Proceedings of the Institute of Acoustics

PERCEPTUAL EVALUATION OF THE BS 4142:2014 PENALTY METHOD FOR MULTIPLE SOUND CHARACTERISTICS

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ABSTRACT

The aim of this paper is to evaluate the BS 4142:2014 penalty method for multiple sound characteristics. BS 4142:2014 is one of the most widely used standards, and is used for rating and assessing industrial and commercial sound. It contains a graduated approach to sources containing multiple characteristic features where tonal, impulsive and intermittent characteristics can be considered separately and corrections applied cumulatively to sources that contain more than one of these characteristics. Whilst there is good evidence to show an increased annoyance response to sound with tonal, impulsive or intermittent features, there has been little research performed on the response to sound containing multiple characteristics, suggesting that the application of linearly applying penalties has little perceptual basis. To assess the validity of this linear summation of penalties, an annoyance matching experiment was performed. The stimuli consisted of seven samples of an industrial broadband fan noise that had been modified to introduce tonal, impulsive and intermittent characteristics. Seventeen subjects adjusted the levels of each sample to match the perceived annoyance of a reference. The results indicate that the annoyance response to a sound containing multiple characteristic features is not well represented by linearly summing penalties for each characteristic feature. This suggests that further research is required to provide the scientific basis for additional guidance on the linear summation of penalties in BS 4142:2014.

1 INTRODUCTION

BS 4142:2014 took a significant departure from the now superseded BS 4142:1997 in its approach to applying a characteristic penalty to sources containing multiple features. In the previous standard, a rating level for a source containing characteristics could be obtained through applying a subjective penalty of 5 dB, regardless of character prominence or how many characteristics a source might contain. The latest iteration of the standard now contains a graduated approach to sources containing multiple characteristic features, where tonal, impulsive and intermittent characteristics can be considered separately and corrections applied cumulatively to sources that contain more than one of these characteristics. This paper aims to assess the perceptual validity of the linear summation of characteristic penalties through presenting and discussing the results of an annoyance matching experiment that was performed at the University of Salford.

2 PREVIOUS RESEARCH

Negative effects of noise on human health and behaviour are well documented. These range from the auditory health effect of noise-induced hearing loss to other non-auditory health effects such as disturbance of sleep, hypertension and ischemic heart disease[1, 2]. The non-auditory health effects are often responses to what is the most widespread community response to environmental noise; namely annoyance[3], which has been identified as the main effect of environmental noise[4]. *Predicting* annoyance caused by noise is a complicated problem, as it has been shown that human reaction to noise is more than just a purely psychoacoustic problem. Psychological and environmental variables must also be taken into account, (such as state of anxiety, personality, attitude, time of year etc.)[4-6]. Whilst noise can be steady-state and without features that draw