All of the chapters, with the sole exception of Chapter 29, *Single- and Multiple-Station Alarms and Household Fire Alarm Systems*, contain relevant requirements that are to be used for all fire alarm and emergency communications systems. In other words, the chapters do not stand alone. This is an important concept to understand as many first-time users of the Code often will look at the chapter they think applies to their application and do not recognize that the following statement occurs in all of the chapters, "**24.1.3** The requirements of Chapters 7, 10, 12, 17, 18, 21, 23, 26, and 27 shall also apply unless otherwise noted in this chapter." I have used the requirement from Chapter 24, but as previously mentioned, a similar statement appears in all of the other chapters with the exception of Chapter 29.

[1] NFPA 72-2016, *National Fire Alarm and Signaling Code*® is available from the National Fire Protection Association at www.nfpa.org.

Users of the Code generally refer to Chapter 24, *Emergency Communications Systems* (ECS) when reviewing requirements for MNS. Mass notification systems are not required by building codes. However, when an MNS is to be installed, the system installation is required to follow all of the requirements of NFPA 72.

For example, all ECS systems (including MNS) must ensure the following is complied with:

"24.3.1.1* Emergency communications systems shall be capable of the reproduction of prerecorded, synthesized or live (e.g., microphone, telephone handset, and radio) messages with voice intelligibility in accordance with Chapter 18."[2]

The asterisk next to the section number means there is additional guidance (not requirements) in Annex A. See below as an example of typical Annex material.

> "A.24.3.1.1 In certain situations, it is important to provide a distributed sound level with minimal sound intensity variations to achieve an intelligible voice message. This differs from past fire alarm design practice that used fewer notification appliances but with each having greater sound pressure output levels. Nonemergency system design practice is to use more speakers and less sound intensity from each speaker.
> Besides improving intelligibility of the message, this approach minimizes annoyance to building occupants from the system and lessens the likelihood of tampering with the system by occupants because of speakers being too loud. In other applications, such as outdoor signaling where reverberation is not a problem, intelligibility can be achieved by using fewer appliances or clusters of appliances covering larger areas. Intelligibility is a complex function of the source audio, the acoustic response of the architectural features and materials of the immediate vicinity, and the dynamics created by the room's occupants. Refer to Annex D for more information on speech intelligibility and how it is predicted. Spacing speakers closely can be an intelligibility-enhancing technique but can occasionally lead to opposite results when improperly designed.

[2] NFPA 72-2016

> There are several techniques using directionality features that do not use closely spaced speakers but rather use the room/space acoustic response in their favor."[2]

To ensure that all non-required (i.e., voluntary) ECSs are installed properly, the following requirements apply:

"24.3.4.1 Nonrequired emergency communications systems and components shall meet the requirements of this chapter."[1]

The intent of section 24.3.4.1 is to ensure that if a user, owner or facility director decides to install a new MNS or upgrade an existing sound system to serve as an MNS, then all of the applicable Code requirements must be followed.

Many specifiers and users who are unfamiliar with the Code will misstate requirements found in the Code. For example, Section 24.3.10 states "Control units installed as part of a mass notification system shall be in compliance with this Code and at least one of the following applicable standards:

> (1) ANSI/UL 864, *Standard for Control Units and Accessories for Fire Alarm Systems*
> (2) ANSI/UL 2017, *Standard for General-Purpose Signaling Devices and Systems*
> (3) ANSI/UL 2572, *Mass Notification Systems*.

And the material in the annex for section 24.3.10 clarifies that, "A fire alarm control unit that is listed in accordance with ANSI/UL 864 or ANSI/UL 2017 can be used for MNS. A control unit only listed in accordance with ANSI/UL 2572 or ANSI/UL 2017 cannot be used as a fire alarm control unit"
In accordance with Chapter 10, section 10.3.1, the equipment that is connected to be included in the design and operation of one of the above listed systems must also be listed for the purpose for which it is installed. This section does not require equipment to be listed that is not acting as part of a MNS. Any building equipment that is simply shut off (like an HVAC fan or building management system or sound system) or silenced in any fashion in

order to ensure the correct operation of a fire alarm system or MNS is not required to be listed.

Additionally, whenever an MNS is to be installed or an existing system is converted to an MNS application using another system, such as a paging system, NFPA 72 requires that a Risk Analysis be performed. The risk analysis is to ensure the MNS is installed to the specific nature and anticipated risks of each facility for which it is designed. Chapter 24 provides some specific criteria and/or limitations to a risk analysis and provides some suggested potential event questions to help the owner and designer better understand the direction the MNS should take regarding responses to those events. In other words, the systems will not be designed using a salesperson listing out equipment to meet what they think the MNS should look like. For example, here are some of the questions from NFPA 72 that a designer might ask the owner of a property:

(1) What is the type of emergency event?
(2) What is the urgency of the emergency event?
(3) What is the anticipated or expected severity of the emergency event?
(4) What is the certainty of the emergency event is likely to occur?
(5) What is the location of the event, or from what direction is the emergency event?
(6) What zone or areas should receive the emergency message?
(7) What is the validity of the emergency event?
(8) What instructions should we send to our personnel?
(9) Are there any special instructions, procedures, or special tasks that we need to remind personnel about or to accomplish?

Not all of these questions will be applicable to every MNS design however they provide a general idea of the information needed to accomplish an effective design. The important thing to remember with any MNS design is that the correct response must be made by the occupants based on the information provided and this risk analysis must consider both fire and non-fire emergencies when determining risk tolerances for survivability for the mass notification system.

Survivability is required for In-Building Fire Emergency Voice/Alarm Communications Systems (EVACS). Survivability means that the wiring to each floor will continue to operate the system during a fire condition that is impacting the cable. UL Lists cable for this purpose to survive a fire of 1800 degrees Fahrenheit lasting for a 2-hour duration. Survivability is only required for an MNS when the risk analysis shows that it will be necessary, hence the requirement for the risk analysis anytime an MNS is to be designed.

Specifiers and users should understand that an MNS is not simply an equipment solution. In addition to the risk analysis, the messaging to be used for each risk associated with the system must be addressed. To help with understanding how to develop the correct message for each risk to be addressed by the MNS, the technical committee for Chapter 24 added Annex G, *Guidelines for Emergency Communication Strategies for Buildings and Campuses*. For those unfamiliar with the correct method to develop messaging for an MNS, the material in Annex G is based on the National Institute of Standards and Technology (NIST) and Fire Protection Research Foundation Research *Guidance Document: Emergency Communication Strategies for Buildings*, by Erica Kuligowski, Ph.D. and H. Omori, 2014.

Hopefully by now, you have recognized the importance of understanding what NFPA 72-2016 requires and the fact that partial quotes from, or references to the Code may, and can be, both inaccurate and misleading.

The sections of the Code referenced or quoted herein were simply examples of some of the details that one must address when designing and installing an MNS. If you are going to design and install an MNS, then it certainly makes sense to own a copy of the *National Fire Alarm and Signaling Code*® and you can visit the National Fire Protection Association's website (www.nfpa.org) to purchase your own copy.

ANSI/UL 2572, *Mass Notification Systems*

One of the Underwriters Laboratories documents refenced for MNS by NFPA 72-2016 is UL 2572. UL tests equipment submitted for an MNS based on the requirements of NFPA 72 and its expected or designed use. There are other nationally recognized laboratories that can perform the testing to the UL Standard 2572 and those listings are of course, specific to MNS as described above.

What is important to understand about the listing of a product, either for fire alarm or mass notification use, to any UL Standard is that the product must be installed in accordance with NFPA 72.

Sound Masking Systems and NFPA 72

As you may perceive from the above discussion, designing and installing an MNS is a totally different undertaking and has a totally different operational result than a sound masking system. NFPA 72 specifically does not address sound masking systems. When any emergency communication system needs to reduce the ambient noise levels, it is done so to ensure that the signals produced by the ECS will produce a sound level "at least 15 dB above the reduced average ambient sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds after reduction of the ambient noise level, whichever is greater, measured 5 ft. (1.5 m) above the floor in the area required to be served by the system using the A-weighted scale (dBA)."[3]

Sound masking is defined as the introduction of a continuous, engineered spectrum of broadband sound, similar to the sound of airflow, into an environment to reduce the perceived intelligibility of speech.

When a sound masking system is present and operating at the normal sound levels of approximately 48 dBA, there may be a need to shut down the sound masking system. This is typically performed using a relay to operate when the ECS operates so that the relay would disengage the sound masking system. However, sound masking does not impede or normally effect the intelligibility of emergency notification systems. Also, the

[3] NFPA 72-2016, Chapter 18, section 18.4.3.1

decibel level of sound masking is not loud enough to interfere with mass notification broadcasts.

If there is something in the protected area, like a music system, PA system, non-voice fire alarm system, or sound masking system for example, that is producing ambient noise that may interfere with the occupants hearing and understanding messages from either a fire EVACS or an MNS, then that noise producer must be shut down. It may not be necessary to shut down the sound masking system. Whether the sound masking system needs to be controlled by either the Fire EVACS or MNS can be determined through sound measurements as necessary. The requirement to control the ambient noise came from the environmental issues found in nightclubs for example, where the noise levels can approach the threshold of pain.

This interface and operation does not require the system or device that is being controlled by a relay (normally integral with the fire alarm system or MNS control unit) to be UL listed to either ANSI/UL 864, *Standard for Control Units and Accessories for Fire Alarm Systems* or ANSI/UL 2572, *Mass Notification Systems*.

According to NFPA 72, “Relays, circuits, or interfaces necessary to stop or reduce ambient noise shall meet the requirements of Chapters 10, 12, 21, and 23[4] which generally means there must be some way to ensure the relay, circuit or interface is in place and working. But it does not mean that the system being controlled by the relay (such as an HVAC, building management system or sound masking system) is required to be UL Listed for either UL 864 or UL 2572. As stated above, the relay integral with the system control unit is required to be monitored for integrity but there are no requirements for the controlled system, such as a sound masking system, to be listed in any fashion as a fire alarm system or an MNS.

[4] NFPA 72-2016, Chapter 18, 18.4.3.5.3

Based on the current edition of UL 2572[5], "Section 33.16 Systems or equipment arranged to stop or reduce ambient noise shall comply with monitoring for integrity requirements in 40.4, Common Performance and Monitoring for Integrity, Section 41, and with other applicable requirements of this standard." It should be noted that UL 2572 does not reference sound masking systems

Conclusion

NFPA 72, *National Fire Alarm and Signaling Code*® does not regulate Sound Masking Systems. NFPA 72 does regulate all fire alarm systems and emergency communications systems, both In-Building Fire Emergency Voice/Alarm Communications Systems (Fire EVACS) and In-Building Mass Notification Systems (MNS). Sound masking systems are not referenced by name in the Code and are not considered an integral part of an MNS or a Fire EVACS.

NFPA 72 does require that all ambient sound levels that could interfere with the intelligibility or audibility of a fire EVACS or MNS shut down automatically by the control units of the MNS or Fire EVACS system. Typically, these other systems may be defined as Emergency Control Functions. Emergency control functions are meant to be observed functions, not equipment or devices. Examples of emergency control functions are fan control (operation or shutdown), smoke damper operation, elevator recall, elevator power shutdown, door holder release, shutter release, door unlocking, activation of exit marking devices, and so forth. Fans, elevators, smoke dampers, door holders, shutters, locked doors, or exit marking devices themselves are not emergency control functions. Sound masking systems are not listed as an emergency control function, however, depending on the ambient noise levels measured in the occupied spaces, the MNS or Fire EVACS control unit may be arranged to shut down the sound masking system.

The sound masking and other building systems like HVAC are controlled by an integral relay in the MNS or Fire EVACS system control panel that provides the controlled shut

[5] UL2572 – 2nd Edition

down as needed. When shut down occurs, the system being controlled by the MNS or Fire EVACS is not required to be listed to UL 864 or UL 2572.