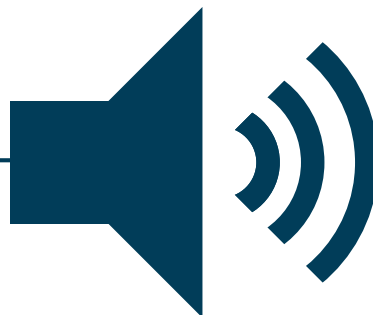


**Guidance
Note**



Fire Industry Association

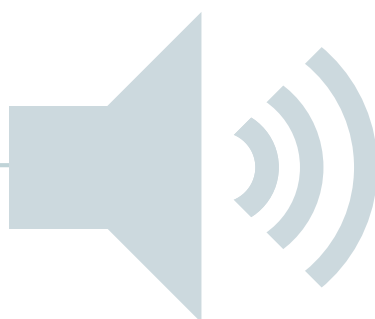
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**Guidance Document – Fire alarm considerations
for people with sensory sensitivities**

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2. INTRODUCTION

In recent years, technology has advanced and produced fire alarm devices which are capable of providing higher audible and visual outputs. Whilst BS 5839-1 addresses the needs of those who have a hearing impairment and those with photosensitive epilepsy, the code does not address the needs of those with other sensory sensitivities who may not behave as designers expect during an evacuation. Those with hypersensitivities are highly likely to have an extreme emotional reaction to sudden loud noises or bright/flashing lights. Behaviours in response to becoming overloaded can include screaming, crying, running, freezing or hiding. In this state, individuals may not be able to respond to direction or instruction. Emotional upset can last for hours after an event.

This document is intended to provide guidance to those involved in the specification, design, and application of fire alarm systems in premises where occupants have sensory sensitivities. Examples include special schools, units and resource provisions for autistic students within mainstream schools, as well as some types of day centres, residential care premises and supported housing. The guidance herein may be applicable to any situation where the fire alarm is intended to notify, but where occupants may not respond in a safe or predictable manner.

This document aims to identify the considerations that should be taken into account for certain fire alarm systems but does not offer any recommendations for any specific situation. This should always be subject to a risk assessment by competent persons. Competency should relate to both fire alarm design and also to understanding the needs of the occupants.

3. BACKGROUND

Contrary to popular belief, there are more than 5 human senses: smell, touch, taste, hearing, sight, vestibular (body movement), proprioception (body awareness) and interoception (internal body awareness). Individuals can be either hyper-sensitive or hypo-sensitive to sensory stimuli. Those with hyper-sensitivities have a heightened response to stimuli and can become overstimulated and experience an increased emotional reactivity. They may experience sensory overload. Contrastingly, those with hyposensitivity have a significantly reduced response to stimuli. Both of these conditions, in excess, are symptoms of a sensory processing disorder. While sensory processing disorder and autism are different disorders, they are commonly linked – in fact, traits of hypersensitivity or hyposensitivity are used (in association with other tests) to diagnose autism, (a sensory disorder alone is not an indication of autism). Other terms for sensory processing disorders include sensory issues, sensory difficulties, sensory challenges or sensory overload. People with autism commonly have such issues and it is estimated that there are around 700,000 people in the UK, including one in 100 children, with a diagnosis of autism spectrum disorder (ASD) (Source: [British Medical Association](#)).

The human responses to audible alarms can vary from person to person. Where a person is highly sensitive to loud and sudden noises, they are likely to have an adverse or unpredictable reaction to unexpected, loud audible alarms. Visual alarms can also negatively affect those with sensory processing disorders who find sudden flashing lights disorientating. There is already guidance in relation to visual alarms which seeks to ensure those with photosensitive epilepsy are not triggered to have seizures.

The responses to an audible or visual alarm can cause an adverse reaction irrespective of the cause of the alarm – whether it is a routine test, a fire drill, a false alarm, or a real fire situation. Giving individuals prior warning of tests and drills at least removes the element of surprise and enables mitigating measures to be organised, such as ear defenders or relocation of individuals near to a final exit. However, such preparations are not an option during an unexpected alarm situation and we need to identify better fire alarm design solutions to prevent adverse reactions occurring.

Employers and service providers have a responsibility for ensuring that all people, including those with disabilities, can evacuate safely from the building they control in the event of a fire. A warning system forms part of the evacuation procedure and therefore, those responsible for the systems should ensure they meet the relevant legislation inclusive of the Equality Act 2010.

4. THE PROBLEM

Fire alarm warnings in non-domestic premises should follow the recommendations of BS 5839-1 clause 16 (Audible alarm signals). However, strict application of these recommendations may cause problems for people with sensory sensitivities. Consideration needs to be given to alternative methods of providing adequate warning of fire whilst still following the intent of the Code of Practice.

When strict adherence to the recommendations in BS 5839-1 is deemed unsuitable for the application, a “variation” should be sought from all interested parties as discussed in Clause 7 of BS 5839-1.

5. GUIDANCE AVAILABLE

It is well recognised that allowances are often made for people in hospitals and residential care home settings. The guidance in The Health Technical Memorandum document ([HTM 05-03 Part B](#)) allows for reduced volume of audible alarm devices, or provision of alarm devices capable of producing musical output, in areas where a loud alarm warning would cause unnecessary anxiety to patients.

For schools, Building Bulletin 100 ([BB100](#)) provides general design recommendations for fire safety in schools, but separate guidance is provided for children with disabilities and special needs. The original Building Bulletin 102 ([BB102](#)) for disabled children and children with Special Educational Needs (SEN), indicates (in the section on “Fire alarm and detection systems”) that where there are diverse needs, alternative alarm systems may be used – including voice alarms and visual alarms. Unfortunately, BB102 was withdrawn on 25th June 2018 and superseded by [BB104](#), which does not give any guidance on fire alarm provision and suitability for those with sensory sensitivities. However, despite this, the general guidance of BB102 is still widely regarded as relevant.

It is particularly important to appreciate that the guidance contained in Building Bulletins, in HTMs and in BS 5839-1 are recommendations; none of them are specifications or regulations. For example, HTM 05-03 Part B paragraph 1.13 clarifies “It is therefore recommended that contracts should also include appropriate technical specifications interpreting these recommendations to suit the particular site circumstances”.

Further information can be found in the NFCC [Fire Safety in Specialised Housing](#) guide which, at the time of writing this document, is undergoing a revision. It is recognised that the needs of those people in supported housing for instance, may to some degree be similar to those in residential care homes.

Further comment on the recommendations of these national documents is given in the “Appropriate solutions” section below.

In addition to these national documents, East Sussex Fire & Rescue Service have provided helpful [fire safety advice](#) for autistic children and adults based on a variety of sources including the National Autistic Society. It explains that children and adults with autism and other special needs may have unexpected reactions to a smoke alarm or a fire. They could get distressed and become overwhelmed, particularly in relation to loud, sudden noises. They could react by hiding, freezing, running, crying, avoiding, screaming and other reactions. The guidance helpfully points out that there is a spectrum to sensory sensitivities and that whilst some people with ASD may require significant support in their daily lives, others can live entirely independently.

6. DEPARTING FROM THE RECOMMENDATIONS OF BS 5839-1

BS 5839-1:2017 clause 7.1 discusses that the recommendations in the Code of Practice are “based on recognized good practice” and “they are likely to be suitable for the majority of normal applications”. The commentary notes that strict application of the recommendations may lead to systems being unnecessarily expensive or, in extreme cases, be inadequate to provide the appropriate level of protection.

This clause then explains that variations are “aspects of design that were appropriate and intentional, albeit not compliant with one or more recommendations of the standard”. Some variations may arise from the findings of a fire risk assessment, or may be detailed in the building’s fire strategy or included as part of the fire alarm design.

As the minimum recommended values expressed in the code (e.g. sound pressure levels) are often arbitrary and based on proven custom and practice, or on the judgement of experts, it may for instance, be appropriate in certain situations to deviate from the minimum recommended values. This should always be the subject of specific agreement by all interested parties and clearly identified in the relevant system documentation.

Thus, variation from the recommendations of the code is possible/necessary where they make sense and are appropriately justified and recorded.

7. OCCUPANTS’ NEEDS

It is important to ensure that the fire alarm is designed to be appropriate for the occupants of the building. Designers need to be aware of any sensory sensitivities that building occupants are likely to have. As discussed earlier, this is particularly relevant in some categories of special schools, such as those catering for communication and interaction needs, cognition and learning needs, social, emotional and mental health needs, and sensory needs. It is also relevant to units and resource provisions which cater for these needs, and which are attached to mainstream education facilities. It is also relevant to some types of day care centres and some types of residential care premises.

- BS 5839-1:2017 highlights the importance of the designer understanding the needs of the occupants and providing a specification for the system, which is appropriate for the building users. HTM 05-03 Part B discusses tailoring the fire safety strategy to the occupant profile in paragraph 1.15, and paragraph 1.16 advocates that “the specifier/designer of the system should therefore consult all those concerned with the design and operation of the system...”.
- HTM 05-03 Part B states in paragraph 1.6 that “It is understood that the dependency and behaviour of building occupants can greatly influence the efficacy of fire safety precautions. As every occupant must be provided for appropriately, the measures installed must recognise and address the local needs of those at greatest risk”. Moreover, in paragraph 5.1.6 it states that “immediate and appropriate response in the event of fire is essential to the safety of patients...”
- BB102, although now withdrawn, stated on page 158 that “The most suitable warning methods will depend on school building occupants”.

Current guidance gives detailed information in relation to people who have a hearing impairment or who are epileptic – see Clause 18 of BS 5839-1:2017, and paragraph 4.2.1.2 of BB100. However, current guidance does not address the issue of sensory sensitivity. Current guidance on special schools (BB104) makes no mention of occupants and adverse reactions to loud noise such as fire alarms. BB100 advocates that a number of things should be considered when designing the building (paragraph 4.1.3.1) but fails to include occupants and their needs as an aspect – this is unhelpful. Despite this, BB100 does discuss how pupils should be familiar with how to leave the school quickly and with minimum anxiety in an emergency, particularly while the fire alarms are sounding (paragraph 4.1.3). HTM 05-03 Part B clarifies that “causing confusion and distress to occupants is unhelpful” in paragraph 4.18.

8. APPROPRIATE SOLUTIONS

Although now withdrawn, BB102 suggests on page 158 that “Where there are diverse needs, alternative alarm systems may be used:

- Voice alarm systems (as part of a public address system)
- Visual beacon (VID) alarms in certain areas
- Vibrating paging systems for hearing impaired and other disabled people”

Currently, HTM 05-03 Part B provides the most appropriate guidance on fire alarm provision which accommodates those with sensory sensitivities, albeit under the auspices of mental health patients: “The alarm system serving this occupancy should be configured in a manner appropriate to the needs of the patient profile”, in paragraph 4.19.

Voice alarm systems

Voice alarms can be less startling than sounders so may be more appropriate for those with sensory sensitivities, particularly if the voice, message and accompanying tone are carefully chosen. Voice alarms can provide clear information and instruction. They also provide a break in the alarm tone whilst the voice message is playing.

BB100, in paragraph 4.2, recommends that “Consideration should be given to installing a voice alarm system” – this would be particularly appropriate in a school which had a unit or resource for children with sensory sensitivities, although it should also be remembered that many mainstream schools now also accommodate children with disabilities.

HTM 05-03 Part B recommends in paragraph 4.26 that “In some healthcare premises, it may be desirable (or beneficial) to incorporate the use of voice alarm systems. Any voice alarm system must comply with BS 5839-8”.

Voice alarm systems could take the form of standalone voice sounders or a system comprising a central CIE and distribution of speakers, where a message is delivered to the listener.

Conventional sounders could be swapped for voice sounders, although it will be important to check audibility and intelligibility. There will likely be a small additional cost for each voice alarm device in comparison to standard audible sounders.

BS 5839-8 recommends that an attention drawing signal should precede the message. However, commentary in Clause 20 of BS 5839-8:2013 states “Care needs to be taken that this attention-drawing signal does not encourage panic, yet draws the attention of the listener to the message which follows”. Clause 20.1 then recommends “The characteristics of the attention-drawing signal should be agreed between the building operator and the relevant parties”. This could, for example, be a less startling sound such as meeting [chimes](#). Alternatively, a 2-tone sound alternating no more than every 0.5 seconds which fades in and out and operates between 550Hz and 825Hz is significantly less startling. The evacuation tones provided by some products on the market meet these parameters. Products also exist which allow you to record your own voice and accompany it with the tone of your choice, which allows greater flexibility in designing a more appropriate solution, although this should be in line with BS 5839-8.

Where it is felt that any attention-drawing signal is inappropriate and would cause alarm or undue upset, its removal could be justified and considered as a variation, subject to agreement with all interested parties.

Visual alarm devices

The commentary of BS 5839-1 Clause 17 discusses the use of visual alarm devices in situations where disturbance by an audible warning would be undesirable.

There are two types of visual warning devices used in fire alarm systems – Visual Indicating Devices (VIDs) and Visual Alarm Devices (VADs). VIDs are used to supplement the audible sounders, whereas VADs are used to provide a primary alarm warning signal for alerting or evacuating the occupants of a building (e.g. for people who are hearing impaired). VADs are designed to meet the requirements of BS EN 54-23 and will give a specific light output.

For people with sensory sensitivities, the light output from VADs might be overwhelming and frightening. In contrast, VIDs may not produce as bright an output but still give a visual indication of fire. The level of light output of a VID may be adjustable and by choosing a VID with a wide range of adjustability this may be appropriate in buildings accommodating people with sensory sensitivities or photosensitive epilepsy. It is important to remember to synchronise any visual warning devices to avoid a strobe effect.

HTM 05-03 Part B says in paragraph 4.25 that “Visual alarm devices may be provided as an alternative to alarm sounders in areas where an audible alarm is unacceptable” and gives the example of very high dependency patient access areas, such as operating theatres, ITU and special care baby units. It may be necessary to label the visual alarm devices with the word “FIRE” in order to distinguish them from other visual signals.

Portable alarm devices

Devices such as pagers can be used to supplement the primary means of giving an alarm of fire. They may be appropriate in situations such as schools, to alert teachers and key personnel to an incident so that an evacuation can be managed safely.

Pagers would be useful if used with an investigation period in a staff alarm arrangement, to limit the impact on people when false alarms occur. However, there can be large associated costs for additional panels and boosters to ensure adequate radio signal strength across the site and there are ongoing costs for battery replacement. Staff would also need to remember to carry the pagers at all times.

It should be noted that, at the time of writing this document, there are no British Standard specifications for such equipment. Therefore, following the recommendations of BS 5839-1:2017 Clause 18 and Annex C would give some assurance that the use of portable alarm devices will be effective in the warning of fire to appropriate personnel.

Sound levels

BS 5839-1 recommends a minimum sound pressure level of 65 dB(A) throughout all accessible areas of a building (relaxed to 60 dB(A) in some specific areas). The code also recommends a maximum sound pressure level of 120 dB(A). This means the fire alarm system could be compliant even if sound levels are excessive at the top of this range. It can be difficult to design the location and type of sounders to comply with minimum recommendations without knowing all the building details, so often the solution is overprovision and results in excessively loud alarm systems. For those with sensory sensitivities, this can produce extreme adverse reactions when the fire alarm activates and hinder organised evacuation of the building, which is counter-productive to the intended response.

In some situations, BS 5839-1 deems that it might not be appropriate to provide a warning to all occupants throughout the building. For example, in hospitals and certain residential care premises in which occupants might need assistance to evacuate. Given the adverse reactions of some individuals with sensory sensitivities, it seems appropriate to include special schools, day centres and mainstream units or resource provisions in this bracket where occupants have this disability.

HTM 05-03 Part B gives us further guidance, relating to mental health patients where, when confronted with high sound pressure levels, there is a risk of them reacting adversely in a manner that may prove detrimental to an evacuation. It is therefore recommended that the design of the alarm system take account of the nature of the occupants and mitigates the potential for this unpredictable reaction. Furthermore, the guidance recommends that, in those areas accommodating mental health patients, alarm devices should be of reduced volume and capable of alerting staff without causing unnecessary anxiety to the patients.

Within high dependency units, HTM 05-03 Part B advocates that the audibility of the general alarm in areas where patients require assistance to evacuate need only be typically in the range 45-55 dB(A), or 5 dB(A) above the notional noise level, whichever is greater. As far as possible, sound pressure levels in excess of this should be avoided. Within some special schools, the activities intentionally seek to maintain quiet and calm for the benefit of the students. The assumption that background noise levels in special schools will mirror those in mainstream may not be valid. As well as understanding the disabilities of occupants, it would therefore be appropriate for fire alarm designers to discuss background noise levels with building managers in order to assess appropriate sound pressure levels. Variations to the sound pressure levels given in BS 5839-1 can reasonably be made using risk assessment and will be of significant benefit to both occupants and staff, facilitating a more organised evacuation of the building.

In designing sounder locations, it might be preferable that a greater number of quieter sounders, rather than a few very loud sounders, be used to prevent noise levels in some areas becoming too loud. Similarly, the selection of sounders with a wider range of adjustability is helpful. It should be noted that, whilst most electronic sounders are adjustable, electronic bells are not. HTM 05-03 Part B advises that devices used to produce the audible alarm may be bells or electronic sounders but electronic sounders having an adjustable sound output may be more beneficial in some circumstances. The extent of adjustability to sound pressure levels possible for individual devices varies between manufacturers and products. High output sounders are considered inappropriate for most settings where there are people with sensory sensitivities. Open area sounders are intended for open spaces. It might be considered appropriate to install a single sounder in each room (e.g. in a classroom, dance studio or small hall) intentionally set at an appropriate sound pressure level, perhaps with a supplementary visual indicator which is labelled "Fire alarm" and which (where in a classroom) is sited on the wall at an upper corner of the whiteboard. Sounders should be sited furthest away from the door – this encourages occupants to walk away from, rather than towards the noise.

In larger areas such as sports halls, wall mounted sounders are likely to be most appropriate. In these scenarios, the correct selection of output sound pressure is essential. It might be more suitable to have a lower sound pressure accompanied by visual warning from a VID.

In rooms where ambient noise levels can be high, such as Design Technology workshops in a school, BS 5839-1 seeks to achieve 5 dB(A) above background noise for the fire alarm sounders. In these scenarios, where occupants have sensory sensitivities, it may be more appropriate to isolate power to the machines thereby silencing the machines, rather than increasing sound levels. The use of visual alarm signals in these areas (where hearing protection is likely to be worn) is also recommended in 17.2 of BS 5839-1, although for those with sensory sensitivities VID's are considered more appropriate than VADs.

BS 5839-1 advises that “Particular care needs to be taken to ensure adequate sound pressure levels in small cellular spaces, such as cellular offices, toilets and plant rooms”. It gives no mention of how hard wall and floor surfaces in toilets will magnify sound levels. Installation of open area sounders within small rooms with hard wall surfaces, such as toilets or changing rooms, is highly inappropriate for individuals with sensory sensitivities given the sound pressure levels produced. Therefore, careful consideration needs to be given to siting fire alarm sounders within toilet areas, particularly as individuals may exhibit adverse reactions to excessive sound levels and choose to lock themselves in a toilet cubicle. Given that toilets are generally quiet areas which are visited for only a short period of time, consideration might be given as to whether sounders can be excluded from within these areas as a design variation under risk assessment. Similarly, the installation of fire alarm sounders within small classroom cupboards (as opposed to store rooms) is considered to be inappropriate given that they are only likely to be accessed with the door open.

It is suggested in this document that a lower sound pressure level is more appropriate, and that a deliberately selected tone which is less startling is also helpful. There is no standard fire tone adopted in the UK and there are a wide range of available tones on the market and used within buildings. Many sounders on the market have up to 32 selectable sounds and some tones are more appropriate for those with extreme sensory sensitivities than others based on how startling they are. As a rule, a low tone is generally more effective than a high frequency. When installing a new fire alarm system in buildings which have occupants with sensory sensitivities, time spent discussing available sounds and tones with clients is likely to ensure a much more appropriate fire safety solution. In general, sweep sounds are less likely to be appropriate because they are startling whereas 2-tone alternating sounds with a minimum 0.5 seconds between change are more likely to be appropriate and less startling, particularly if within the alternating range of 550Hz to 825Hz.

It is feasible to depart from the British Standard and design variations into a fire alarm system, where it is appropriate to do so. As an example, BS 5839-1 recommends that the sounders should produce a continuous output, although the frequency and amplitude might vary (e.g. as in a warbling tone), to indicate the need for evacuation or other immediate response. Whilst these are recommendations made in the British Standard, agreed variations can be made on a risk assessment basis and are valid, as long as rationale and details are fully documented.

Fire alarm tone

It is important that, in all buildings, there is a common fire alarm sound across a site. A single easily distinguishable sound reduces potential confusion. BS 5839-1 recommends that on a site where occupants move regularly between buildings, there is a benefit to adopting a fire alarm signal that has similar sound characteristics throughout all buildings. One example of this is a school with numerous blocks. To avoid confusion, within a building which adopts a simultaneous evacuation strategy, sounders ought to be sited and programmed so that they synchronise and do not produce a staggered output.

For those with sensory sensitivities, or who may have particularly extreme reactions and are unable to function independently, musical output may be a more appropriate provision than an alarm sound. This is mentioned in HTM 05-03 Part B paragraphs 4.20 and 5.20 and is worthy of discussion with the client. This coded alarm alerts staff whilst providing minimum disturbance to patients and has been used successfully in a limited number of special schools and residential care settings. However, most individuals with disabilities will need to learn what a fire alarm sounds like and how to respond appropriately in order to live a more independent life. For these individuals, it would be unhelpful not to assist them in gaining this skill, so a fire alarm sound may be preferable. However, unlike some countries, in the UK there is no standard adopted fire tone. Therefore, it would be both beneficial and appropriate to select a tone which is less startling, and have it operate at a sound pressure level that produces the required response of evacuating without extreme adverse reactions.

External sounders

It is common, especially in school buildings, to install fire alarm sounders externally. Installing high output and open area external sounders on a building for those with sensory sensitivities means they are likely to remain affected by the loud noise even at the assembly point. This is unhelpful and prevents individuals from calming. Siting these sounders close to final exit doors exacerbates the problem since occupants will need to pass them to leave the building, causing further distress. This, again, should be discussed at an early stage, taking into account the points raised in this document.

Documenting variations

Any variations from the recommendations BS 5839-1 should be clearly identified and should be agreed amongst the interested parties. All variations should be listed on the relevant system certificate.

It is also important that maintenance personnel and fire risk assessors are aware of the variations. In particular, major non-compliances that are agreed variations should be clearly recorded in the logbook so that they are readily available for future reference by maintenance companies and any other interested parties.

9. CONCLUSIONS

Much has been done in recent years to achieve higher audible and visual outputs, ensuring the safety of building occupants who have a hearing impairment. This guidance document has considered how we can improve on existing provision and design fire alarm systems that are more appropriate for those with sensory sensitivities.

It has highlighted the importance of ensuring that the system is appropriate for the user, the issues that those with sensory sensitivities tend to have with fire alarms and the adverse reactions that can occur. Guidance in HTM 05-03 Part B for mental health patients has been highlighted as being particularly appropriate for people with this disability.

Careful selection of a sound and tone is advocated and ensuring that sound pressure levels are appropriate is of paramount importance. The application of the variation process has been explained and identified that variations made via a risk assessment process can be both reasonable and valid, but rationales and details should be fully documented.

It is anticipated that this guidance document will encourage designers to collaborate with clients to gain a full understanding of building occupants, and thus provide for fire alarm systems that assist evacuation in preference to inappropriate application of the recommendations of a national code which are likely to cause distress and hamper the evacuation of those with sensory sensitivities.

This guidance document will assist fire risk assessors in asking appropriate questions as part of their work, particularly when assessing special schools, mainstream schools with resource provisions or units, day centres or residential accommodation.

DISCLAIMER

The information set out in this document is believed to be correct in the light of information currently available but it is not guaranteed and neither the Fire Industry Association nor its officers can accept any responsibility in respect of the contents or any events arising from use of the information contained within this document.



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