

Making Sense of NFPA 72's Low Frequency Signal Requirements

NFPA 72: 2010 and 2013 edition's low frequency signal requirements have architects, specifying engineers, and building owners scratching their heads about the requirements, the purpose of which is to awaken as many people as possible in sleeping areas. The code has two important low frequency (520 Hz) signal requirements. One requires that *smoke alarms* in the sleeping areas within single and multi-family residences, hotels, and dormitories designated for individuals with hearing impairments, emit low frequency signals. The other requires that all *building fire alarm systems* in sleeping areas of newly constructed hotel, dormitory, and apartment/condominium facilities, as well as retirement/assisted-living facilities without staff responsible for waking residents, emit low frequency signals. This white paper explains why the code includes these requirements, provides details about the requirements, and describes current realities around meeting the code.

Why NFPA added 520Hz to its 72 Standard

In response to data showing that high numbers of elderly, very young, hearing-impaired, and alcohol-impaired people were dying in household fires during which smoke alarms functioned properly, the Fire Protection Research Foundation commissioned a study in 2005 to identify characteristics of alarm signals most effective in awakening all individuals—regardless of hearing acuity, age, blood alcohol level, or other factors. The research, performed at Victoria University in Australia, showed definitively that the most effective awakening signals were of lower frequency, and that the commonly used continuous high pitched 3 kHz alarm was least effective at awakening people. The improved results for the low frequency alarm signals applied to hearing-impaired individuals, alcohol-impaired adults, children under 10 (whose developing ears cannot hear high frequencies as well as adults), and other high-risk “staying asleep” groups. Interestingly, the better outcome also applied to sober adults.

The research results were so compelling that the NFPA standards committees subsequently incorporated the lower frequency alarm signal requirements into several chapters of the NFPA 72 Code.

What the code requires

To make sense of the NFPA 72 Code, it is important to understand how it applies differently to smoke alarms and fire alarm systems. Smoke alarms are standalone devices that contain a smoke detector and an alarm sounder in one discrete unit. When a smoke alarm is activated, it only alerts those near it. You likely have a number of smoke alarms in your home. A fire detection system, on the other hand, has many detectors monitored by a fire alarm control unit which typically sends signals to a central or remote station, and incorporates many separate alarm sounders in a building. When a fire detection system is activated, alarms sound throughout a building.

Smoke alarms are required in all residences, and both smoke alarms and smoke detection systems are required in every hotel or dormitory sleeping area. But the NFPA 72 Code requirements for low frequency (520 Hz) signals for smoke alarms and for smoke detection systems are different for different use cases. Here is the distinction.

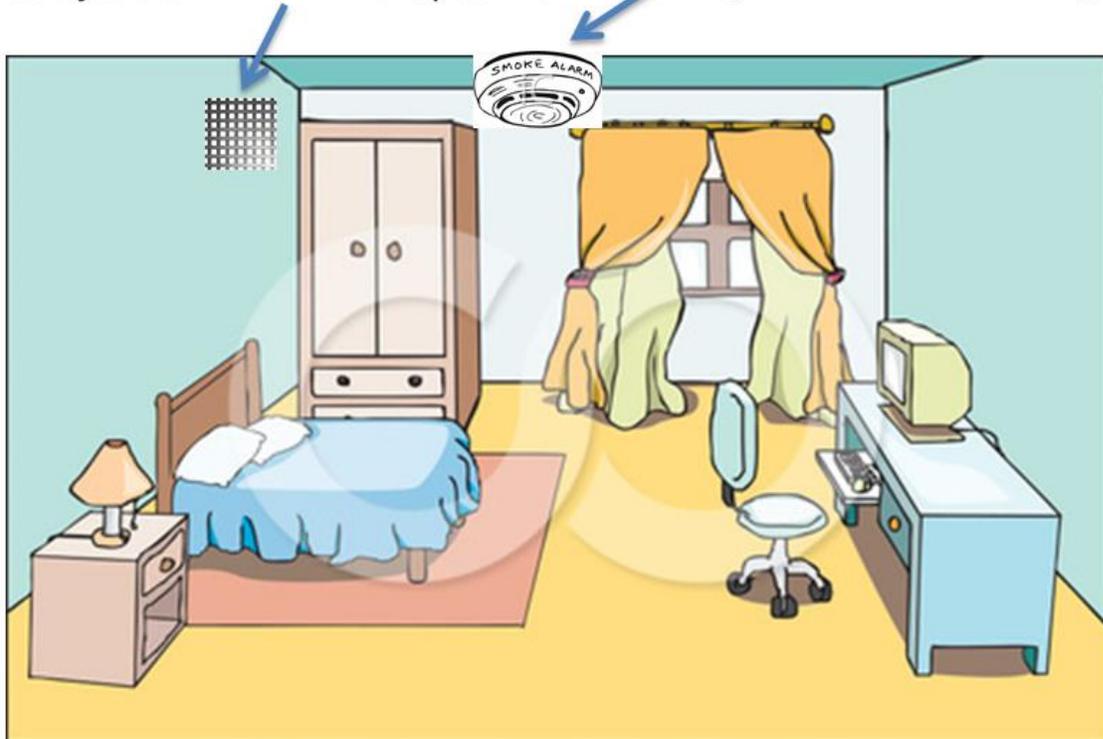
Chapter 29 covers only smoke alarms and household fire detection systems, and requires a 520Hz low frequency signal in residential, hotel, or dormitory **sleeping areas designated for people with mild-to-severe hearing loss** where required by governing laws, codes, or standards, as well as where provided voluntarily for people with hearing loss. This portion of the code was to take effect immediately upon its inclusion in the NFPA 72 Standard.

Chapter 18 covers fire detection systems, and requires 520Hz low frequency signals in fire detection systems in **all sleeping areas** of newly constructed hotel guest rooms and dormitory sleeping rooms. Unlike Chapter 29, which applies only to sleeping areas where occupants have self-identified as hearing impaired, this applies to all sleeping areas. The low frequency signals are intended to awaken people who are asleep, and thus are not required in non-sleeping areas such as hallways. Chapter 18, Notification Appliance, took effect on January 1st of 2014. Chapter 18 does not apply to sleeping areas within healthcare, correction/detention, and other facilities where on-site staff members are responsible for awakening sleeping occupants.

The picture below shows which chapter of the code applies to which life-safety devices in sleeping areas.

Subject to NFPA 72: Chapter 18

Subject to NFPA 72: Chapter 29



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Many find it confusing to determine which NFPA 72 code chapters apply to which use cases. The table below attempts to clear up that confusion by summarizing which chapter of the code applies to which facility type.

Building Type	Chapter 29 Low Frequency Code Applies	Chapter 18 Low Frequency Code Applies
Single-family Residence	Yes	No
Multi-family Residence	Yes	No
Apartment/Condominium	Yes	No
Dormitory	Yes	Yes
Hospital	No	No
Hotel/Motel	Yes	Yes
Correction/Detention Facility	No	No
Retirement/Assisted Living Facility (with 7 x 24 onsite trained staff)	No	No
Retirement/Assisted Living Facility (without 7 x 24 onsite trained staff)	Yes	Yes

Current realities

The current reality is that 520Hz-compliant smoke alarms are not yet available. So although NFPA 72: Chapter 29 stipulates that in households where people with hearing loss sleep, such alarms should be in place immediately, this requirement cannot be met today.

This is primarily due to lack of demand to date, and technical difficulties that make 520Hz-compliant smoke alarms difficult and expensive to manufacture. They also require more power than a typical smoke alarm—using multiple 9V batteries, compared to one in current off-the-shelf smoke alarms—and it is estimated that they will cost about five times more. Most smoke alarms use inexpensive and easy-to-manufacture Piezoelectric technology, in which oscillating voltage causes crystalline material to vibrate, producing a loud, high-pitched alarm that consumes very little current.

In contrast to high frequency alarms, a sounding device that produces a 520 Hz square wave tone that meets the NFPA 72 Code is neither cheap nor easy to make. Square waves have more penetrating qualities, but they are hard to generate—and generating them requires considerably more power than high frequency alternatives. A perfect square wave has instantaneous transitions between the high and low levels, which can never be fully achieved in the real world because of the physical limitations of any system that generates the waveform. The technology needed to satisfy this new requirement is evolving. As code adoption increases within specific markets and regions, cost-effective solutions will need to be developed and enhanced.

Tyco SimplexGrinnell's Position [for Internal Use]

The adoption of this new code is relatively new. Interpretation of the code varies among industry leaders, with some implying that the code requires low frequency alarm signals in all sleeping areas. The result may add expense to a project, not just for the alarm signals, but for additional power, cabinets, power supplies, cable, backup batteries, and maintenance. The local Authority Having Jurisdiction (AHJ) will ultimately interpret and enforce the code for each area. You should check with your local AHJ to determine the exact interpretation of this code in your situation.

Tyco SimplexGrinnell is scheduled to release new technologies by the end of 2014 to address the 520Hz requirement. Our technologies will meet NFPA 72: Chapter 18 requirements for a square wave 520Hz alarm signal. We are expanding our notification appliance offerings to serve our customers and provide the greatest system design flexibility. Our goal is to offer total compliance for all types of new or existing projects.