Code Changes and Alternative Technology

Sounders for Fire Alarm and ECS applications

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Silent Knight

SILENT KNIGHT
by Honeywell

SYSTEM SENSOR

Low Frequency Agenda

- **Industry** Advancements
- **Challenges** Facing Fire Alarm Industry
- **Origin** of Low Frequency requirement
- **NFPA 72** Code Changes
- **UL Requirements** for Low Frequency
- **Low Frequency** Applications
- **States and Regions** Impacted by code change
- **Design** Considerations

Importance of Smoke Detection

Statistics show that smoke detectors and fire alarm systems save lives

Home fire deaths[1] have decreased from 6,015 deaths in 1978 to 2,644 deaths in 2010

Commercial fire deaths[2] have decreased from 640 deaths in 1977 to 120 deaths in 2011

Hotel and motel fire deaths[3] have decreased from 62 in 1980 to 16 in 2010

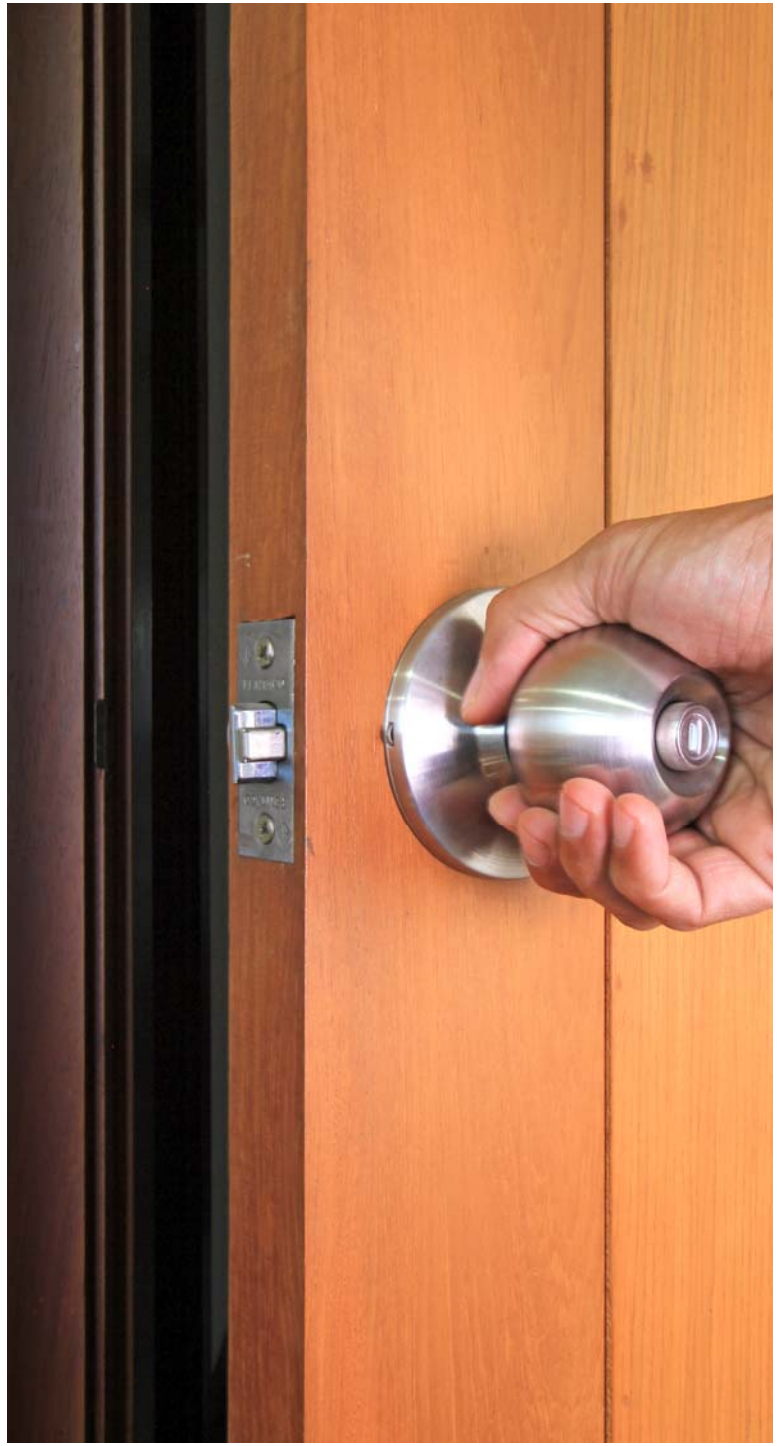
Sources:

1. *Fire Loss in the U.S. During 2010, NFPA Michael J. Karter, Jr. Sept. 2011*
2. The US Fire Problem, NFPA 2011 Non-home structure fire deaths
3. *U.S. Hotel and Motel Structure Fires, NFPA Ben Evarts July 2012*

Challenging Factors

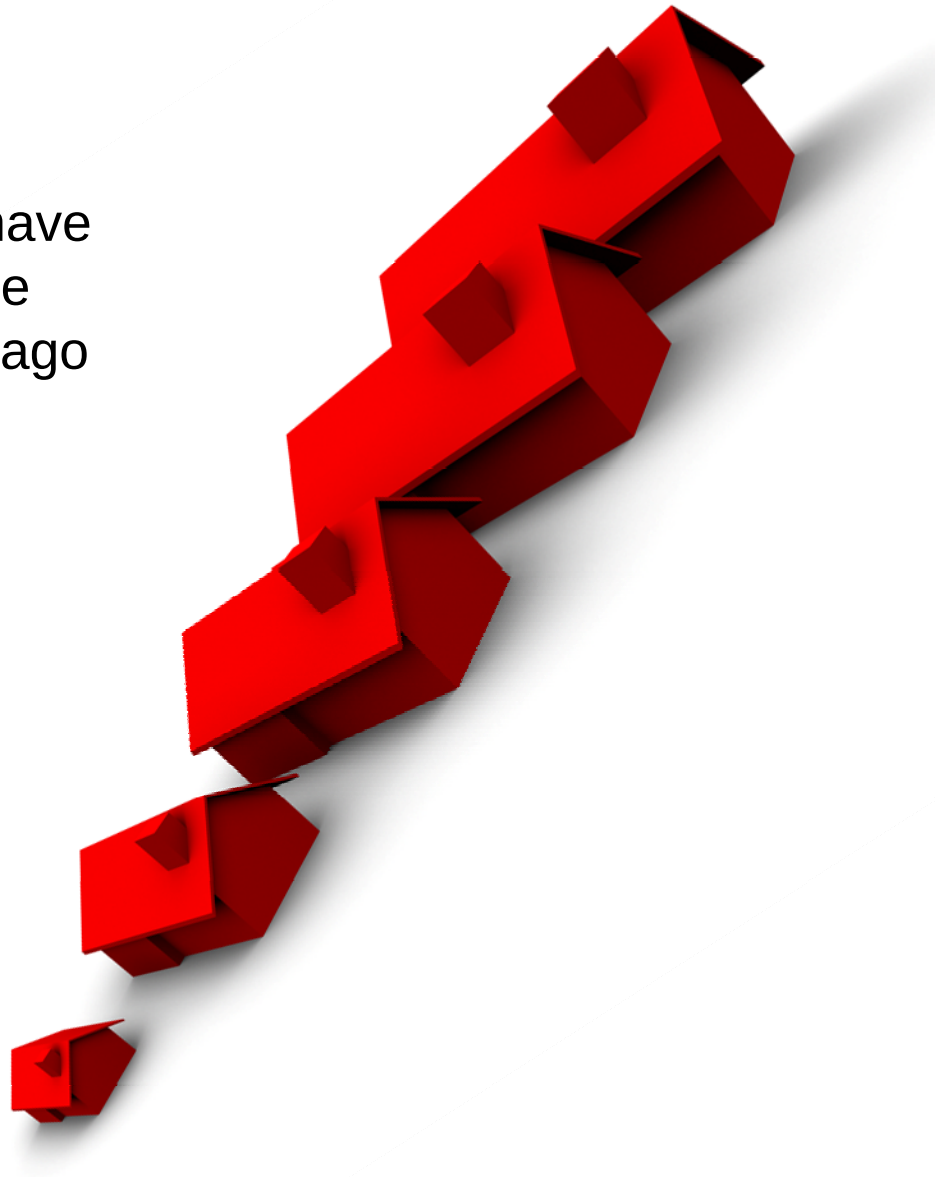
Factors that **limit an occupant's ability to safely exit** the dwelling or building during a fire:

- **Escape Time**
- **Waking effectiveness** of the audible alarm signal in high-risk groups



Decreased Escape Times

Dwellings and buildings today have increased in size and contain more synthetic materials than 35 years ago



Decreased Escape Times

Furnishing manufacturers in the last 30 years have replaced **natural fibers** with lower-cost, man-made **synthetic materials**

- **Natural materials:** Legacy furnishings used wood, cotton batting, linen, and silk
- **Synthetic materials:** Modern furnishings utilize polyurethane foam for padding and synthetic fabrics for covers

Decreased Escape Times

Combustion behavior between synthetic and natural materials are different

Synthetic materials:

- **Ignite and burn faster** than natural materials used 40 years ago
- **Generate higher heat and smoke release rates** than the natural materials

Waking Effectiveness

High Risk Groups:

- **School aged children**: Thirteen percent of civilian fire fatalities in residential buildings were under the age of 10 [4]
- **Alcohol or drug-impaired**: It's suspected that over 27% of civilian fatalities in residential building fires are linked to alcohol, drug, or chemical influence [4]
- **People with hearing loss**: More than 34.5 million people in the US are hard of hearing [5]

Sources:

4. *USFA, Civilian Fire Fatalities in Residential Buildings 2008-2010 Report*

5. *Waking Effectiveness of alarms for adults who are hard of hearing, NFPA Dorothy Bruck, Ian Thomas June 2007*

Waking Effectiveness

Most **unimpaired adults** normally awaken quickly to current available audible fire alarm signal[6]

- Most fire alarm horns produce a **2Khz to 4Khz** audible signal
- Most integral smoke alarm sounders produce a **3Khz** audible alarm signal

Source:

6. Awakening of Sleeping People – a Decade of Research, Ian Thomas and Dorothy Bruck July 2008

Waking Effectiveness

The low frequency signal with a fundamental frequency of 520 Hz is most effective in waking most of the participants[6]

- The **low frequency signal** is 6 to 10 times more effective at waking children and young adults than the standard 3 KHz audible fire alarm signal[6]
- In adults with hearing loss, the **low frequency** signal is more than six times as effective than the 3 KHz signal and more effective than the bed and pillow shakers[6]
- **Strobe lights** were found to have very poor waking effectiveness[6]

Source:

6. Awakening of Sleeping People – a Decade of Research, Ian Thomas and Dorothy Bruck July 2008

Waking Effectiveness Study

In **2006, the Fire Protection Research Foundation (FPRF)** funded two research studies to focus on the effectiveness of the 3Khz tone on high risk groups

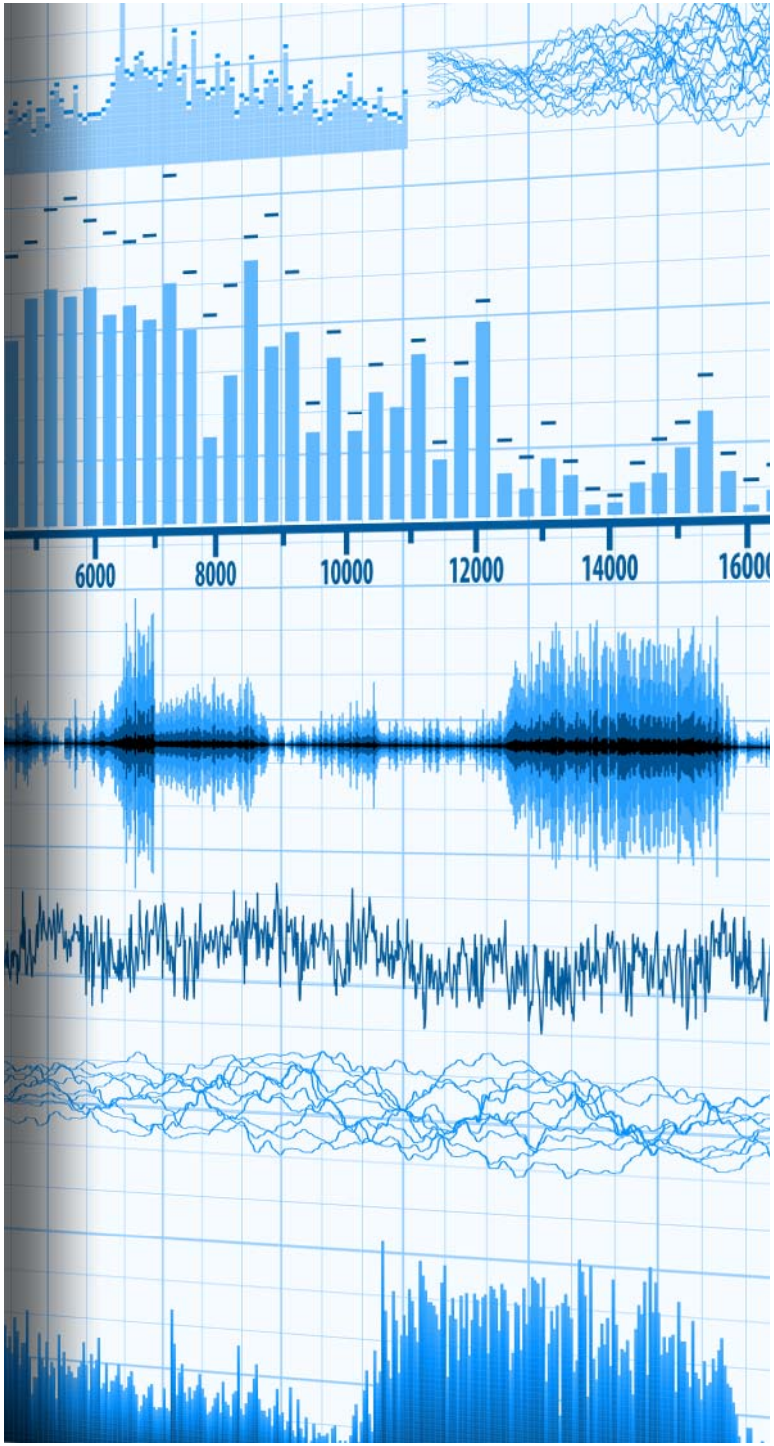
- Waking Effectiveness of Alarms and Adults who are hard of hearing
- Waking Effectiveness of Alarms for Alcohol Impaired

Aim of the studies is to **optimize the performance requirements** to meet the needs of these high risk groups

Waking Effectiveness Study

The Studies tested **six signals:**

1. **400 Hz** square wave signal
2. **520 Hz** square wave signal
3. **3 KHz** pure tone (standard)
4. **Bed** shaker (under mattress)
5. **Pillow** shaker
6. **Strobe light** in T-3 pulse (modified)



Source:

7. *Waking Effectiveness of alarms for adults who are hard of hearing, NFPA Dorothy Bruck, Ian Thomas June 2007*
8. *Waking Effectiveness of alarms for the alcohol impaired , NFPA Dorothy Bruck, Ian Thomas June 2007*

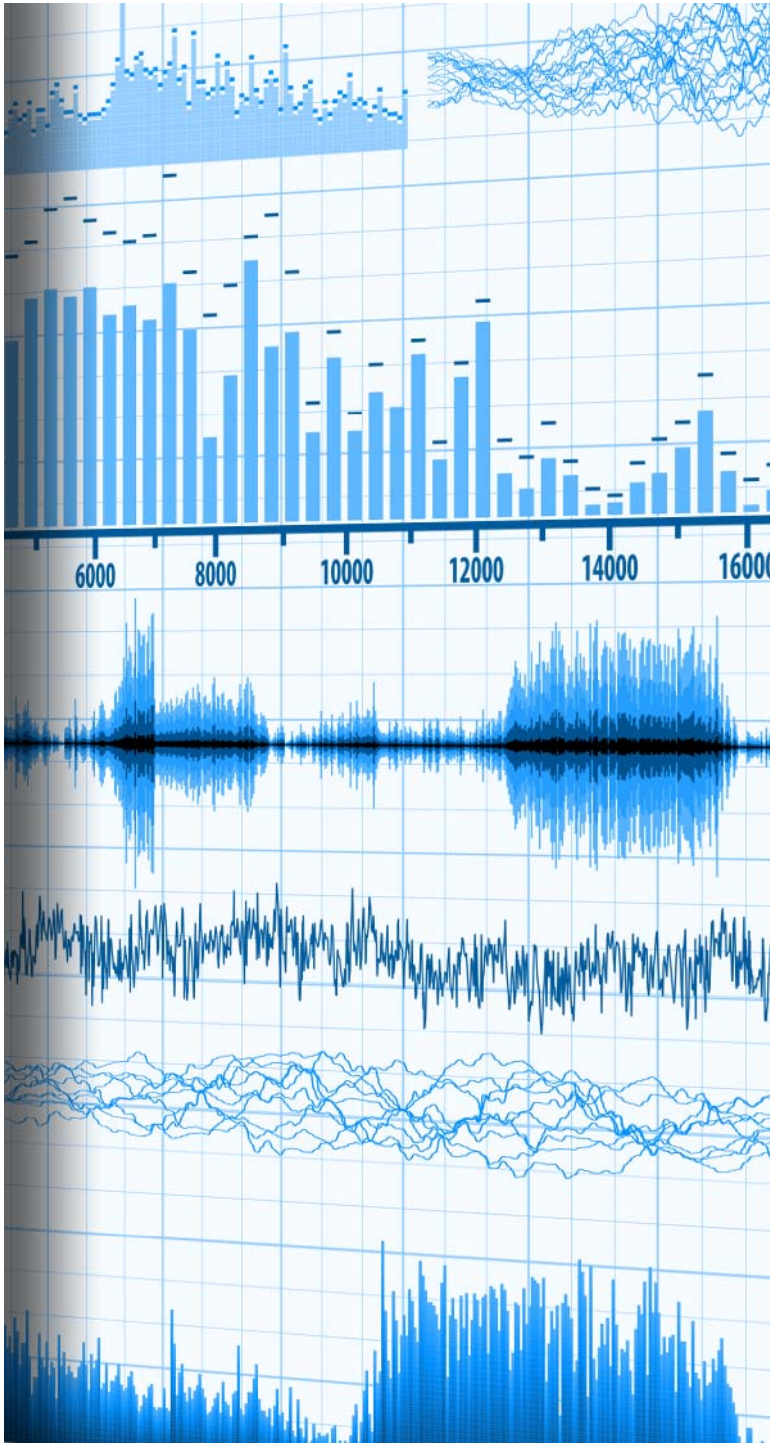
Waking Effectiveness Study

Conclusions:

The low frequency signal with a fundamental frequency of 520 Hz is the **most effective signal** for awakening people who are hard of hearing

- Low frequency signal **awoke 92%** between 55 dBA and 75 dBA
- 3 KHz pure tone signal **awoke 56%** between 55 dBa and 75 dBA

The low frequency signal is superior to bed and pillow shakers and strobe lights



Source:

7. *Waking Effectiveness of alarms for adults who are hard of hearing, NFPA Dorothy Bruck, Ian Thomas June 2007*
8. *Waking Effectiveness of alarms for the alcohol impaired , NFPA Dorothy Bruck, Ian Thomas June 2007*

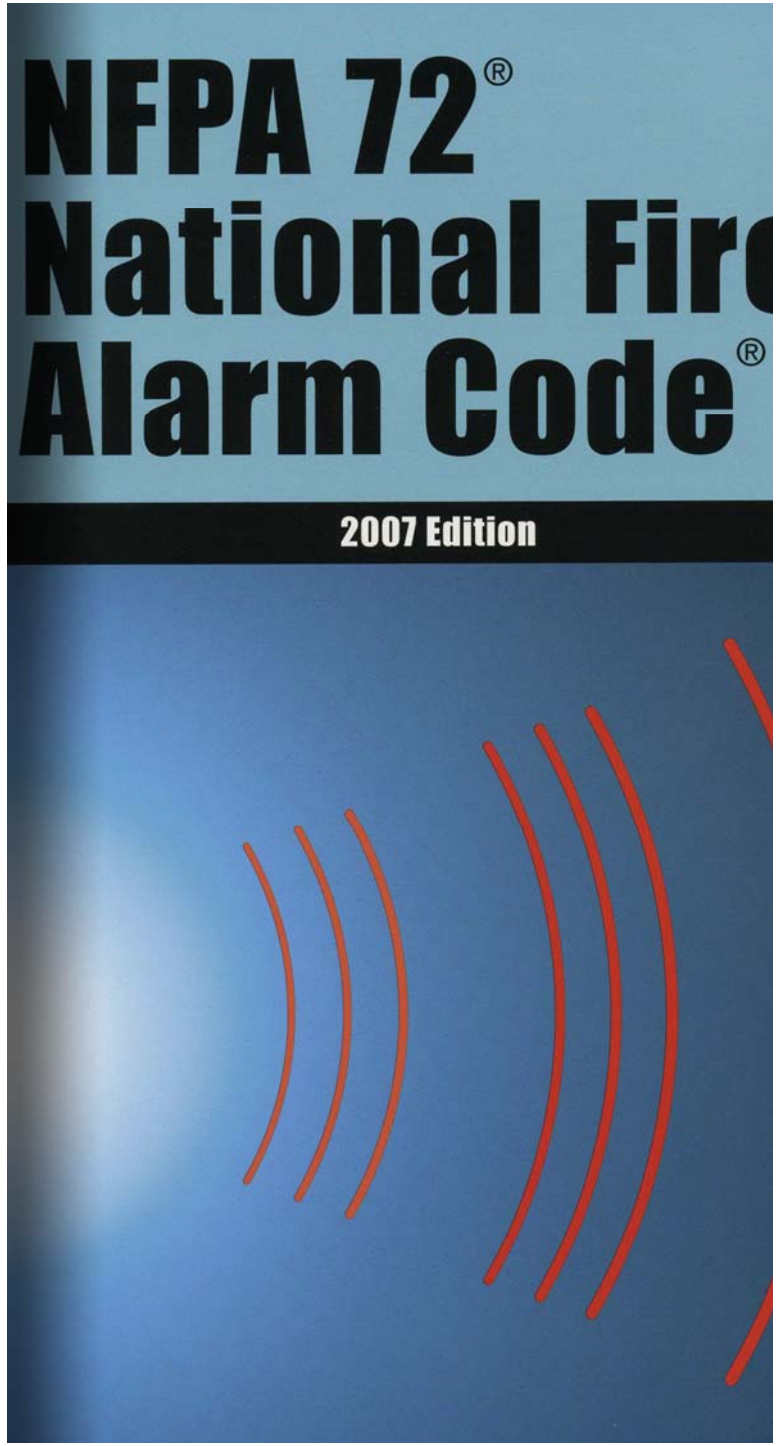
NFPA 72 2010 Low Frequency Requirements

NFPA 72 2007

NFPA 72 2007 sleeping area requirements:

7.4.4.1 Where audible appliances are installed to provide signals for sleeping areas, they shall have a sound level of at least **15 dB above the average ambient** sound level or 5 dB above the maximum sound level having a duration of at least 60 seconds or a sound level of at least 75 dBA, whichever is greater, measured at the pillow level in the area required to be served by the system using the A-weighted scale (dBA).

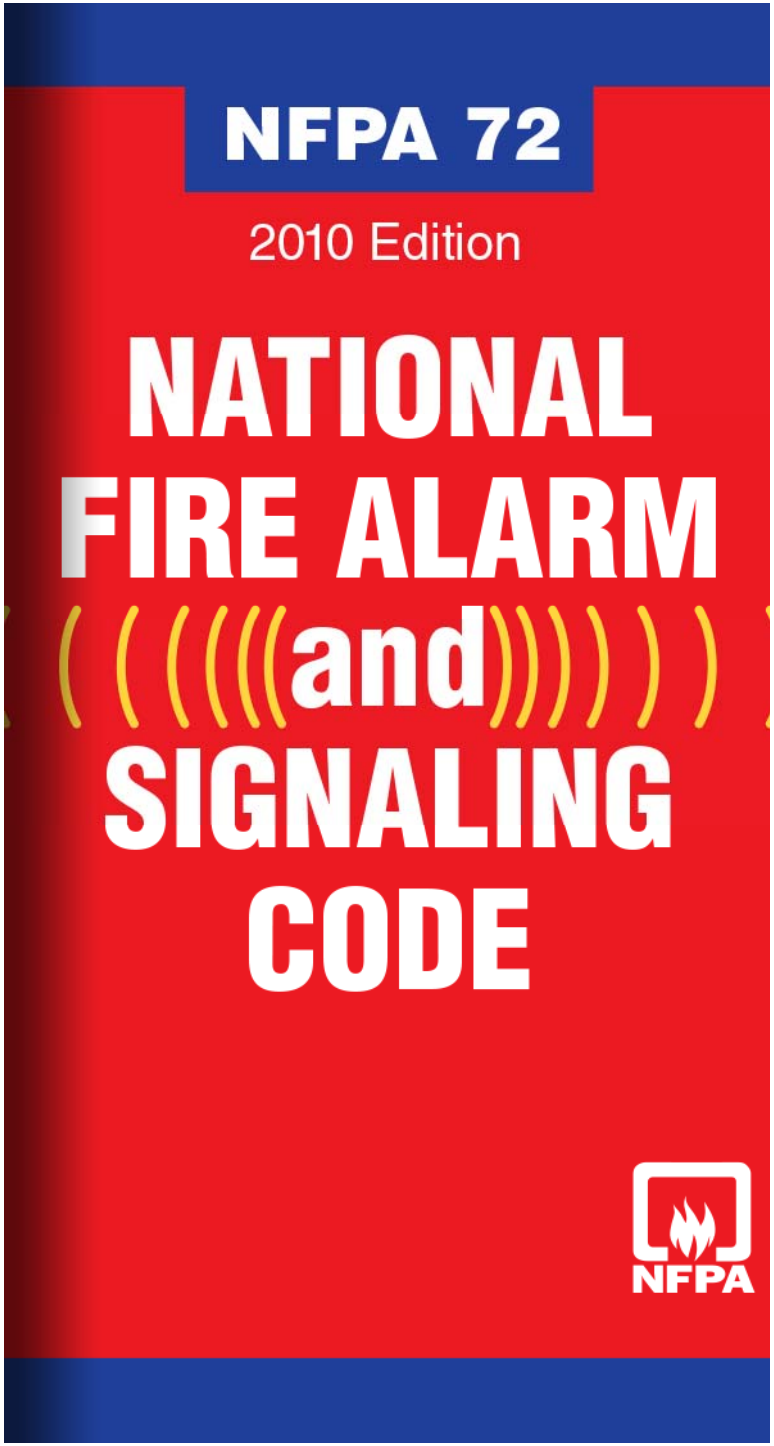
No frequency requirements prior to the 2010 edition of NFPA 72, only audibility requirements.



NFPA 72 Low Frequency Requirements

New low frequency requirements added to the **2010 edition of NFPA 72**

- **Chapter 18** – Notification Appliances
- **Chapter 24** – Emergency Communications Systems (ECS)
- **Chapter 29** – Single- and Multiple-Station Smoke Alarms and Household Fire Alarm Systems

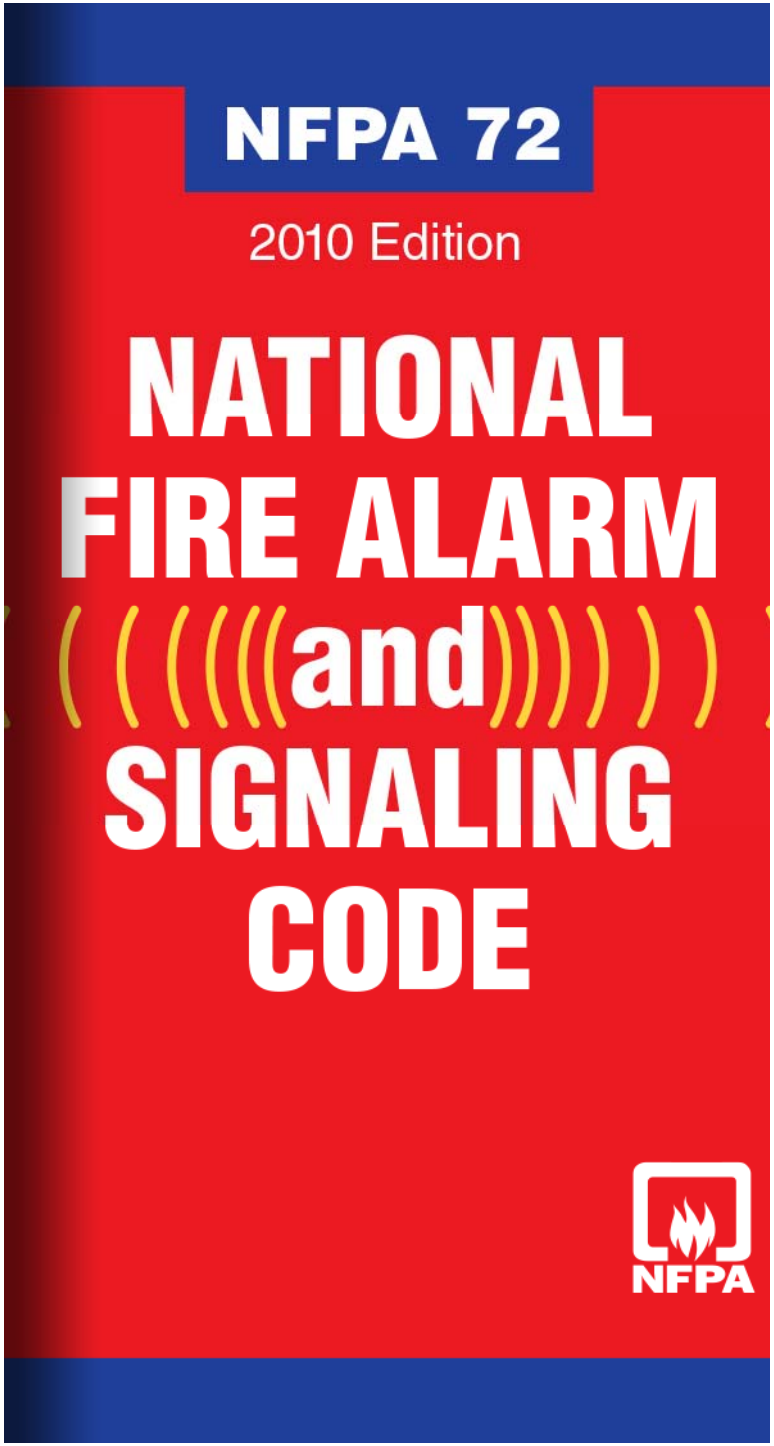


NFPA 72 Chapter 18

2010 edition of NFPA 72

18.4.5.3* Effective January 1, 2014, where audible appliances are provided to produce signals for sleeping areas, they shall produce a **low frequency alarm signal** that complies with the following:

1. The alarm signal shall be a **square wave** or provide equivalent awakening ability.
2. The wave shall have a fundamental frequency of **520 Hz ± 10 percent**.



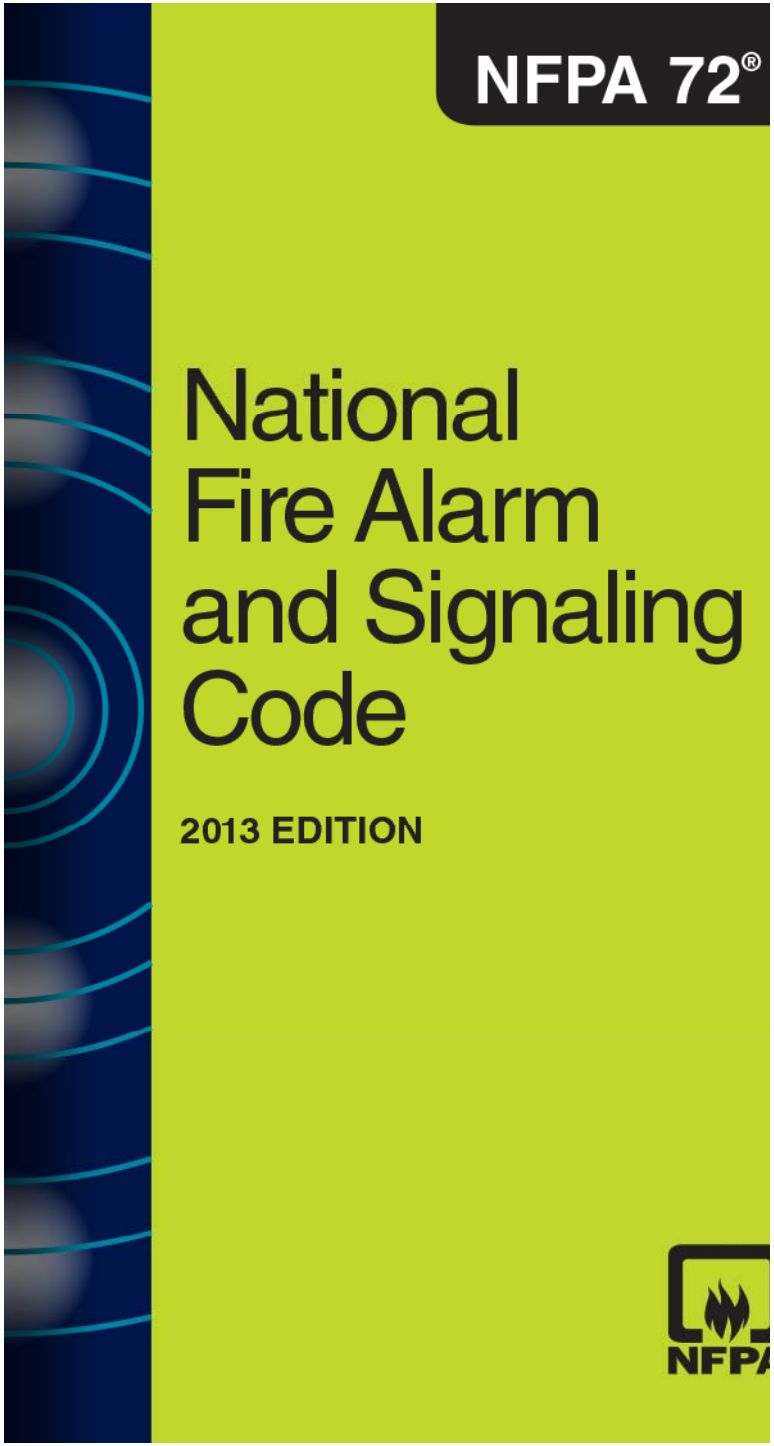
NFPA 72 Chapter 18

2013 edition of NFPA 72

The Chapter 18 Committee revised the wording to clearly state the low frequency requirement is to **awaken people only**

18.4.5.3* Effective January 1, 2014, audible appliances provided for the sleeping areas to awaken occupants shall produce a low frequency alarm signal that complies with the following:

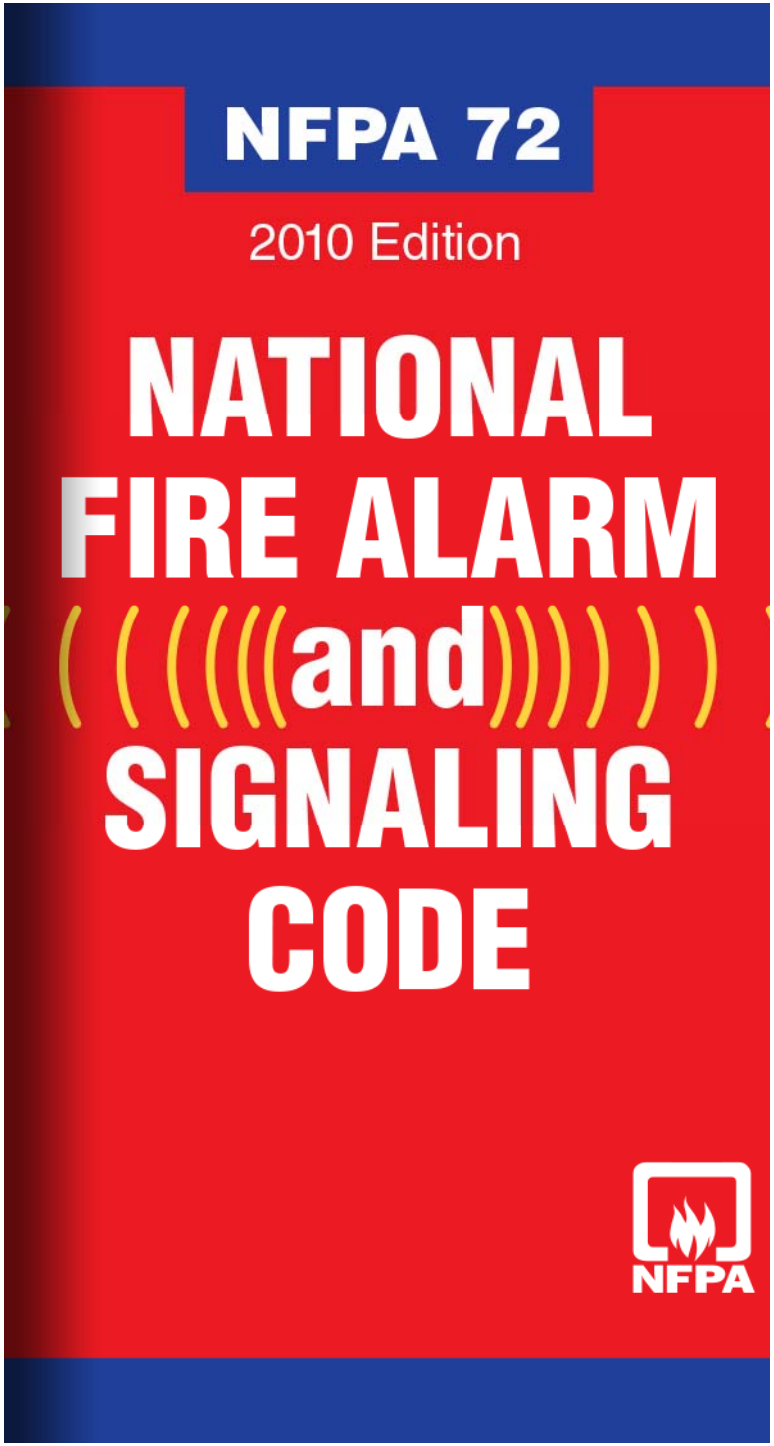
1. The alarm signal shall be a **square wave** or provide equivalent awakening ability.
2. The wave shall have a fundamental frequency of **520 Hz ± 10 percent.**



NFPA 72 Chapter 24

2010 edition of NFPA 72 added a new low frequency requirement to Chapter 24

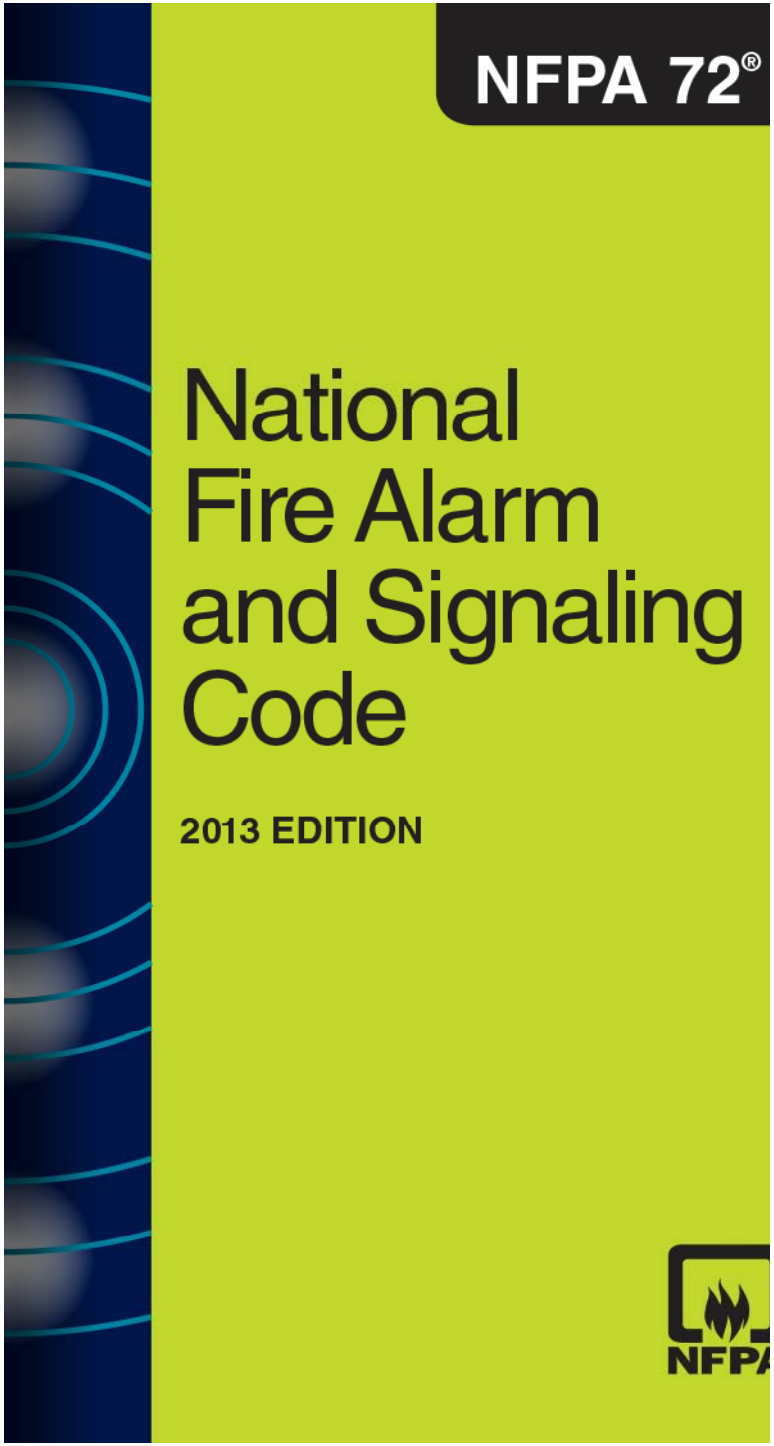
24.4.1.4.1* In occupancies where sleeping accommodations are provided, the pre-alert tone shall include a low frequency component of 520 Hz square wave range to accommodate the need of the hearing impaired for fire voice messages and emergency communication messages.



NFPA 72 Chapter 24

24.4.2.4.2* Except as specified in 24.4.2.4.3, in occupancies where **sleeping accommodations are provided** and the voice message is intended to **communicate information to those who could be asleep**, a low-frequency tone that complies with 18.4.5 shall be used.

24.4.2.4.3* In areas where **sleeping accommodations are provided**, but the voice communication system is used to **communicate to occupants who are awake**, the low-frequency tone shall not be required.

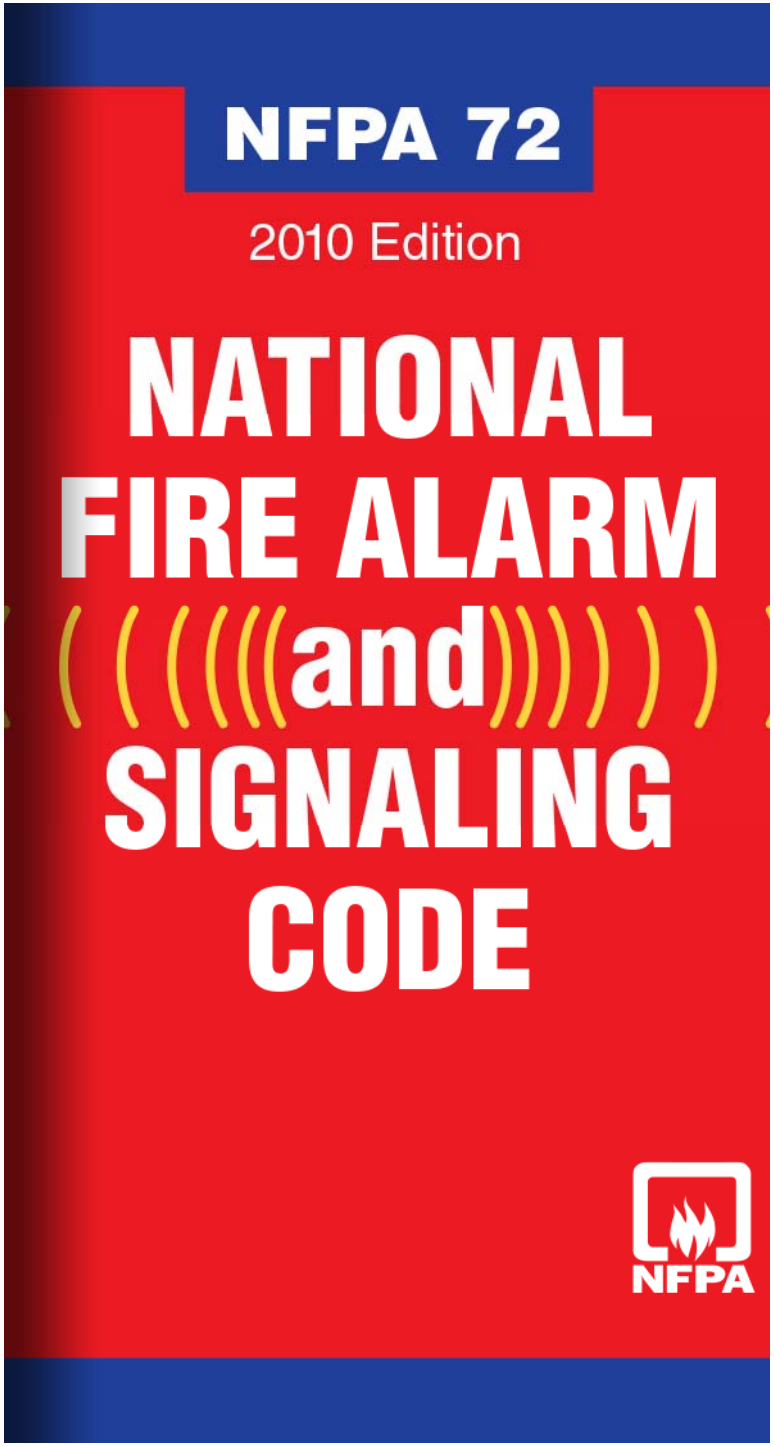


NFPA 72 Chapter 29

2010 edition of NFPA 72

29.3.8.1 Mild to Severe Hearing Loss. Notification appliances provided for those with mild to severe hearing loss shall comply with the following:

1. An audible notification appliance **producing a low frequency alarm signal** shall be installed in the following situations:
    a. *Where required by governing laws, **codes or standards** for people with hearing loss
    b. Where provided **voluntarily** for those with hearing loss



Hierarchy of Codes and Standards

Comprehensive, Systematic, and Interlinked Process

- Building Codes are the foundation of the system
- Installation Standards are implementation of codes
- Product Standards the equipment design operation and robustness
- Laws are local implementation of regulations
- **AHJ is the gate keeper**

IBC/IFC Code Adoption

2010 NFPA 72 is referenced in

- 2012 IFC Chapter 80
- 2012 IBC Chapter 35

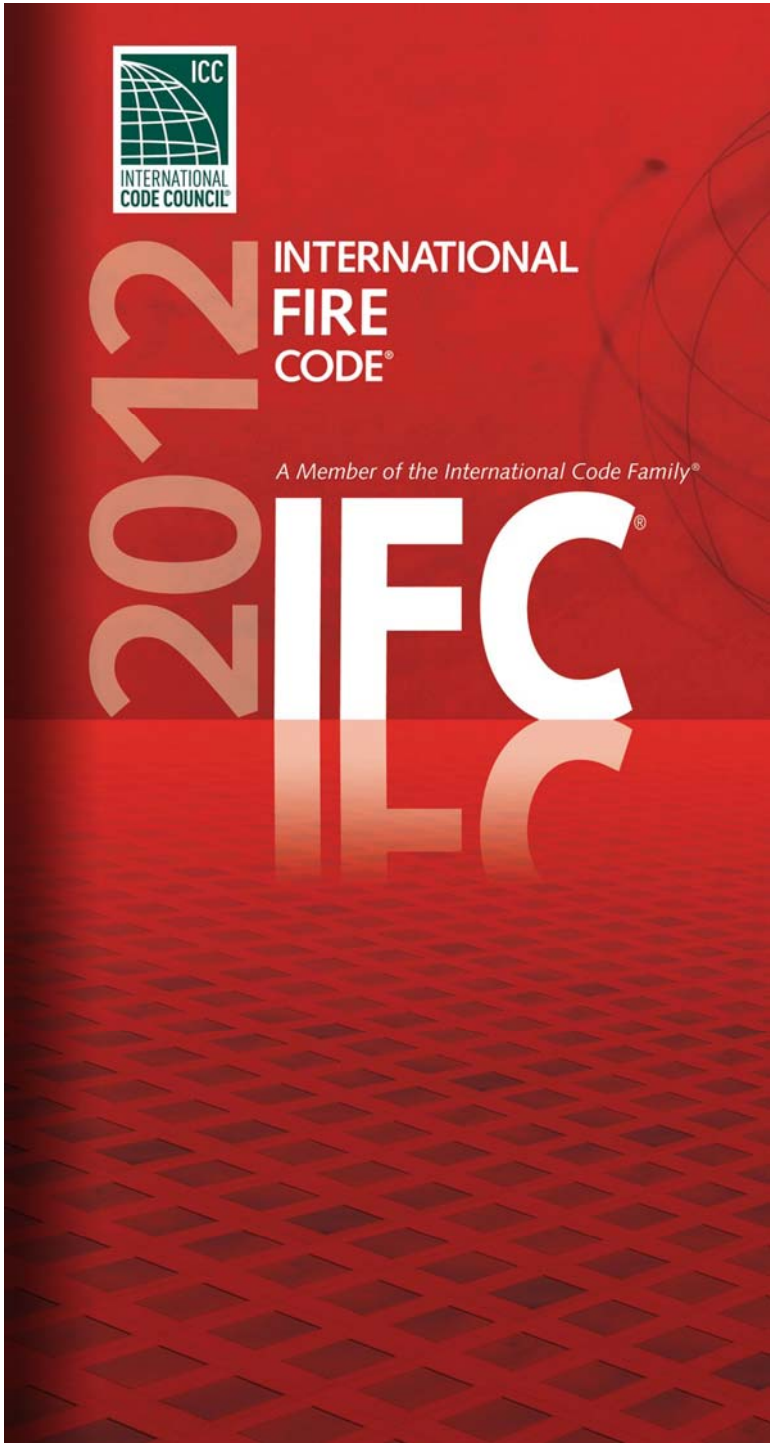
18.4.5.3* Effective January 1, 2014, audible appliances provided for the sleeping areas to awaken occupants shall produce **a low frequency** alarm signal

Required in Certain Group R Occup.

2012 IFC/IBC indirectly requires a low frequency signal in certain Group-R occupancies

907.2 Where required, an approved fire alarm system installed in accordance with the provisions of this code and **NFPA 72** shall be provided in new buildings and structures and **provide occupant notification** in accordance with Section 907.5

907.5 A fire alarm system shall annunciate at the fire alarm control unit and **shall initiate occupant notification** upon activation



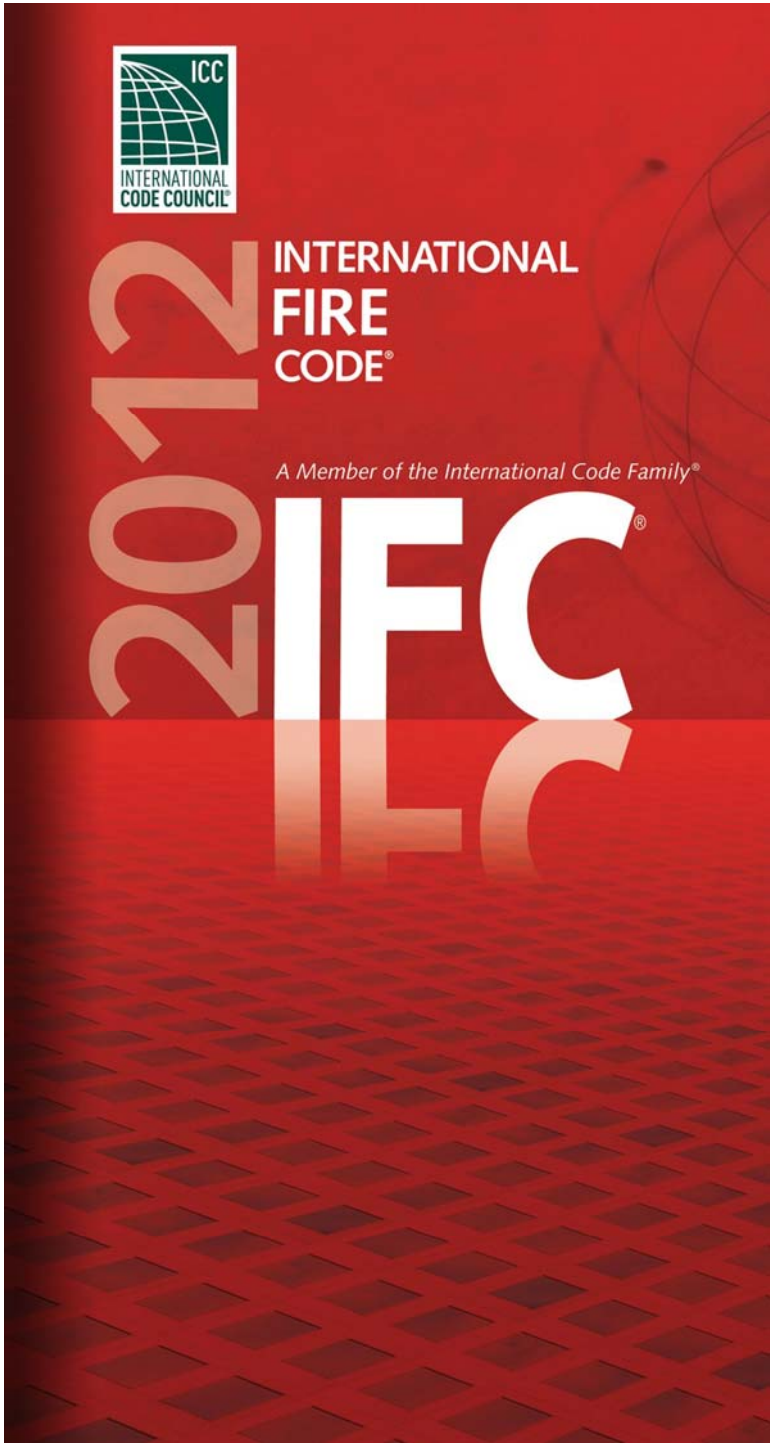
Required in Certain Group R Occup.

Group R-1 Hotels and motels

907.2.8.1 A manual fire alarm system that activates the occupant notification system

Exceptions:

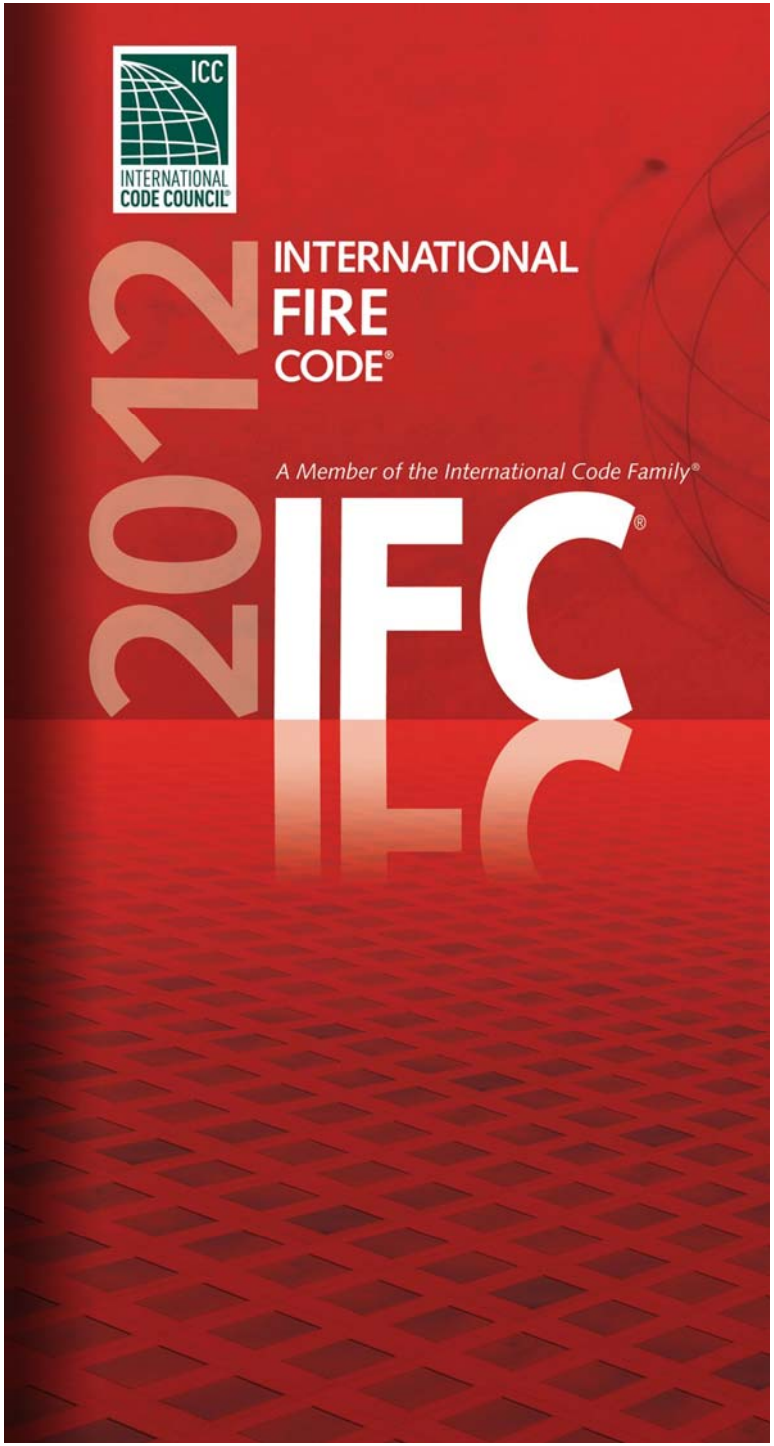
1. A manual fire alarm system is not required in buildings **not more than two stories in height** where all individual sleeping units have an **exit directly to a public way**, egress court, or yard.
2. Permits the fire alarm system to be activated by a **sprinkler system and provide occupant notification**



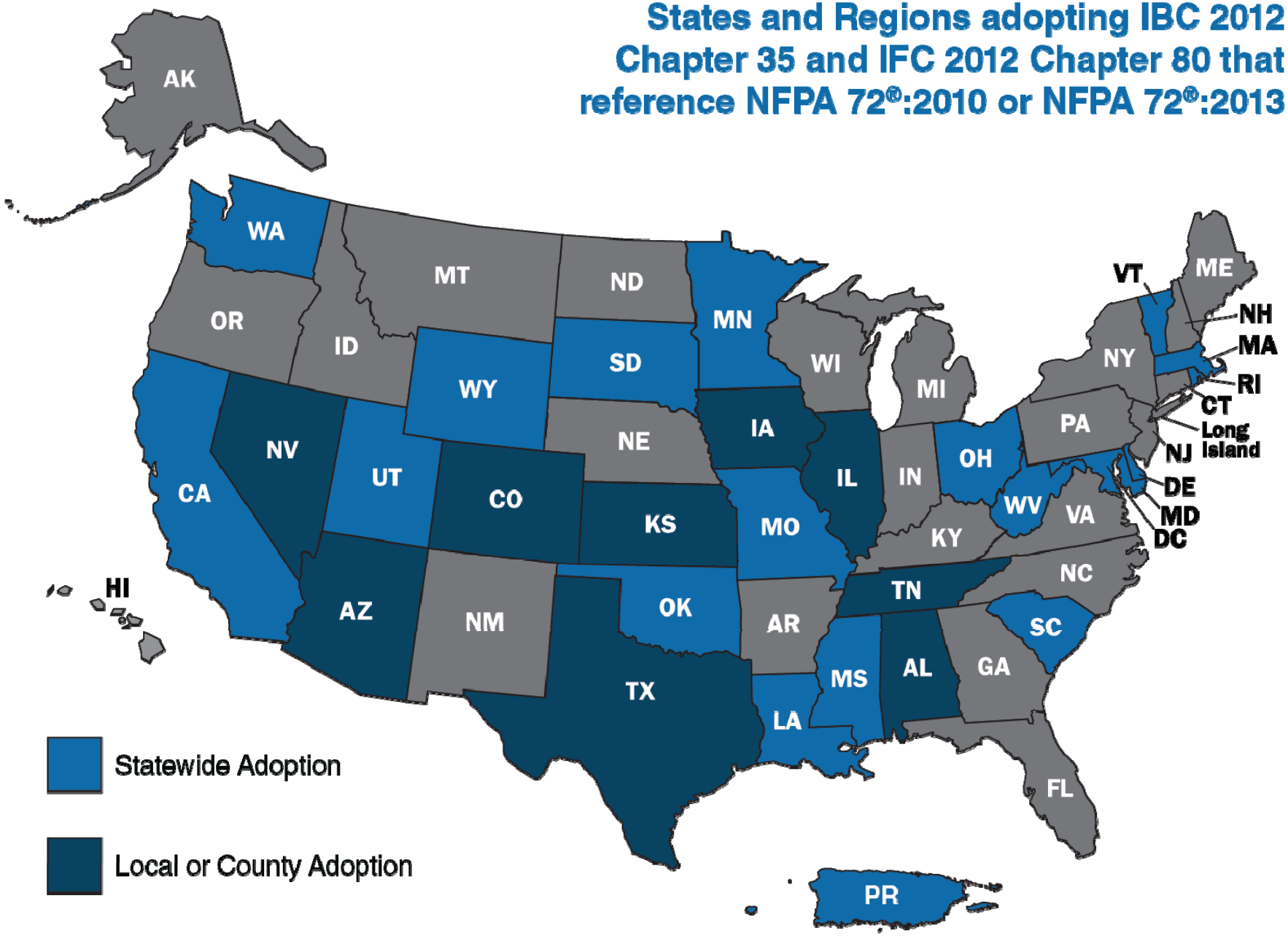
Required in Certain Group R Occup.

Group R-2 college and universities

907.2.9.2 An automatic smoke detection system that **activates the occupant notification system**



States and Regions adopting IBC 2012 Chapter 35 and IFC 2012 Chapter 80 that reference NFPA 72®:2010 or NFPA 72®:2013



*Refer to your local building code or state fire marshals office for effective dates.

www.iccsafe.org/gr/Pages/adoptions.aspx

UL Low Frequency Requirements

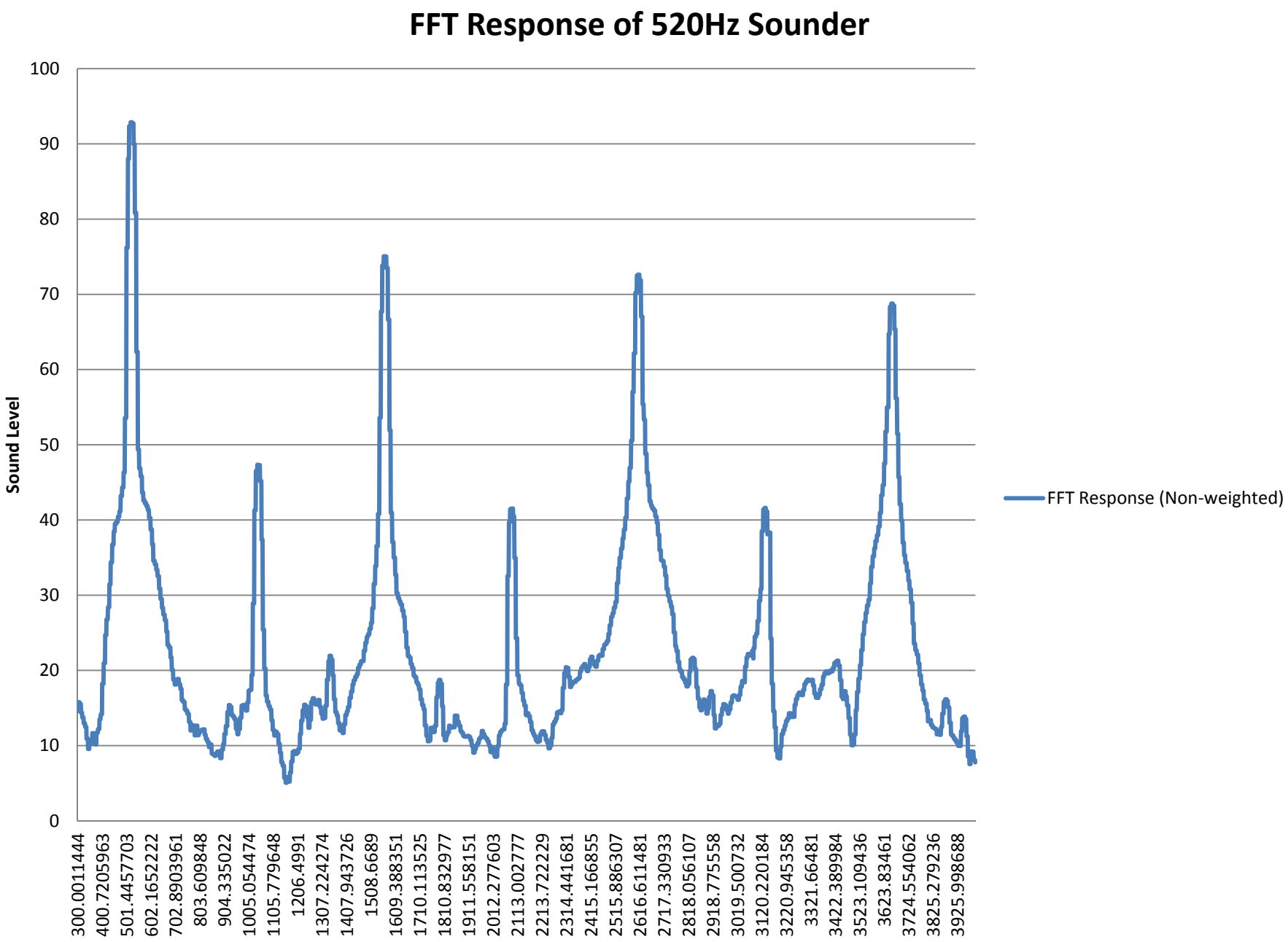
New low frequency **test protocols** added to product safety standards:

ANSI/UL 464, *Standard for Safety Audible Signal Appliances*

- A low frequency notification appliance complying with section 24.1, shall be marked “Low Frequency Alarm”

ANSI/UL 217, *Single and Multiple Station Smoke Alarms*

- A low frequency alarm complying with Section 65, Audibility Test, shall be marked “Low Frequency Alarm”


FFT Response of 520Hz Sounder
Sound Level
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501.4457703
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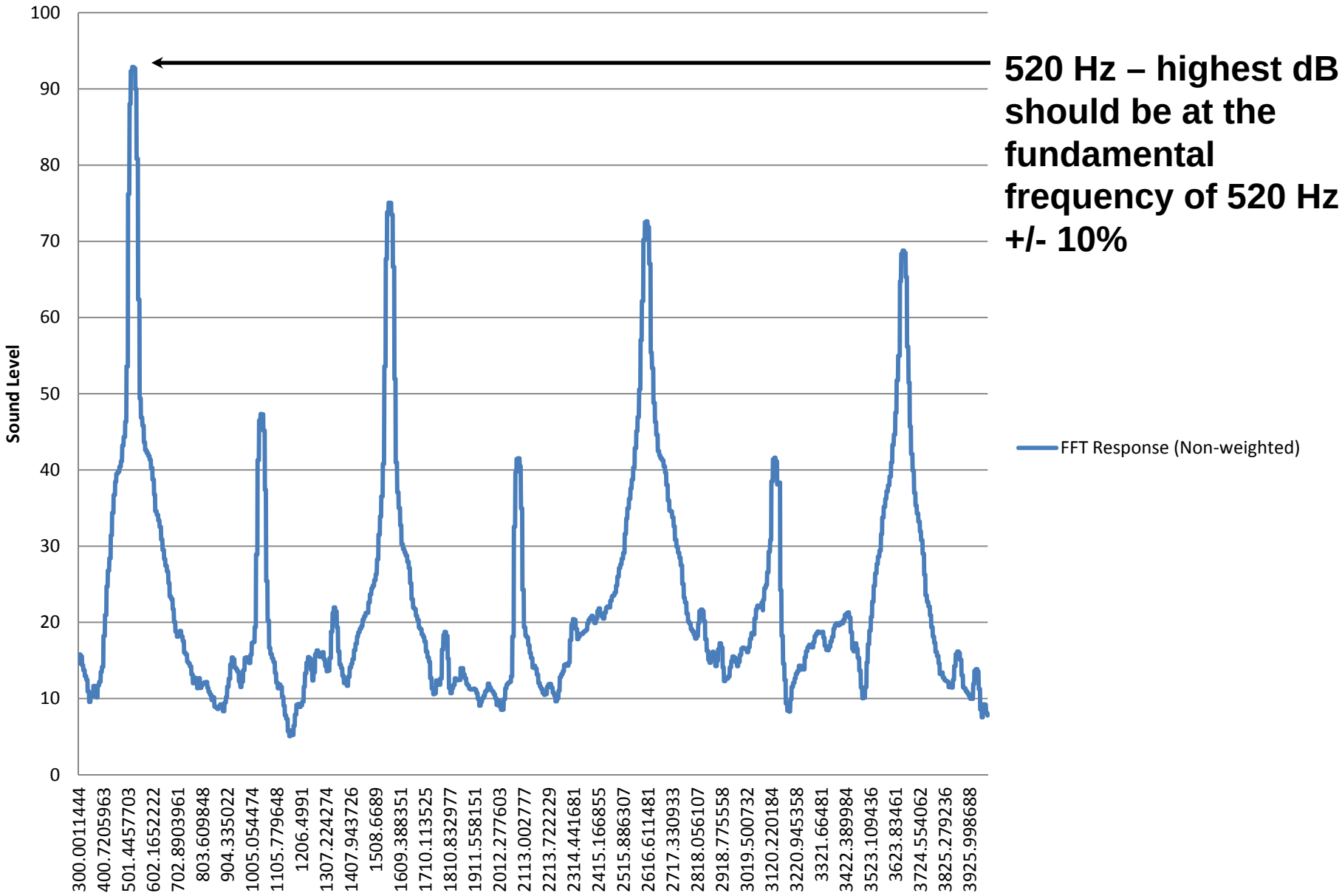
FFT Response (Non-weighted)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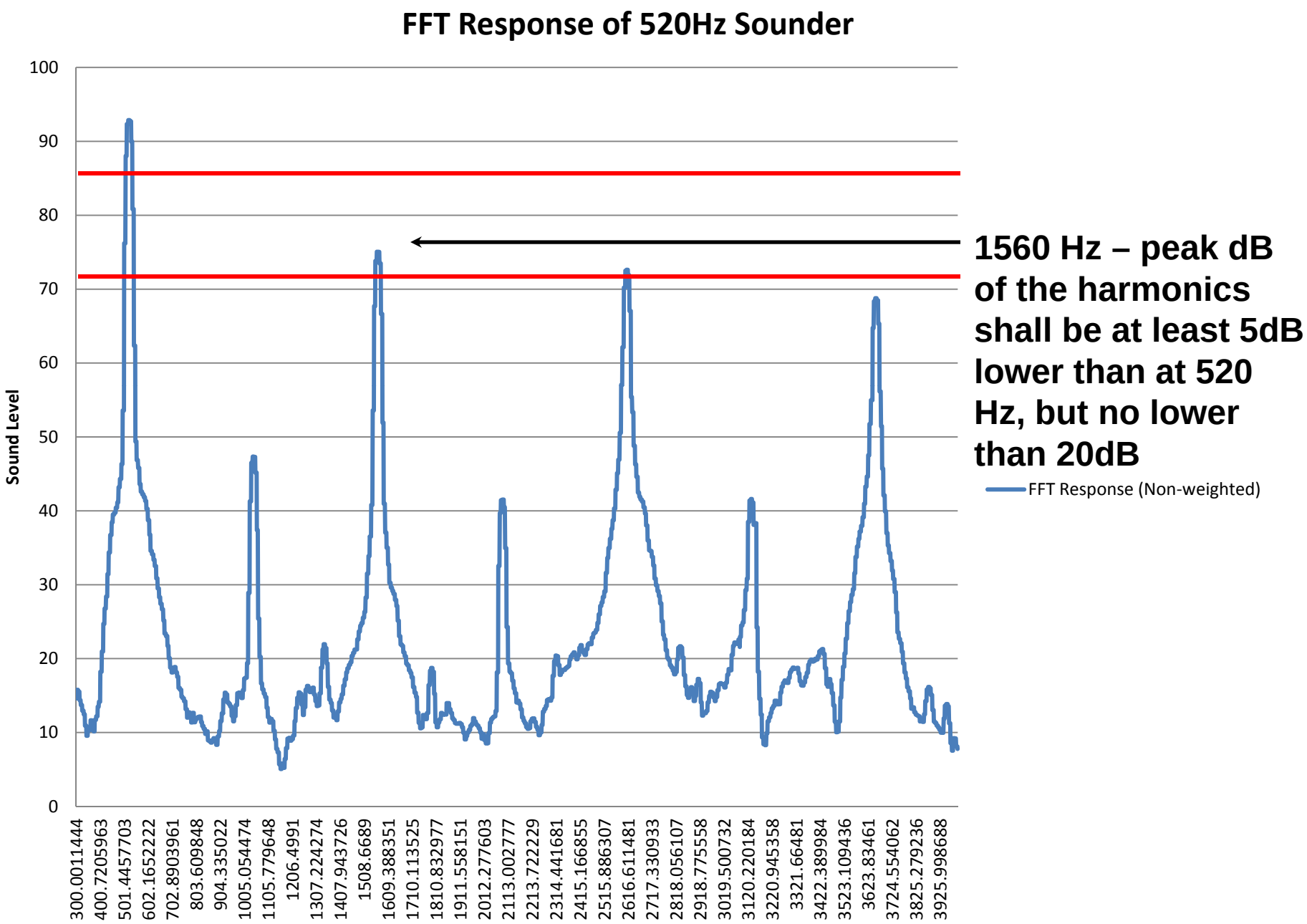
520 Hz – highest dB should be at the fundamental frequency of 520 Hz +/- 10%
FFT Response (Non-weighted)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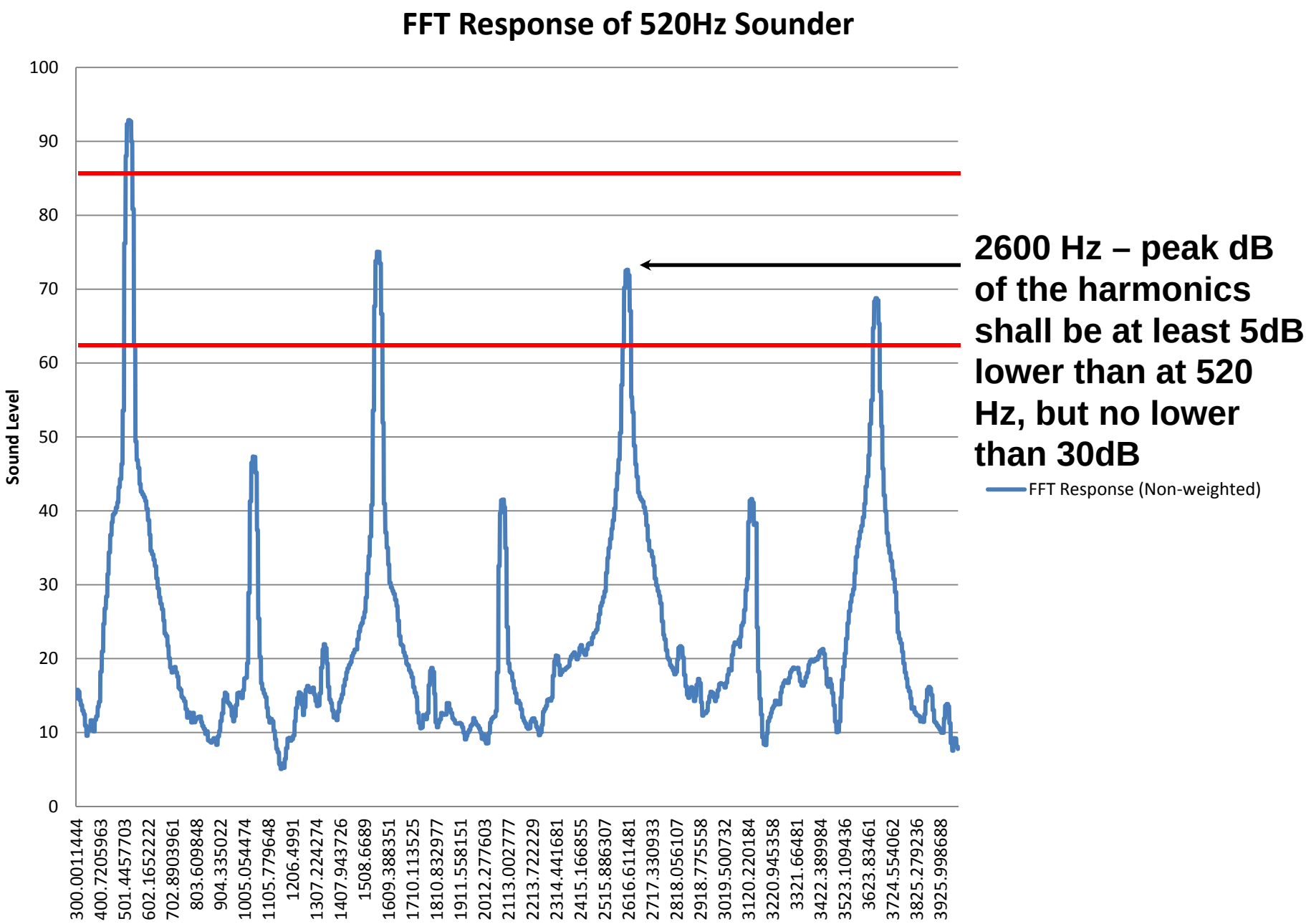
1560 Hz – peak dB of the harmonics shall be at least 5dB lower than at 520 Hz, but no lower than 20dB
FFT Response (Non-weighted)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3321.66481
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3523.109436
3623.83461
3724.554062
3825.279236
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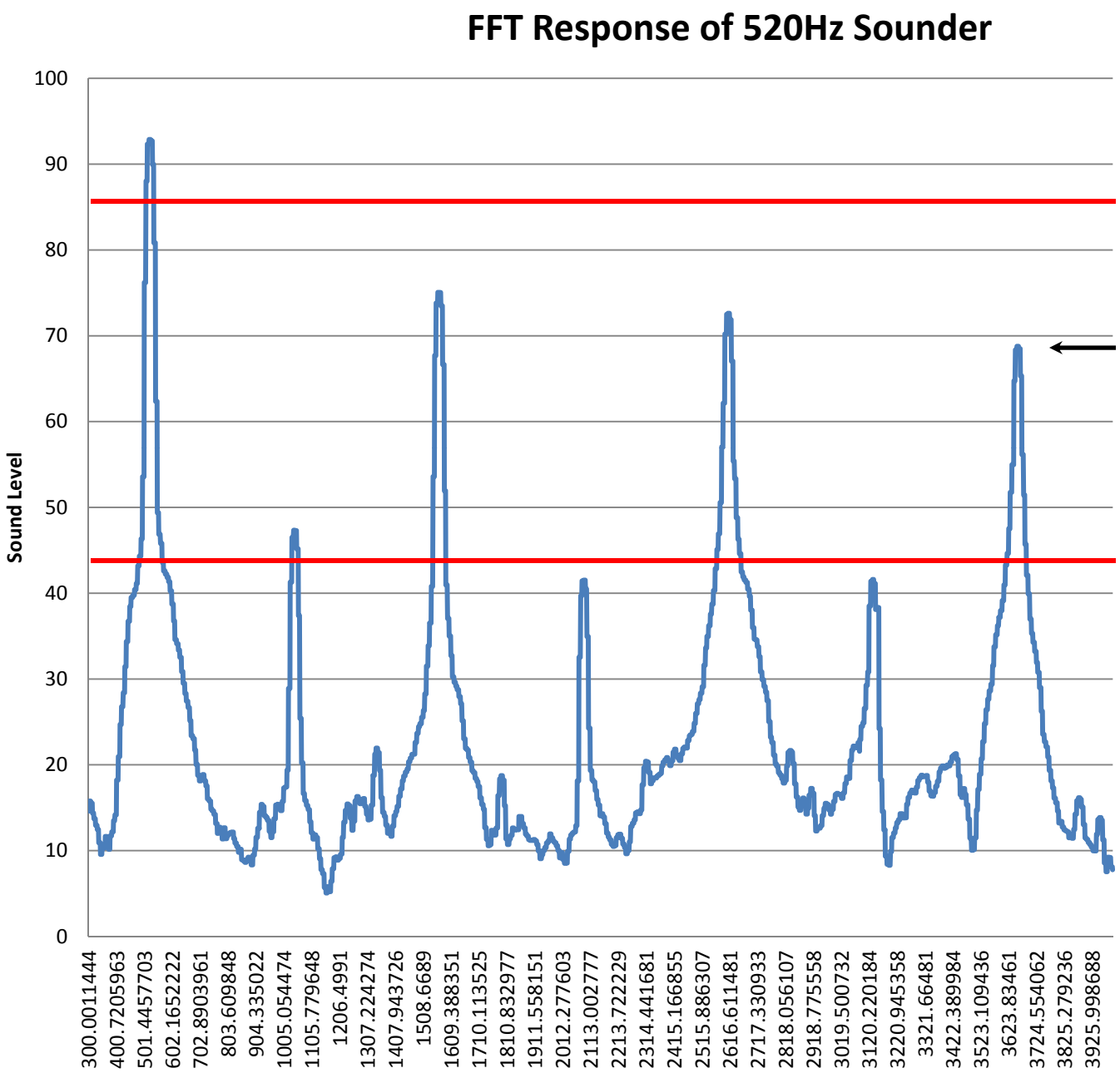
2600 Hz – peak dB of the harmonics shall be at least 5dB lower than at 520 Hz, but no lower than 30dB
FFT Response (Non-weighted)



3640 Hz – peak dB of the harmonics shall be at least 5dB lower than at 520 Hz, but no lower than 50dB

Standard Signal versus Low Frequency Signal

Mini-Horn

520 Hz

Standard Signal versus Low Frequency Signal

Mini-Horn

520 Hz

Low Frequency Product Design

520 Hz

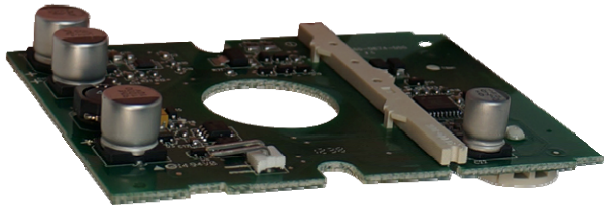
Piezo Horn

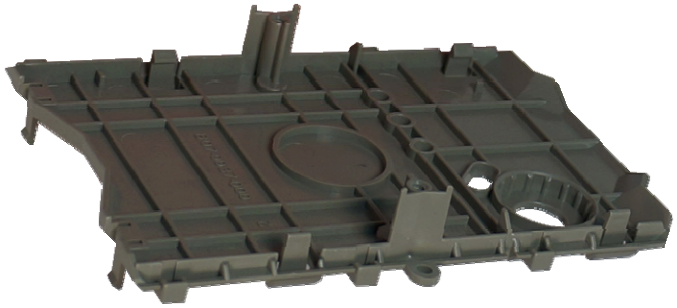
Speaker

Low Frequency Product Design

The **custom product** was designed to:

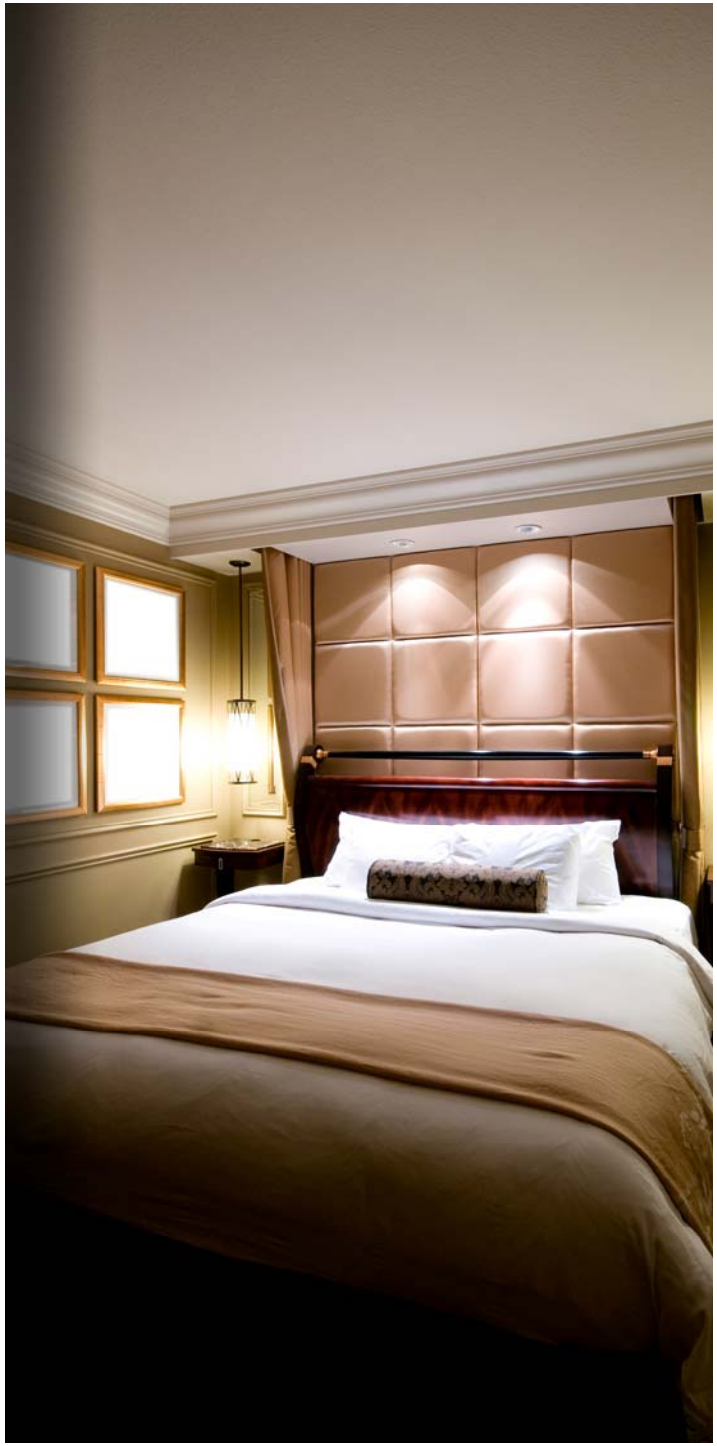
- Resonate around 520 hz
- Produce maximum sound output
- Utilize an efficient circuit design
- Keep a small footprint





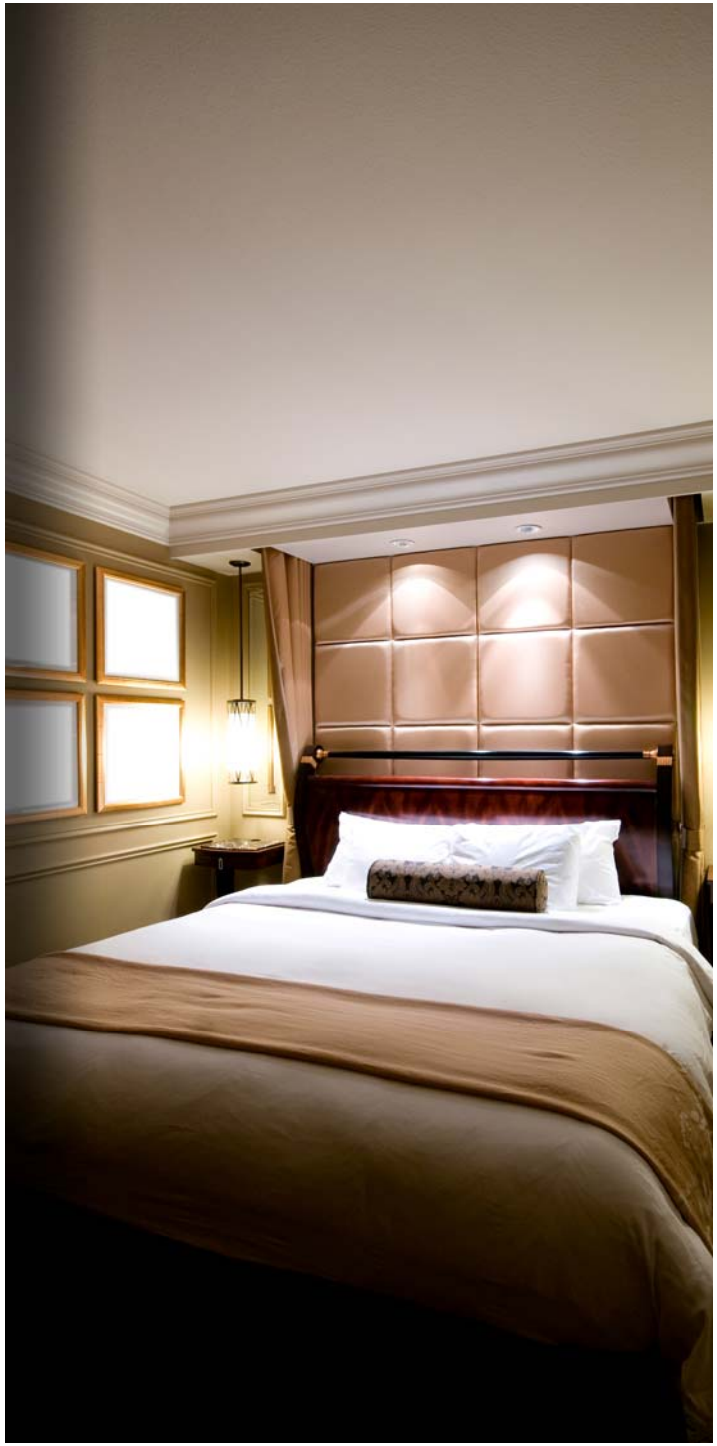
Applications

- **Hotels/Motels**
- **College/University Dormitories**
- **Assisted Living/Nursing Home Facilities**
- **Apartments/Condominiums**



Low Frequency Facts

- **Requirements for sleeping spaces:**
  - **Commercial – every sleeping room**
  - **Single and Multi-Dwelling – designated hearing loss sleeping rooms**
  - **NOT required – Janitor closets, hallways, stairwells**
- **Voice evacuation requirements:**
  - **System compatibility – FACP, amplifier, signal, and speakers**



Where are the devices required

The devices are only required in the designated sleeping rooms

- They are not required to be installed in hallways, janitor closets, stairwells

- They are not required for retrofit applications, unless the retrofit has been designated as a complete tear down

- Special rooms will not need to be created and occupants are not required to self declare the quality of their hearing*

Please follow manufacturer instructions and your local building/code regulations for the use and installation of any audible visilbe notification devices.

Low Frequency Sounder Specifications

- Model number: **HR-LF , HW-LF**
- Operates on NAC circuit (12 or 24 VDC/FWR)
- Rated 76+ dBA at 16V
- Dual Listed-Wall or Ceiling
- **Universal Mounting Plate**
- **Plug In Design**
- **Listed** to UL, FM and CSFM

Low Frequency Sounder Strobe Specifications

- Model number: **P2RH-LF , P2WH-LF**
- Operates on NAC circuit (24 VDC/FWR)
- High CD: 135,150,177 and 185
- Dual Listed- Wall or Ceiling
- dB output 76+dBA at 16V
- Universal Mounting Plate
- Plug In Desing
- **Listed** to UL, FM and CSFM

Design Considerations

- Comparison

Model #	135	150	177	185
P2RH Temporal High	245mA	259mA	290mA	297mA
P2RH Temporal Medium	235mA	253mA	288mA	297mA
P2RH Temporal Low	232mA	251mA	282mA	292mA
P2RH-LF Temporal 3	277mA	292mA	325mA	344mA

Low Frequency Sounders Use More Energy

  - Generate square wave at 520Hz
  - Uses NAC to power self contained circuit that drives speaker (NOT Piezo)

- Will Require More NAC Power Supplies in Design

Design Considerations

5820XL-EVS

EVS-100W

System Sensor Speakers / Speaker-Strobes

Model Number	Description
SPR	Wall High-Fidelity Speaker, Red
SPW	Wall High-Fidelity Speaker, White
SPCR	Ceiling High-Fidelity Speaker, Red
SPCW	Ceiling High-Fidelity Speaker, White
SPSR	Wall High-Fidelity Speaker Strobe, Red
SPSRH	Wall High-Fidelity Speaker Strobe, High Candela, Red
SPSW	Wall High-Fidelity Speaker Strobe, White
SPSCR	Ceiling High-Fidelity Speaker Strobe, Red
SPSCW	Ceiling High-Fidelity Speaker Strobe, White
SPSCWH	Ceiling High-Fidelity Speaker Strobe, High Candela, White
SPSCRH	Ceiling High-Fidelity Speaker Strobe, High Candela, Red
SPSCW-CLR-ALERT	Ceiling High-Fidelity Speaker Strobe, Clear Lens, ALERT, White
SPSCW-P	Ceiling High-Fidelity Speaker Strobe, Plain, White
SPSCWH-P	Ceiling High-Fidelity Speaker Strobe, High Candela,Plain, White
SPSR-P	Wall High-Fidelity Speaker Strobe, Plain, Red
SPSRH-P	Wall High-Fidelity Speaker Strobe, High Candela, Plain, Red
SPSW-ALERT	Wall High-Fidelity Speaker Strobe, Amber Lens, ALERT, White
SPSW-CLR-ALERT	Wall High-Fidelity Speaker Strobe, Clear Lens, ALERT, White
SPSW-P	Wall High-Fidelity Speaker Strobe, Plain, Red
SPSWH	Wall High-Fidelity Speaker Strobe, High Candela, White
SPSWH-P	Wall High-Fidelity Speaker Strobe, High Candela, Plain, Red

Design Considerations

- Single Station / Multi-Station
  - B200S-LF/B200SR-LF Low Frequency Sounder Bases available January 2015
  - Current Draw Comparison

    - B200S Aux Power Alarm Current Draw 35mA
    - B200S-LF Aux Power Alarm Current Draw 140mA

    - B200SR Aux Power Alarm Current Draw 35mA
    - B200SR-LF Aux Power Alarm Current Draw 125mA

Q &A

Questions?

Code Changes and Alternative Technology

Sounders for Fire Alarm and ECS applications

For more information visit us:

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