



# The impact in the workplace of hearing protector standards development

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## Summary

Hearing protectors can be an important part of a noise control programme. But they will only be an effective control measure if they are selected, used and maintained in an appropriate manner. Anecdotal and experiential evidence suggests that the myth ‘the hearing protector with the biggest number will do the best job’ still pervades. A consequence of this belief is that hearing protectors may overprotect the user’s hearing, which can lead to workplace injuries and even fatalities.

In 2004, European guidance document EN 458 was issued to help users select, use and maintain their hearing protectors. Since then, many different types of hearing protector have been developed, which are now available for purchase within the European market. This wide choice can present a challenge to those responsible for hearing protection selection. The CEN Technical Committee Working Group with responsibility for EN 458 (TC 159/WG 5) has completely revised the document to take account of the much larger selection of hearing protectors and the criteria that influence their selection.

The CEN Technical Committee Working Group with responsibility for the EN 352 hearing protector product safety standards (TC 159/WG 6) is trying to reduce the minimum attenuation requirements that are placed on hearing protector manufacturers. The current product safety standards do not allow for low attenuation hearing protectors, although user demand for such protectors is growing.

This paper discusses the changes to both EN 458 and the EN 352 series of standards, highlighting how these changes are likely to affect hearing protector choices in the workplace. It will also highlight the continuing need for education in hearing conservation, what happens when hearing protection selection goes wrong, and why one size does not fit all.

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## 1. Introduction

Hearing protectors can be an important part of a noise control programme in the workplace. But they will only be effective if they are selected, used and maintained in an appropriate manner. Anecdotal and experiential evidence suggests that the myth ‘the hearing protector with the biggest number will do the best job’ still pervades. A consequence of this belief is that hearing protectors may overprotect the user, which can lead to workplace fatalities.

There is a wide range of hearing protectors from which to choose, but the product and test standards involved are small in number. It is therefore not unreasonable to suggest that developments within this small group of standards could have a large effect on hearing protection choices in the workplace.

## 2. Hearing protector standards

Two CEN<sup>1</sup> Technical Committees (TC) within the European Union, TC 159 and TC 63, have overall responsibility for hearing protector standards, including EN 458 and the EN 352, EN 13819 and EN 4869 series of standards. This paper focusses on EN 458 and EN 352, for which TC 159 is responsible. TC 159 has a number of working groups (WG), each of which is made up of national experts; WG 5 is responsible for EN 458 and WG 6 covers parts of the EN 352 series of standards.

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<sup>1</sup> Comité Européen de Normalisation (European Committee for Standardisation)

### 3. EN 458: a complete revision

In 2004, EN 458 [1] was published as a guidance document to help users within European Member States select, use, care for and maintain their hearing protectors. Since then, many different types of hearing protector have been developed, which are now available for purchase within the European market (Figure 1). Correct selection of a suitable hearing protector from the wide choice available can be challenging.



Figure 1. Examples of available types of hearing protectors.

#### 3.1. The revision process

WG 5 has been actively working on the revision of EN 458 since 2012. EN 458 was revised following the process specified by CEN. This included extensive technical revision by the WG followed by a wider technical and editorial review within each Member State. Publication of the revised EN 458 in the Official Journal of the European Union (OJEU) is anticipated for mid-2015. When published in the OJEU, the draft revised standard will become the revised, published standard.

#### 3.2. Changes in the revised version of EN 458

The revised version of EN 458 is designed to help those with responsibility for hearing protector selection, to make an informed choice. It also provides information to all those who wear hearing protectors. The advice and guidance included in EN 458 has been deliberately written so that it does not burden the reader with overly technical information. Some technical appendices are included for further information, but, with the exception of Appendix A, they are not essential for hearing protector selection.

The content of EN 458 has been extended to cover the many different types of hearing protector now available in the EU. In addition to traditional passive earmuffs and earplugs, it also covers hearing protectors with additional functionality

such as level-dependent features, active noise reduction and external audio input.

The guidance on selection within EN 458 is now designed to allow the end-user to cross-reference their choice of hearing protector against individual requirements. These include: type of noise hazard; work environment; communication requirements; compatibility with other personal protective equipment (PPE); type of hearing protector; medical requirements; ergonomic requirements; intrinsic safety and electromagnetic compatibility.

The section on use of hearing protection has been expanded to include advice and guidance on the importance of training and education.

Existing EN 458 annexes have been revised and new ones added:

- Annex E now includes a simpler method for calculating the maximum number of hours for which the audio input on a hearing protector with audio input can be used;
- Annex F (new) gives guidance on improving the use of hearing protection in the workplace;
- Annex G (new) gives guidance on fit check methods for hearing protection;
- Annex H (new) gives pictorial representations for the different types of noise referred to in the main body of the text.

The revised version of EN 458 is more extensive than its predecessor. However, it was recognized during the review process that while some EU Member States are likely to write their own guidance, complementary to EN 458 others will rely solely on the standard. With this in mind, the type of language used was carefully considered.

### 4. EN 352: lowering the minimum attenuation requirements

Parts 1 to 3 of the EN 352 series, published in 2002, are product safety standards. Subsequent parts of this series are dedicated to specialized types of hearing protector, for example, earmuffs and earplugs with a level-dependent facility. However, all require initial basic testing in accordance with one of the first three parts.

Table 1 in EN 352 parts 1-3 [2][3][4] details the minimum attenuation requirements a hearing protector must meet. This information is repeated in Table I.

Table I. Minimum attenuation requirements for hearing protectors (from EN 352-1:2002)

Frequency Hz	125	250	500	1000	2000	4000	8000
( $M_f - s_f$ ) dB	5	8	10	12	12	12	12

Frequency: octave-band centre frequency

$M_f$ : mean attenuation data

$s_f$ : standard deviation

WG 6 has been aware for a long time that these minimum attenuation requirements, particularly at low frequency, restrict the production of hearing protectors with low attenuation values. Low protection devices can be made, but as they do not meet the minimum attenuation requirements of EN 352 they cannot be CE marked nor therefore be sold in the EU. WG 6 agreed that the minimum attenuation requirements should be lowered but the quality of the hearing protectors coming onto the market should be maintained. In early 2013, after extended dialogue, debate and technical discussion, WG 6 agreed the following changes: the minimum attenuation requirements specified in EN 352 should be maintained, but expressed in terms of the H, M and L values rather than in octave-band values ( $H = 12$ ,  $M = 11$ ,  $L = 9$ ), with the requirement that the  $APV_{98}$  (Assumed Protection Value for 98% of the sample population) must be greater than or equal to 0 dB at all current mandatory octave-band test frequencies.

The modifications agreed by WG 6 should allow hearing protectors with lower attenuation than previously possible to be CE marked. However, some Member States would have preferred to reduce the minimum attenuation requirements further, allowing much lower attenuation devices to be CE marked.

Modifications to the minimum attenuation requirements in EN 352 parts 1-3 should have been implemented as a technical amendment to the 2002 documents as soon as the modifications were agreed in early 2013. Unfortunately this did not happen. These changes will instead be included in the next full review of the standards, currently in progress.

## 5. Use of hearing protection in the workplace

### 5.1. Demand for low attenuation hearing protectors

The Physical Agents (Noise) Directive 2003/10/EC [5] introduced lower noise exposure action values for employees' workplaces. This reduction meant that more employers found themselves having to comply with the requirements of the Directive (and the national regulations that implemented these requirements); some for the first time. Moreover, employers whose employees' daily noise exposure levels,  $L_{EX,8h}$ , were estimated to lie between 80 and 85 dB(A) were now required to supply hearing protection upon request.

The UK Health and Safety Executive (HSE) provides guidance on the hearing protection performance likely to be suitable for different levels of noise (this guidance is based on noise levels rather than noise exposures) [6]. This guidance is reproduced in Table II. It is based on the SNR value (single number rating), which should be provided with a CE marked hearing protector. Table II is intended as a guide; it is not intended as a substitute for more accurate selection methods, and in particular is not appropriate if there are significant low frequency components to the noise.

Table II. Indication of protection factors

A-weighted noise level (dB)	SNR
85 to 90	20 or less
90 to 95	20 to 30
95 to 100	25 to 35
100 to 105	30 or more

Table II indicates that when the A-weighted noise level is between 85 and 90 dB a hearing protector with an SNR value of 20 or less is likely to be suitable. Due the restrictive minimum attenuation requirements, there are very few products that fall into this category.

The full revision of EN 458 and the lowering of the EN 352 minimum attenuation requirements seek to address the demands of those employers who try to provide suitable hearing protectors that do not overprotect.

## 5.2. The consequences of overprotection

Overprotection occurs when the supplied hearing protection provides too much attenuation, making the level at the ear of the wearer too quiet. This may cause difficulties with communication and audible warning signals, leading to safety risks.

Overprotection may also cause users to feel isolated from their environment, making them likely to remove the hearing protection and risk damage to their hearing.

Overprotection can occur when little thought has been given to the hearing protector selection. An employer may be aware of the need to protect hearing but unaware of any kind of selection process. They may, with good intentions, choose a hearing protector with the largest attenuation value.

Overprotection can also occur when an employer has estimated the level of protection needed, but no hearing protectors are available on the EU market with the required performance characteristics.

## 5.3. Custom-moulded earplugs – just one of many options

A pervading myth is that custom-moulded earplugs can solve a lot of the challenges associated with other forms of hearing protection, for example continuity of fit. For some wearers, custom-moulded earplugs may be easier to fit than other types of earplug; there is however, an associated belief that more predictable levels of protection are afforded by a custom-moulded earplug. This belief is misplaced; custom-moulded earplugs come with their own set of challenges.

HSE carried out a study [7] on a selection of CE-marked custom-moulded earplugs available in the UK. The purpose of the work was to examine the protection provided by such devices and identify any influencing factors on protection, comfort and fit.

The attenuation data for five models of earplug were obtained using the subjective test method described in EN 24869-1 [8] using either six or seven subjects. Apart from one poorly performing self-moulded earplug, the earplugs provided attenuation (SNR values) in the range 16 to 24 dB. The measured attenuation for all the earplugs was lower than indicated by the manufacturers' attenuation data; statistical analysis suggested that three of the five earplug models tested were not adequately represented by the manufacturer's attenuation data. There was no evidence to support the view that custom-moulded earplugs provide

more predictable levels of protection compared to other forms of hearing protection.

When checked against the labelling and information requirements of the relevant product standard, EN 352-2:2002, only one of the custom-moulded earplugs completely satisfied the requirements of the standard. Missing information typically included attenuation data and fitting instructions.

A certain level of skill, training and experience is required to take ear impressions for custom-moulded earplugs. During the study, a custom-moulded earplug intended to be moulded by the end user gave very low attenuation values where the end user was unfamiliar with the ear impression process. It is important therefore that skilled, trained and experienced personnel are used to make ear impressions for custom-moulded earplugs.

Custom-moulded earplugs can be considered as one of many hearing protector options. However the user should be aware of the possible issues associated with the manufacturer and use of this type of earplug.

## 5.4. Educating employers and employees

The case studies highlighted in this paper, and those available on the HSE website [9], clearly demonstrate the need for both employees and employers to receive ongoing training and education in the area of hearing conservation. This includes the correct selection, use, care and maintenance of hearing protectors. Experiential evidence suggests there is a belief that the issue of workplace noise is considered as 'dealt with'. However, a rising number of insurance claims for noise-induced hearing loss suggest that this is not true. Employers and employees still require training and education on hearing conservation, and on the use of hearing protectors within such a programme. This can take many forms including 'toolbox talks', fit-testing [10] and e-learning [11].

## 6. What happens when hearing protection selection goes wrong

### 6.1. Case study 1: the fork lift truck drivers

Fork lift truck (FLT) drivers were issued with earplugs with an SNR value of 21 dB. A-weighted noise levels at the ear of FLT drivers were between 74 and 94 dB(A); the  $L_{EX,8h}$  was 80 dB(A). The estimated effective level at the ear was 69 dB(A), which indicated that overprotection was an issue. Overprotection in this particular work environment, with moving vehicles and the

dependency on audible reversing alarms, presented a serious safety issue.

Two hearing protectors were identified as being suitable: an earplug with an SNR of 16 dB and an earmuff with an SNR of 23 dB. The estimated effective level at the ear for these hearing protectors was between 71 and 73 dB. Although low attenuation hearing protection is available, it is difficult to find and choice is limited.

## 6.2. Case study 2: the recycling operative

A kerb-side recycling operator was fatally injured after being knocked over by a car. The operative was wearing an earplug with an SNR of 28 dB at the time of incident. The noise levels at the accident site were between 71 and 79 dB(A), generated by passing traffic and the recycling vehicle. The estimated effective level at the ear was 56 dB(A), which suggested that correct use of the earplugs would have made it extremely difficult for the operative to have heard the sound of the approaching car until it was too late.

## 7. Conclusions

There are a relatively small number of European standards pertaining to hearing protectors, which have the potential to influence a large number of people, workplaces and products. Custodians of standards shoulder a great responsibility to produce effective documents.

When the current draft of EN 458 is published, it will provide advice and guidance on the selection, use, care and maintenance of the much wider range of hearing protectors now available in the EU.

When the EN 352 series of standards is revised it will include reduced minimum attenuation requirements, which should allow hearing protector manufacturers to bring low attenuation hearing protectors to the market. These products are desperately sought by employers whose employees' noise exposures are between the lower and upper exposure action values.

For as long as people continue to work in noisy workplaces, there will be a need to educate and train people on hearing conservation. This is always likely to include the selection and use of appropriate hearing protection. While this is the case, there will also be the need for effective and up-to-date hearing protector standards.

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