
Achieving Intelligibility for ECS

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Introduction

- Associate Professor of Fire Protection and Safety Engineering Technology
 - Teach courses primarily related to life safety and fire alarms
 - In charge of MS program
- Professional activities
 - NFPA101 and NFPA72 Technical Committees
 - SFPE
 - Research Roadmap
 - Human Behavior
 - Others



Learning Objectives

- Distinguish between audibility and intelligibility
- Explain appropriate applications of ECS
- Apply effective design considerations



Requirements

- Provides more information
 - Better response
- Depends on occupancy
 - Number of people
 - Limited abilities



Voice Notification

- Pre-recorded
- Live
 - Message templates
 - Overrides pre-recorded message
- Zoned
 - Acoustically distinguishable spaces
- One-way
- Provides instructions to occupants
 - Message
 - Attention
 - Source
 - Event
 - Actions
 - Actions
 - Evacuation
 - Area of refuge
 - Defend in place



ECS

- NFPA 72 Chapter 24
- New as of 2010
- Before, everything fire hardened
- Need ability to have security override
- Protection of life
- Not just for fire
- Message must be intelligible
- Can use nonlisted if needed



ADS

- Acoustically Distinguishable Space
 - A notification zone that might be an enclosed or other physically defined space distinguished from other spaces because of different acoustical characteristics such as reverberation or ambient sound levels
 - Areas less than 400 ft.² will simply be defined by the walls
 - In larger areas, change and ceiling height, acoustical finish such as carpet instead of tile would require the area to be defined as a separate ADS
 - Should be an area of consistent size and materials
- Coordinate with other design subject experts to ensure intelligibility can be achieved



Intelligibility

- Acoustically Distinguishable Spaces (ADS)
- Building environment
- Speaker type and location
 - Fewer, smaller usually better
- Testing
 - Stipa signal http://www.studiosixdigital.com/support/downloads-2/stipa-looplong1pt1_44k.wav
 - Trained listeners
 - Can it be understood



Conducting Tests

- Test when an area is occupied and when ambient sound level is near expected maximum
 - This is preferred
- The choices of testing in occupied areas is based on convenience versus disruption of normal use of the space
- Unlike audibility testing, intelligibility testing is less likely to contribute to the “Cry Wolf syndrome”
 - The test signal is not the same as the evacuation tone which would be sounded throughout the test of a tone signaling system



Intelligibility Requirements

- Intelligibility is first determined by ensuring that all areas have the required level of audibility
- Not required to meet the audibility requirements of tone alarm signals
 - Why?
- Certain areas may not have intelligibility requirements
 - Private bathrooms
 - Mechanical or electrical equipment rooms
 - Kitchens
 - Closets



Design

- The quantity and spacing of speakers
- Many system designers design a space using the same number of speakers as they would horns for a basic tone-only fire alarm design
 - Or use combination speaker-strobes wherever a strobe is required.
 - Neither method addresses the real factors that affect speech intelligibility
- If your ear is close to a sound source, the source does not need a lot of energy to be audible.
 - Think of head phones
 - Deliver a small amount of sound energy directly to your ear
 - Even when the volume is turned up to where you perceive it as being loud, those near you might not hear it at all
 - Use more speakers, spaced closer together and driven at lower wattage levels



Design

- How many speakers are required? And at what spacing and power level?
 - It depends
 - Start with the goal of having a uniform sound level where the listener never experiences more than about a 6 dB variation as they move about a space
 - This is a target used by engineers designing sound reinforcement for meeting rooms and some paging systems
 - An emergency system can usually tolerate a greater variation
- The sound pressure level must be enough to overcome most background noises
 - Not to the point where it's judged "loud"
 - For most occupancies, the level can be based on the ambient noise level measured at about 2000 Hz
 - A loudspeaker's output varies with frequency and also varies as you move off axis
 - Both will affect the required spacing
 - A higher ceiling might actually require fewer speakers than a lower ceiling
 - Might require a slightly higher dB output
 - Annexes A and D of NFPA 72 have diagrams and some discussion of these principles



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- Questions?

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