SOME USER ASPECTS OF PERSONAL HEARING PROTECTORS

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1. Introduction

Several authors have discussed the factors governing the choice and design of hearing protectors (e.g. Acton, 1967 and 1970, Coles, 1970, Coles and Rice, 1965, Rice and Coles, 1966). The present contribution represents an attempt to examine objectively some of the factors which may cause an actual user to accept or reject a particular type of hearing protector, and has been based, in part, on the Canadian Standard Z94.2 (1965 with revisions dated October 1967) supplemented by the experience of the author and his colleagues and acquaintances from industry. Many of the points may seem obvious when written down, but it is felt that a list of these points, with appropriate qualifications, will prove of value to those with responsibility for the design or marketing of hearing protectors, or for the implementation of hearing conservation programmes.

2. Materials

Materials for hearing protectors of all types should obviously be inherently clean and sterile, and should not absorb atmospheric moisture or support the growth of moulds or yeasts. Protectors of the permanent type (i.e. as opposed to disposable) should be made of materials that do not readily stain and are capable of being cleaned and sterilised by normal everyday procedures such as washing with soap or a mild detergent and water or immersion in a weak disinfectant solution. Materials should also be resistant to sweat, hair oil, ear wax, barrier creams, cosmetics, etc.

All materials coming into contact with the body should not be of a type known to be irritating or dermatatic. Medical grade silicone rubbers and many plastics are suitable, but attention should be given to plasticizers and fillers which may have been used in the manufacture of the raw material.

3. Durability

It seems reasonable to assume that hearing protectors may be worn outside in winter, or be subjected to radiant heat from furnaces, etc. No deleterious changes should occur between the temperature extremes -10°C and 50°C (approximately 14°F and 120°F) within a suggested life of twelve hours in the case of disposable material and one year in the case of permanent hearing protectors.

The degree of shock which a hearing protector is designed to withstand is a matter for debate, but it seems most likely that they

will be dropped from about waist height. Following the lead given by the Canadian Standard, three drops in quick succession from a height of three feet onto a smooth horizontal concrete surface immediately after being maintained at a temperature of -10°C for three hours is suggested. A statistical sampling technique should be applied to the selection of samples and processing of results, and a particular brand or type should not necessarily be condemned because a single test specimen failed.

4. Physical Requirements

To accommodate differences between individuals, permanent type hearing protectors should be available in at least three, and preferably five, sizes, or, if appropriate, be capable of continuous adjustment over a size range. Because the sides of the head are rarely, if ever, parallel the cups of ear muffs should be pivoted in directions mutually perpendicular and also perpendicular to the direction of opening of the head-band to allow movement through an angle of $\pm$ 15° without twisting the head-band.

The weight of ear muffs is often an excuse given for not wearing them, and the weight should not exceed sixteen ounces except for those of special design for use in exceptional circumstances (e.g. those embodying an electronic peak limiting communication system for use in situations where explosions are likely to occur without warning). This accommodates most of the brands of ear muffs at present available on the British market, but it is worth noting that ultra-lightness is inevitably achieved at the expense of attenuation, particularly at lower frequencies. The weight should be supported by a band passing over the head, and muffs of designs with behind-ear or under-chin spring-bands should also have a supporting band of webbing or plastic passing over the head, otherwise the weight is supported by, and a twisting moment may be applied to the outer ear.

The force applied by the cups with their faces aligned parallel and symmetrical at a distance of six inches apart and with the spring-band adjusted to half extension should not exceed forty-two ounces (Canadian Standard). The harder the seal, the greater is the force necessary to achieve a given attentuation, and some of the early foam-filled seals required undue spring-band pressure to provide a reasonable attenuation. The pressure exerted by the spring-bands in several brands of muffs with modern liquid- or foam-filled seals is very much less than the above figure, yet they still give good attenuation. The force applied by the spring-band of captive insert and semi-insert types of ear plug should be very much less, and eight ounces at a separation of five inches may be too great for reasonable comfort.

5. Safety

The hearing protector should be inherently safe and, in the event of misuse or an accident, not likely to injure the user through secondary causes. For example, an ear plug should not have sharp edges which may cause injury if inadvertently inserted the wrong way round.

The use of ear muffs attached to safety hats is not recommended for two reasons. Firstly, there are difficulties of adjustment, fitting, and maintaining correct pressure at the seals. Secondly, the hard shell of these hats is designed to move with respect to the wearer's head in the event of an impact (British Standard 2826). This movement would be transferred to a shearing motion over the ears

with ear muffs rigidly attached to the shell. There should be sufficient clearance between the muffs and a safety hat to allow movement of the latter in the event of an impact, and muffs have been designed with the minimum width of seal at the top in order to give maximum clearance.

6. Instruction and Maintenance

If the hearing protector is designed to be asymmetric, then the mode of use should be permanently marked on it, for example by an arrow and "front" moulded onto the cups of ear muffs. Instructions for use, cleaning and maintenance (where appropriate) should be provided with each protector (or pair of plugs or packet of disposable material, or be displayed on or close by a dispenser of disposable material).

Certain component parts of muffs in particular are subject to damage or deterioration and should be replaceable and readily available. Regretably this is not always so.

7. References

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