BACKGROUND NOISE: BS4142 PARTIALLY RE-ASSESSED.

S. Rintoul[1], B. Olding[2] and J. Roberts[3].

1. Lewisham Borough Council.
2. Tonbridge and Malling Borough Council.
3. South Bank Polytechnic, London, SE1 0AA

ABSTRACT.

This paper reports the correlation of subjective assessment with objective measurement of background noise. It also reports the measurement of background noise over a 24 hour period at thirty-one sites. L_{90} and L_{eq} are compared and suitability as measures of background noise commented upon. The validity of various of the correction factors presently contained in BS 4142 are also assessed.

INTRODUCTION

Background noise is judged important both as a descriptor of the acoustic environment and as a parameter for the assessment of the likely acceptability of new noise sources. This paper reports on what simple measure might most suitably describe it.

The implementation in July 1988 of the E.C. Directive on environmental impact assessment [1] will require the promoters of major development projects to produce assessments of their likely effects on the environment. Such assessments must include an evaluation of the effects of expected noise emission.

PRESENT MEASURES.

There are in force in the United Kingdom many statutes wholly or partially concerned with noise nuisance. The most important of these are the Control of Pollution Act 1975 [2] and the Town and Country Planning Act 1971 [3].

It is clear from reference to superior court judgements that nuisance is a subjective matter based upon concepts of reasonableness and good neighbourliness [4, 5, 6]. Fortunately when assessing noise it is possible to make objective measurements which can be helpful in supporting such subjective judgements. One commonly quoted Standard in cases brought under both the above Acts is BS 4142:1967 [7]. Indeed, when considering applications for industrial development submitted under the Town and Country Planning Act, Circular 10/73 [8] makes specific reference to undertaking an assessment in accordance with BS 4142.

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Despite criticisms [9,10] BS 4142 remains a popular rating procedure commonly quoted in legal proceedings concerning noise nuisance.

BS 4142 is used to assess the likelihood of complaints arising from the introduction of a new, fixed noise source into a given environment. It does this by comparing the noise from the source with the background level present at the site in question. The Standard describes background noise as "that level which is exceeded for 90% of the time", L_{90}, and this is the usual definition met in the U.K.

This report also considers the suitability of the equivalent continuous sound level, L_{eq}, as possible measures for background noise, this scale having been recommended by several workers [11,12].

THE LABORATORY INVESTIGATION.

Recordings of naturally occurring environmental noise were played to twenty-seven practising Environmental Health Officers. During each playback the EHOs were required to note down from visual observation of a SLM display the sound level which best represented the background noise. To ensure reproducability the experiments were carried out indoors.

Tape 1 was of a pile-driver operated about once every 8 seconds. Between the impacts the noise levels were relatively low and steady. No subject professed any difficulty in making their assessment of the background noise. The distribution of responses was normal with a mean value of 39.4 dB(A) and a standard deviation of 1.3 dB(A). The mean agrees well with the L_{90} value of 39 dB(A). It was very clear, however, that the L_{eq} level of 59.4 dB(A) was greatly in excess of any subjective estimate of background noise.

Tape 2 was traffic noise at a busy round-about on a major carriageway. The noise was continuous but the passage of certain individual vehicles resulted in significant variations in noise level. The distribution of estimates was normal with a mean of 66.2 dB(A) and a standard deviation of 2.9 dB(A). Again the mean value is within 1 dB of the L_{90} value of 65.5 dB(A), but three subjects did give values for background noise which were equal to or greater than the L_{eq} value of 70.2 dB(A).

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Tape 3 was recorded on the boundary between a building site and a warehouse premises and included a helicopter flyover, near and distant traffic and noise from pedestrians. In many ways this tape could be said to represent fairly typical city centre noise. The distribution of responses was normal at the 95% level with a mean of 67.2 dB(A) and a range of 62 dB(A) to 78 dB(A). The range of values was due to the appearance of a helicopter flyover on the tape. Seven subjects considered this noise to be a genuine part of the background and gave higher estimates than the nineteen who considered it should be ignored. Only one subjective estimate of the background level was equal to the L_{eq} value of 78 dB(A).

Tape 4 was of construction site noise. The five minutes duration was selected so that at every instant one or other noise source on the site was in operation. This tape gave considerable difficulty and only fifteen subjects would give an assessment of "background" noise. The distribution of the subjects' responses for this tape exhibits two distinct and independent groupings; one centred on 62 dB(A) and the other on 76 dB(A), but neither group was significantly close to the L_{eq} value of 79.4 dB(A).

TABLE 1. ANALYSIS OF TAPES.

Tape No.	1	2	3	4
L_{90}	38.5	64.5	64.0	64.0
L_{90}	39.0	65.5	65.0	65.5
L_{eq}	59.4	70.2	78.0	79.4

This experiment indicates strongly that of the simple scales available and in present usage L_{90} appears an adequate measure of non-complex background noise levels. Where the acoustic environment contains several discrete and readily identifiable sources the simple L_{90} level may not be a sufficient descriptor of subjective assessment, but in no case was L_{eq} a better measure.

FIELD STUDIES.

The second stage of the investigation was to measure L_{90} and L_{eq} in the real world to determine if a significant difference is likely to exist between them, and thus whether the subjective differences between L_{90} and L_{eq} noted in the laboratory might be of importance to the practical assessment

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of noise annoyance.

This investigation examined in detail the background noise that prevailed in the north-west Kent area, measuring both L_{90} and L_{eq}. The area selected was the Borough of Tonbridge and Malling, located in the Medway Valley between the North Downs and the High Weald. At the southern limit is the town of Tonbridge and at the northern end is the urban sprawl of the Maidstone/Medway gap. The area's principal industries are agriculture, paper manufacture, mineral extraction/processing and printing. The M2, M20 and M26 motorways and three railway lines pass through the Borough.

Within the selected area the measurement sites were chosen on a 3 kilometre grid to give a total of 28 locations. Each location was classified according to the six types referred to in paragraph A3 of the Standard. In some cases the grid point fell in open countryside and in these cases the nearest dwelling was used as the measurement site. As this method of site selection did not produce a sufficient number of "general industrial" and "predominantly industrial" sites three additional sites were chosen, one in the former and two in the latter catagory.

Table 2 gives the mean differences between the measured hourly values of L_{90} and L_{eq} for each of the periods 07.00-19.00 (day), 19.00-22.00 (evening) and 22.00-07.00 (night) at each of the measurement sites.

RESULTS.

It was clear from the data gathered that background noise levels vary widely, with very low values occuring at night. Indeed it is likely that in some cases night time noise level was below the measurement system's lower limit of 21 dB(A). Night time hourly values of L_{90} of 25 dB(A) or lower occurred at eight of the thirty-one sites investigated, and 30 dB(A) or lower at thirteen sites.

The difference between the hourly values of L_{eq} and L_{90} varies considerably, but there is a clear trend for the difference to decrease as the site shifts from rural through the intermediate classifications to predominantly industrial.

Where the background noise level is consistent and relatively high there will be less of a difference between L_{eq} and L_{90} than when the the basic background level is low with

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intermittent sounds imposed upon it. In these latter circumstances the use of L_{eq} for assessing background level may underestimate the intrusive nature of any unwanted sound.

TABLE 2

$L_{eq} - L_{90}$ Mean Hourly Difference/Standard Deviation		
Day	Evening	Night
Rural (residential) Type 1 BS4142 Para. A3		
12.6	13.2	9.91
Suburban (little road traffic) Type 2		
7.97	7.12	6.24
Urban (residential) Type 3		
10.6	11.6	9.65
Predominantly residential but with some light industry or main roads. Type 4		
9.21	12.0	11.5
General industrial area intermediate between 4 and 6. Type 5		
5.21	4.71	5.49
Predominantly industral area with few dwellings Type 6.		
4.86	4.11	5.91

CORRECTION FACTORS.

BS 4142 corrects for type of neighbourhood in steps of 5 dB(A). Thus in moving from a rural district (correction factor -5 dB(A)) to a predominantly industrial area (correction factor +20 dB(A)) there is a total correction of 25 dB(A). Such a large step is not confirmed by the results presented here, which indicate that 15 dB(A) would be a more realistic value.

It is also possible to assess the correction factor used in the Standard for time of day. BS4142 proposes that for weekdays 08.00 to 18.00 a factor of +5 dB(A) should be used, for night-time 22.00 to 07.00 a factor of -5 dB(A) should be used, and for all other times the correction factor is 0.

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Analysis of the L_{90} data shows the measured differences to be +4.47 dB(A) and -4.96 dB(A) respectively, though the corresponding standard deviations of 3.31 and 3.33 dB(A) confirm that there may be considerable variation between individual sites.

CONCLUSION.

This initial investigation indicates that subjective assessment of simple background noise is better measured by L_{90} than L_{eq}. The survey of actually occurring background levels confirms that there is generally significant difference between L_{90} and L_{eq}, and this is taken as a strong indication that L_{eq} may not be a suitable measure of background noise in these circumstances. Should this be confirmed it will call into question the validity of the preferance for the use of L_{eq} based descriptors for all aspects of environmental noise in the revised ISO Standards [24, 25, 26].

The investigation also indicates that certain of the correction factors presently included in BS 4142 may need revision, and further assessment of their validity is required.

REFERENCES.

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